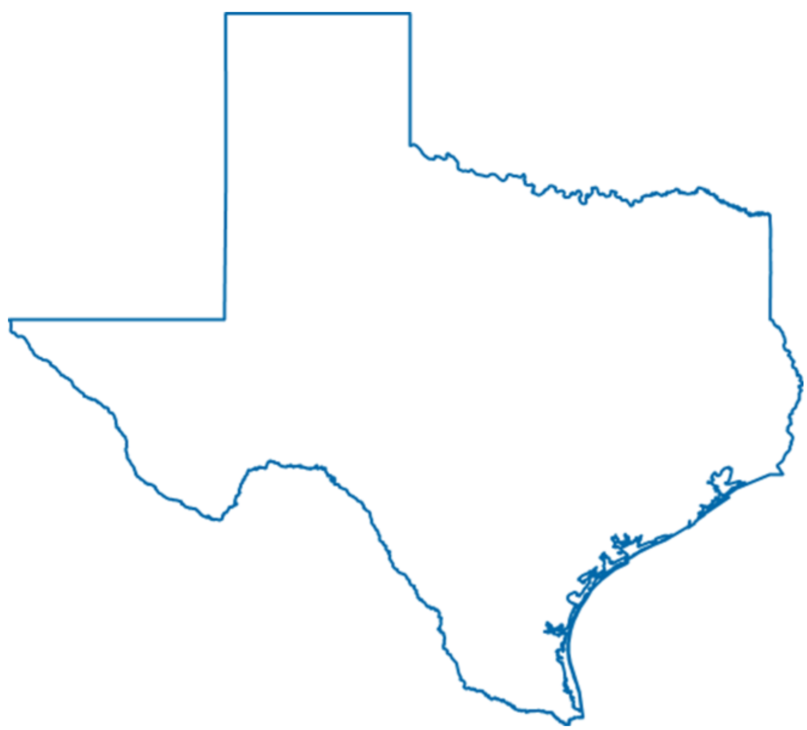
Public Utility Commission of Texas

Texas Technical Reference Manual

Version 7.0

Volume 2: Residential Measures

Program Year 2020



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Acknowledgments

The Technical Reference Manual is maintained by the Public Utility Commission of Texas' independent evaluation, monitoring, and verification (EM&V) team led by Tetra Tech. This version of the Texas Technical Reference Manual was primarily developed from program documentation and measure savings calculators used by the Texas Electric Utilities and their Energy Efficiency Services Providers (EESPs) to support their energy efficiency efforts, and original source material from petitions filed with the Public Utility Commission of Texas by the utilities, their consultants and EESPs such as Frontier Associates (TXu 1-904-705), ICF, CLEAResult, and Nexant. Portions of the Technical Reference Manual are copyrighted 2001-2017 by the Electric Utility Marketing Managers of Texas (EUMMOT), while other portions are copyrighted 2001-2018 by Frontier Energy. Certain technical content and updates were added by the EM&V team to provide further explanation and direction as well as a consistent structure and level of information.

TRM Technical Support

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1 INTRODUCTION

This volume of the TRM contains the deemed savings for residential measures that have been approved for use in Texas by the Public Utility Commission of Texas (PUCT). This volume includes instructions regarding various savings calculators and reference sources of the information. TRM v7.0 serves as a centralized source of deemed savings values. Where appropriate, Measurement and Verification (M&V) methods by measure category are noted for informational purposes only regarding the basis of projected and claimed savings.

Table 1 provides an overview of the residential measures contained within this Program Year (PY) 2019 TRM 7.0 Volume 2 and the types of deemed savings estimates available for each one. There are five types of deemed savings estimates identified:

- *Point estimates* that provided a single deemed savings value correspond to a single measure or type of technology.
- *Deemed saving tables* that provide energy and peak savings as a function of size, capacity, building type, efficiency level, or other inputs.
- *Savings algorithms* that require specified primary inputs that must be gathered on site and the identification of default inputs where primary data could not be collected. In many cases, these algorithms are provided as references to deemed savings tables, point estimates, or calculator explanations.
- *Calculators* are used by different utilities and implementers to calculate energy savings for different measures. In many cases, there are several different calculators available for a single measure. Sometimes their background calculators are similar, and in other cases, estimates can vary greatly between each calculator.
- *M&V* methods are also used for some measures to calculate savings in the event that standard equipment is not used, or the specified building types do not apply. For some of these measures, both a simplified M&V approach and a full M&V approach may be allowed by the utility. M&V methods as a source of claimed and projected savings are noted for informational purposes only.

Please consult Volume I: Overview and User Guide, Section 5: Structure and Content, for details on the organization of the measure templates presented in this volume.

Table 1: Residential Deemed Savings by Measure Category

Measure Category	Measure Description	Point Estimates	Deemed Savings Tables	Savings Algorithm	Calculator	M&V	7.0 Update
Lighting	Standard compact fluorescent lamps	–	–	X	–	–	Updated useful life estimates and removed dual baseline
	Specialty compact fluorescent lamps	–	–	X	–	–	Updated useful life estimates and removed dual baseline
	ENERGY STAR® omni-directional LED lamps	–	–	X	–	–	Updated useful life estimates and removed dual baseline. Added option for new construction savings
	ENERGY STAR® specialty and directional LED lamps	–	–	X	–	–	Updated useful life estimates and removed dual baseline. Added option for new construction savings
HVAC	Air conditioner or heat pump tune-up	–	–	X	–	–	No revision.
	Duct sealing	–	–	X	–	X	No revision.
	Ground source heat pumps	–	X	X	–	–	No revision.
	Central air conditioners and heat pumps	–	X	–	–	–	Merged central air conditioner and heat pumps into one measure.
	Mini-split air conditioners and heat pumps	-	X	-	-	-	TRM v7.0 origin.
	Large capacity split system and single-package air conditioners and heat pumps	-	-	X	-	-	No revision.
	Packed terminal heat pumps	-	-	X	-	-	TRM v7.0 origin.

Measure Category	Measure Description	Point Estimates	Deemed Savings Tables	Savings Algorithm	Calculator	M&V	7.0 Update
	Room air conditioners	–	–	X	–	–	No revision.
	ENERGY STAR® connected thermostats	-	X	-	-	-	No revision.
	Evaporative Cooling	-	X	-	-	-	TRM v7.0 origin.
Load management	Smart thermostat load management	–	X	–	–	–	Clarified participant definition
Building Envelope	Air infiltration	–	X	–	–	X	No revision.
	Ceiling insulation	–	X	–	–	–	Added U-factor methodology.
	Attic encapsulation	–	X	–	–	–	Incorporated guidance from EM&V memo.
	Wall insulation	–	X	–	–	–	No revision.
	Floor insulation	–	X	–	–	–	No revision.
	ENERGY STAR® windows	–	X	–	–	–	No revision.
	Solar screens	–	X	–	–	–	No revision.
	Cool roofs	-	X	-	-	-	Added savings for R-30 insulation.
Domestic Water Heating	Faucet aerators	–	–	X	–	–	No revision.
	Low-flow showerheads	–	–	X	–	–	No revision.
	Water heater pipe insulation	–	–	X	–	–	No revision.
	Water heater tank insulation	–	–	X	–	–	No revision.
	Water heater installation-electric tankless and fuel substitution	–	–	X	–	–	Implemented new baseline and high-efficiency standards.

Measure Category	Measure Description	Point Estimates	Deemed Savings Tables	Savings Algorithm	Calculator	M&V	7.0 Update
	Heat pump water heaters	–	X	–	–	–	No revision.
	Solar water heaters	–	X	–	–	–	No revision.
	Showerhead temperature sensitive restrictor valves	--	--	X	--	--	No revision.
	Tub spout and showerhead temperature-sensitive restrictor valves	--	--	X	--	--	No revision.
Appliances	ENERGY STAR® ceiling fans	–	–	X	–	–	Established deemed savings.
	ENERGY STAR® clothes washers	–	X	–	–	–	No revision.
	ENERGY STAR® clothes dryers	-	X	-	-	-	TRM v7.0 origin.
	ENERGY STAR® dishwashers	–	X	–	–	–	No revision.
	ENERGY STAR® refrigerators	–	–	X	–	X	Established deemed savings.
	ENERGY STAR® freezers	-	X	-	-	-	TRM v7.0 origin.
	ENERGY STAR® pool pumps	--	--	X	--	--	Updated eligibility to include ENERGY STAR® version 2.0
	ENERGY STAR® Air purifiers	-	X	-	-	-	TRM v7.0 origin.
	Advanced power strips	-	X	-	-	-	TRM v7.0 origin.
	ENERGY STAR® Electric	-	X	-	-	-	TRM v7.0 origin.

Measure Category	Measure Description	Point Estimates	Deemed Savings Tables	Savings Algorithm	Calculator	M&V	7.0 Update
	vehicle supply equipment						
	Solar attic fans			X			TRM v7.0 origin
Appliance Recycling	Refrigerator/ freezer recycling	X	–	X	–	–	No revision.

2 RESIDENTIAL MEASURES

2.1 RESIDENTIAL: LIGHTING

2.1.1 ENERGY STAR® Standard Compact Fluorescent Lamps Measure Overview

TRM Measure ID: R-LT-CF

Market Sector: Residential

Measure Category: Lighting

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit; new construction

Program Delivery Type(s): Prescriptive and direct install

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure provides a method for calculating savings for replacement of an incandescent lamp with an ENERGY STAR®-qualified standard CFL in residential applications.

A standard lamp is also called a general service lamp. General service lamps are omnidirectional bulbs that are A, BT, P, PS, S, or T shape bulbs (as defined by the ANSI Standard Lamp Shapes). These lamps are not globe, bullet, candle, flood, reflector, or decorative-shaped (B, BA, C, CA, DC, F, G, R, BR, ER, MR, MRX, or PAR shapes). These bulbs do encompass both twist/spiral and A-lamp shaped CFLs.

Please see https://www.lightingfacts.com/Library/Content/FAQs/EISA for more information on general service lamps and CFLs.

Eligibility Criteria

Customer eligibility to be awarded these deemed savings is at the discretion of the utility for different program and customer types. See program-specific manuals to determine customer eligibility.

These savings values rely on usage patterns specific to both indoor and outdoor applications. In lieu of collecting lamp location, a default weighting of 90.5% indoor and 9.5% outdoor may be assumed.[1]

New homes must exceed the lighting equipment requirements of the current state building code (IECC 2015) to be eligible for prescriptive lighting savings.

Baseline Condition

The baseline is assumed to be the first-tier Energy Independence and Security Act of 2007 (EISA)-mandated maximum wattage for a general service or standard incandescent or halogen lamp (see Table 2). Baseline wattages should be adjusted as EISA regulations dictate higher efficiency standards. A potential second-tier EISA baseline adjustment was scheduled to go into effect beginning January 2020. At that time, general service lamps would need to comply with a 45 lumen-per-watt efficacy standard. However, the Department of Energy (DOE) issued a definition for general service lamps on September 5, 2019, concluding that "no backstop energy conservation has been imposed."[2] Therefore, no additional baseline adjustment will be imposed starting in 2020. However, standard practice must also be considered in determining an appropriate baseline for this measure. To account for a rapidly changing market, measure life assumptions have been reduced as described later in this measure.

Table 2: ENERGY STAR® Standard CFLs—EISA Baselines[3]

Minimum Lumens	Maximum Lumens	Incandescent Equivalent Wattage Pre-EISA 2007	1st Tier EISA 2007 (W_{Base})
310	749	40	29
750	1,049	60	43
1,050	1,489	75	53
1,490	2,600	100	72

New construction applications use the same baselines; however, savings can only be claimed for efficient lighting installed above the minimum amount required by code.

[1] 2015 U.S. Lighting Market Characterization, Department of Energy. November 2017. Table 4.11. https://www.energy.gov/sites/prod/files/2017/12/f46/lmc2015_nov17.pdf.

[2] "Energy Conservation Program: Definition for General Service Lamps", Department of Energy. 9/5/2019. https://www.federalregister.gov/documents/2019/09/05/2019-18940/energy-conservation-program-definition-for-general-service-lamps.

[3] In new ENERGY STAR® lighting standards effective September 2014, lumen bins associated with incandescent wattages have been assigned that do not align with those set out in EISA 2007. Due to the likelihood of continuing sell-through of existing ENERGY STAR® lighting and the on-going use of the EISA bin definitions, this TRM maintains the EISA lumen bins for assigning baseline wattage. Future iterations of the Texas TRM, however, may incorporate these new ENERGY STAR® lumen bins for baseline wattage estimates.

High-efficiency Condition

New CFLs must be standard (general service) ENERGY STAR® -qualified CFLs as outlined in the latest ENERGY STAR® specification.[4] These CFLs are designed to replace incandescent lamps of the following ANSI Standard Lamp Shape: A, BT, P, PS, S and T.[5] These lamps have medium screw or pin bases, are designed for light output between 310 and 2600 lumens, and are capable of operating at a voltage range at least partially within 110 and 130 volts.[6]

See the ENERGY STAR® website for more information on the specification in effect: http://www.energystar.gov/products/certified-products/detail/light-bulbs.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Wattage reduction is defined as the difference between the wattage of a standard baseline lamp according to EISA 2007 (see Table 2) and the wattage of a comparable CFL. A CFL is considered comparable to the baseline lamp if they are aligned on the lumen output ranges set out in EISA 2007.

For new construction projects, programs should calculate savings using the methodology in this section for all efficient lamps installed in the home. The program should claim savings for the percentage of installed high-efficacy lamps that exceed the minimum required by code, which is currently 75% of lamps. For example, if a new home is built with high-efficacy lamps in 85% of the permanently-installed fixtures, the program would claim 10% of the total calculated savings.

Energy Savings

Annual energy (kWh)

$$\Delta kWh = \frac{\left(W_{base,FT} - W_{post}\right)}{1000} \times HOU \times ISR \times IEF_E$$

Equation 1

Equation 2

Where:

$W_{base,FT}$ = *First-tier EISA baseline wattage corresponding with the lumen output of the purchased CFL lamp for the year purchased/installed. First-tier EISA baseline lamp wattage provided in Table 2 under the column "Incandescent Equivalent 1st Tier EISA 2007" (if unknown, see Table 3 for 1st Tier EISA 2007default wattages)*

4 http://www.energystar.gov/products/certified-products/detail/light-bulbs.

5 https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V1%201_Specification.pdf.

6 https://www.lightingfacts.com/Library/Content/FAQs/EISA.

Table 3: ENERGY STAR® Standard CFLs—Default Equivalent Wattages if Lumen Output Unknown

Wattage Range of Installed CFL[7]	7–10 W	9–14 W	18–20 W	15–26 W
If Unknown: Default Installed CFL Wattage[8]	9 W	13 W	19 W	24 W
1st Tier EISA 2007 Default Baseline	29 W	43 W	53 W	72 W

W_{post} = *Actual wattage of CFL purchased/installed*

HOU = *Average hours of use per year = 803 hours (for interior/exterior applications calculated based on an average daily usage of 2.2 hours per day[9])*

IEF_E = *Interactive Effects Factor to account for cooling energy savings and heating energy penalties associated with lighting power reductions (see Table 4)*

ISR = *In-service Rate, the percentage of incentivized units that are installed and in use (rather than removed, stored, or burnt-out) to account for units incentivized but not operating = 0.97[10]*

Table 4: ENERGY STAR® Standard CFLs—Interactive Effects Factor for Cooling Energy Savings and Heating Energy Penalties[11]

	IEF_E				
Heating/Cooling Type*	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Gas heat with AC	1.06	1.13	1.17	1.15	1.12
Gas Heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat Pump	0.91	1.00	1.05	1.11	0.97
Electric Resistance Heat with AC	0.65	0.80	0.90	1.00	0.75

7 Wattage ranges from ENERGY STAR® light bulb savings calculator. Updated October 2016. Accessed December 22, 2016. http://www.energystar.gov/products/certified-products/detail/light-bulbs.

8 ENERGY STAR® Certified Light Bulbs. https://www.energystar.gov/productfinder/product/certified-light-bulbs/results. Accessed December 22, 2016. Mean wattages of omnidirectional, general purpose replacement CFL lamps by incandescent wattage equivalent.

9 The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

10 Dimetrosky, S., Parkinson, K. and Lieb, N.,"Residential Lighting Evaluation Protocol – The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures." January 2015. ISR for upstream programs, including storage lamps installed within four years of purchase. http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf.

11 Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: $1 + HVAC_{savings}/Lighting_{savings}$.

IEF$_E$					
Heating/Cooling Type*	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Electric Resistance Heat with no AC	0.57	0.69	0.76	0.83	0.65
No heat with AC	1.06	1.13	1.17	1.15	1.12
Unconditioned Space	1.00	1.00	1.00	1.00	1.00
Heating/Cooling Unknown[12]	0.88	0.98	1.04	1.07	0.95

* IEF for homes with no AC is most appropriate for customers with evaporative cooling or room air conditioners.

Demand Savings

Summer and winter demand savings are determined by applying a coincidence factor associated with each season. However, summer demand savings should not be claimed for outdoor lamps.

$$\Delta kWsummer = \frac{(W_{base,FT} - W_{post})}{1000} \times CF_{summer} \times ISR \times IEF_{D,summer}$$

Equation 3

$$\Delta kW_{winter} = \frac{(W_{base,FT} - W_{post})}{1000} \times CF_{winter} \times ISR \times IEF_{D,winter}$$

Equation 4

Equation 5

Equation 6

Where:

CF = *Coincidence Factor (see Table 5)*

IEF_D = *Interactive Effects Factor to account for cooling demand savings or heating demand penalties associated with lighting power reductions (see Table 6)*

Table 5: ENERGY STAR® Standard CFLs—Coincidence Factors[13]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.060	0.053	0.063	0.059	0.032
Winter	0.275	0.232	0.199	0.263	0.358

[12] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

[13] See Volume 1, Appendix B.

Table 6: ENERGY STAR® Standard CFLs—Interactive Effects Factor for Cooling Demand Savings and Heating Demand Penalties[14]

$IEF_{D,summer}$					
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas heat with AC	1.45	1.33	1.68	1.23	1.44
Gas heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat pump	1.45	1.33	1.68	1.23	1.44
Electric resistance heat with AC	1.45	1.33	1.68	1.23	1.44
Electric resistance heat with no AC	1.00	1.00	1.00	1.00	1.00
No heat with AC	1.45	1.33	1.68	1.23	1.44
Unconditioned space	1.00	1.00	1.00	1.00	1.00
Heating/cooling unknown[15]	1.39	1.28	1.58	1.20	1.38
$IEF_{D,winter}$					
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas heat with AC	0.98	0.98	0.98	0.98	0.98
Gas heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat pump	0.71	0.67	0.65	0.74	0.81
Electric resistance heat with AC	0.44	0.36	0.38	0.42	0.52
Electric resistance heat with no AC	0.44	0.36	0.38	0.42	0.52
No heat with AC	0.98	0.98	0.98	0.98	0.98
Unconditioned space	1.00	1.00	1.00	1.00	1.00
Heating/cooling unknown[16]	0.76	0.72	0.73	0.75	0.80

* IEF for homes with no AC is most appropriate for customers with evaporative cooling or room air conditioners.

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14 Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: $1 + HVAC_{savings}/Lighting_{saving}$

15 Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

16 Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

Historically the average measure life is based upon the rated lamp life of the CFL. The measure life assumes an average use of 2.2 hours per day based on blended usage for indoor/outdoor applications and applies a 0.85 degradation factor to indoor/outdoor CFLs.

$$= \frac{Rated\ Life \times DF}{HOU \times 365.25}$$

Equation 7

Where:

$Rated\ Life$ = *10,000 hours, 12,000 hours, 15,000 hours, or 20,000 hours, as specified by the manufacturer. If unknown, assume a 10,000-hour lifetime.*[17]

DF = *0.85 degradation factor*[18]

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[17] Minimum lifetime requirement under ENERGY STAR® Lamps Specification V1.1, effective September 30, 2014. http://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V1%201_Specification.pdf.

[18] ENERGY STAR® CFL Third Party Testing and Verification Off-the-Shelf CFL Performance: Batch 3. Figure 27, p. 47.

HOU = 2.2 hours per day[19]

However, to account for a rapidly changing market, standard practice dictates that measure life assumptions be reduced to approximate the point at which the residential lighting market has been fully transformed to high-efficiency lamps. Due to market uncertainty in response to a recent rule issued by the Department of Energy, a simplified approach to claim half of the more conservative 16-year EUL will be implemented during the 2020 program year, resulting in an 8-year EUL. This assumption will be reviewed annually to account for current market trends.

Based on an expected delay in market adoption among certain customer bases, this measure life will be extended to 2030 for programs targeting low-income and hard-to-reach customers, resulting in a 10-year EUL.

Table 7: ENERGY STAR® Standard CFLs—Estimated Useful Life

Range of Rated Measure Life (Hours)	Assumed Rated Measure Life (Hours)	Product Lifetime (Years)	Standard Baseline Measure Life (Years)	Low Income Baseline Measure Life (Years)
10,000–11,000	10,000	11	8	10
11,001–13,500	12,000	13	8	10
13,501–17,500	15,000	16	8	10
≥ 17,501	20,000	20*	8	10

* Measure life capped at 10 years. EUL may be deemed at 8 years in lieu of documenting the customer baseline.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of CFLs installed
- Wattage of each installed CFL
- Lumen output of each installed CFL
- Manufacturer-rated lifetime of each installed CFL in hours
- Heating system type (gas, electric resistance, heat pump) for each home in which a CFL is installed
- Location of installed lamp (conditioned, unconditioned, or outdoor); only required when not assuming default weighting
- Program type (direct install, retail)

[19] The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

- Proof of purchase – with date of purchase and quantity
    - Alternative: representative photos of installed units or another pre-approved method of installation verification
- ENERGY STAR® certificate matching installed model number
    - Alternative: another pre-approved method of certification
- For new construction projects only, these data points must be gathered for all permanently-installed fixtures in the home in order to document the percentage that are high-efficacy.

References and Efficiency Standards

Petitions and Rulings

- Docket No. 41722. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Sharyland Utilities, L.P., Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company to Approve Revisions to Residential Deemed Savings to Incorporate Winter Peak Demand Impacts and Update Certain Existing Deemed Savings Values. Public Utility Commission of Texas.
- Docket No. 39899. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Southwestern Electric Power Company, Texas-New Mexico Power Company, and Southwestern Public Service Company to Revise Existing Commission-Approved Deemed Savings for CFLs in Residential Hard-to-reach Programs. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

- Energy Independence and Security Act of 2007
- ENERGY STAR® specifications for CFL lamps.

Document Revision History

Table 8: Residential Compact Fluorescent Lamps Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor corrections due to phase-in of EISA regulations, updated EUL from DEER 2014. Legacy EISA tables removed.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. Introduction of interactive effects factors and in-service rates. Incorporation of Second Tier EISA standards. New peak savings calculated according to revised peak definition. Modified estimation of measure life.
v3.1	11/05/2015	TRM v3.1 update. Modification of in-service rate, revision of interactive effects factors to reflect indoor-specific values for additional heating and cooling equipment types. Provided default input assumptions for upstream lighting programs. Restricted estimated measure life to several discrete values.
v3.1	3/28/2016	TRM v3.1 March revision. Updated summer and winter coincidence factors.
v4.0	10/10/2016	TRM v4.0 update. Updated IEF values and useful life estimates.
v5.0	10/2017	TRM v5.0 update. Updated useful life estimates.
v6.0	11/2018	TRM v6.0 update. Updated useful life estimates. Updated interactive effects factors.
v7.0	10/2019	TRM v7.0 update. Removed dual baseline and updated useful life estimates. Added invoice and certificate requirements. Added option for new construction savings.

2.1.2 ENERGY STAR® Specialty Compact Fluorescent Lamps Measure Overview

TRM Measure ID: R-LT-SC

Market Sector: Residential

Measure Category: Lighting

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit; new construction

Program Delivery Type(s): Prescriptive and direct install

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure provides a method for calculating savings for replacement of a specialty incandescent or halogen lamp with an ENERGY STAR®-qualified specialty CFL in residential applications. These lamps include reflectors, G-shape lamps, T-shape lamps, B, BA, CA, F G16-1/2, G25, G30, S, or M14 lamps.

Eligibility Criteria

Customer eligibility to be awarded these deemed savings is at the discretion of the utility for different program and customer types. See program-specific manuals to determine customer eligibility.

These savings values rely on usage patterns specific to both indoor and outdoor applications. In lieu of collecting lamp location, a default weighting of 90.5% indoor and 9.5% outdoor may be assumed.[20]

New homes must exceed the lighting equipment requirements of the current state building code (IECC 2015) to be eligible for prescriptive lighting savings.

[20] 2015 U.S. Lighting Market Characterization, Department of Energy. November 2017. Table 4.11. https://www.energy.gov/sites/prod/files/2017/12/f46/lmc2015_nov17.pdf.

Baseline Condition

The baseline wattage will be determined based on the bulb shape of the installed lamp, as outlined below.

New construction applications use the same baselines; however, savings can only be claimed for efficient lighting installed above the minimum amount required by code.

Some baseline conditions for specialty CFLs are affected by EISA and/or a DOE 2009 ruling on incandescent reflector lamps (IRLs). Based on the shape, lumen output, and/or wattage-equivalent of the installed lamp, the appropriate baseline shall be determined from one of the following categories:

- Non-reflector lamps, affected by EISA 2007
- Non-reflector lamps, not affected by EISA 2007
- Reflector lamps affected by the DOE ruling in 2009 on IRLs
- Reflector lamps not affected by the DOE ruling in 2009 on IRLs

Appropriate baseline wattages are presented in Table 11 through Table 14. If a baseline cannot be determined using these tables, the following guidelines may be used to determine appropriate default baseline wattage:

- Non-reflector lamps, affected by EISA 2007: using the exact or range of the installed wattage, determine the appropriate First-tier EISA baseline default wattage in the table below

Table 9: ENERGY STAR® CFLs—Default Equivalent Wattages if Lumen Output Unknown

Wattage Range of Installed CFL[21]	9–11 W	12–15 W	18–20 W	23–27 W
If Unknown: Default Installed CFL Wattage[22]	9 W	13 W	19 W	24 W
1st Tier EISA 2007 Default Baseline	29 W	43 W	53 W	72 W

- Non-reflector lamps, not affected by EISA 2007: 60 watts[23]
- Reflector lamps affected by the DOE ruling in 2009 on IRLs: 60 watts[24]
- Reflector lamps not affected by the DOE ruling in 2009 on IRLs: the appropriate default baseline may be determined using Table 10

[21] Wattage ranges from ENERGY STAR® light bulb savings calculator. Updated October 2016. http://www.energystar.gov/products/certified-products/detail/light-bulbs.

[22] ENERGY STAR® Certified Light Bulbs. https://www.energystar.gov/productfinder/download/certified-light-bulbs/. Accessed October 6, 2015. Mean wattages of omnidirectional, general purpose replacement CFL lamps by incandescent wattage equivalent.

[23] A 2006-2008 California Upstream Lighting Evaluation found an average incandescent wattage of 61.7 Watts (KEMA, Inc., The Cadmus Group, Itron, Inc., PA Consulting Group, Jai J. Mitchell Analytics, Draft Evaluation Report: Upstream Lighting Program. Prepared for the California Public Utilities Commission, Energy Division. December 10, 2009)

[24] Ibid.

Table 10: DOE-ruling Exempt Reflectors—Default Wattages

Lamp Type	W_{Base}
BR30 (65 W)	65 W
BR40 (65 W)	
ER40 (65 W)	
R20 (≤ 45 W)	45 W
BR30 (≤ 50 W)	50 W
BR40 (≤ 50 watt)	
ER30 (≤ 50 watt)	
ER40 (≤ 50 watt)	
Indeterminate	60 W[25]

EISA Standards: Baseline for Non-reflector Lamps

EISA-Affected

EISA-affected bulbs are:

- G-shape lamps with a diameter less than 5 inches
- T-shape lamps greater than 40 watts or a length of 10 inches or less
- B, BA, CA, F G16-1/2, G25, G30, S, or M14 lamps greater than 40 watts.[26]

Baseline wattages should be adjusted as EISA regulations dictate higher efficiency standards.

[25] Ibid.
[26] https://www.lightingfacts.com/Library/Content/FAQs/EISA

Table 11: EISA-Affected Specialty CFL Baselines (Non-reflectors)[27]

Lamp Type	Minimum Lumens	Maximum Lumens	Incandescent Equivalent 1st Tier EISA 2007 ($W_{Base,FT}$)		
• G-shape lamps with a diameter less than 5 inches • T-shape lamps greater than 40 watts or a length of 10 inches or less • B, BA, CA, F G16-1/2, G25, G30, S, or M14 lamps greater than 40 watts	310	749	29		
	750	1,049	43		
	1,050	1,489	53		
	1,490	2,600	72		

EISA-Exempt

EISA-exempt bulbs are:

- Appliance lamps, black light lamps, bug lamps, colored lamps, infrared lamps, left-hand thread lamps, marine lamps, marine signal service lamps, mine service lamps, plant light lamps, reflector lamps, rough service lamps, shatter-resistant lamps, sign service lamps, silver bowl lamps, showcase lamps, 3-way incandescent lamps, and vibration service lamps
- G-shape lamp with a diameter of 5 inches or more
- T-shape lamp of 40 watts or less or a length of more than 10 inches
- B, BA, CA, F, G16-1/2, G25, G30, S, or M14 lamp of 40 watts or less[28]

[27] Ibid.

[28] https://www.lightingfacts.com/Library/Content/FAQs/EISA

Table 12: EISA-Exempt Specialty CFL Baselines (Non-reflectors)

Lamp Type	Minimum Lumens	Maximum Lumens	W_{Base}
• Appliance lamps, black light lamps, bug lamps, colored lamps, infrared lamps, left-hand thread lamp, marine lamp, marine signal service lamp, mine service lamp, plant light lamp, reflector lamp, rough service lamp, shatter-resistant lamp, sign service lamp, silver bowl lamp, showcase lamp, 3-way incandescent lamp, vibration service lamp • G-shape lamp with a diameter of 5 inches or more • T-shape lamp of 40 watts or less or a length of more than 10 inches • B, BA, CA, F, G16-1/2, G25, G30, S, or M14 lamp of 40 watts or less	Nameplate wattage on the removed product. If unknown, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer if available. Otherwise, use 60 watts.[29]		

DOE Standards for Incandescent Reflector Lamps (IRLs): Baseline for Reflector Lamps

DOE-ruling-affected

Certain types of incandescent reflector bulbs are affected by a DOE 2009 ruling on reflector lamps. Products affected by the IRL ruling are:

- R, PAR, ER, BR, BPAR lamps
- BR and ER lamps rated at more than 50 watts
- Reflector lamps between 2.25” (R18) and 2.75” (R22) in diameter
- 40-205 Watt incandescent PAR lamps[30]

Where available, the nameplate wattage of the removed lamp should be used as the baseline. Otherwise, the baseline wattage can be determined according to the lumen range of the installed lamp (see Table 13).

[29] A 2006-2008 California Upstream Lighting Evaluation found an average incandescent wattage of 61.7 Watts (KEMA, Inc., The Cadmus Group, Itron, Inc., PA Consulting Group, Jai J. Mitchell Analytics, Draft Evaluation Report: Upstream Lighting Program. Prepared for the California Public Utilities Commission, Energy Division. December 10, 2009).

[30] http://www.gelighting.com/LightingWeb/na/resources/legislation/2009-department-of-energy-regulations/
https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=23
http://www.bulbrite.com/eisa.php.

Table 13: DOE IRL Ruling-affected Specialty CFL Baselines (Reflectors)[31,32]

Lamp Type	Lumen Range	W_{Base}
BR19	300-500	50
BR30	600-800	75
	801-1000	85
BR38	600-900	75
	901-1400	150
BR40	600-700	75
	701-900	85
	901-950	100
	951-1300	120
	1301-1700	125
	1701-2000	150
	2001-2400	200
ER30	300-450	50
	451-701	75
ER40	1000-1300	120
PAR20	300-450	50
	451-550	40
	551-650	50
PAR30	450-550	35
	551-600	40
	601-850	50
	851-950	60
	951-1200	75
PAR38	550-750	65
	751-1100	75
	1101-1300	100
	1301-1600	120
	1601-2500	150
	2501-3500	175

[31] Wattage values and lumen ranged from a review of GE, Osram Sylvania, and Philips catalogs in January 2015, as well as the Illinois TRM 2014.

[32] Table 13 is based on manufacturers' lumen and wattage data for the most commonly used reflector lamps. However, other manufacturers' ratings may differ from this list. Where available, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer.

Lamp Type	Lumen Range	W_{Base}
R20	401-500	50
	501-600	75
	601-1000	100
R30	700-800	75
	801-950	110
	951-1100	125
R40	1300-1900	125

DOE-ruling-exempt

The DOE 2009 ruling standards do not apply to the following types of IRLs:

- IRLs rated at 50 watts or less that are ER30, BR30, BR40, or ER40 lamps
- IRLs rated at 65 watts that are BR30, BR40, or ER40 lamps
- R20 IRLs rated 45 watts or less[33]

Table 14: DOE-ruling Exempt Reflectors

Lamp Type	W_{Base}
BR30 (65 watt)	Nameplate wattage on the removed product. If unknown, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer if available. Otherwise, use 65 watts.
BR40 (65 watt)	
ER40 (65 watt)	
R20 (≤ 45 watt)	Nameplate wattage on the removed product. If unknown, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer if available. Otherwise, use 45 watts.
BR30 (≤ 50 watt)	Nameplate wattage on the removed product. If unknown, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer if available. Otherwise, use 50 watts.
BR40 (≤ 50 watt)	
ER30 (≤ 50 watt)	
ER40 (≤ 50 watt)	

High-efficiency Condition

New CFLs must be ENERGY STAR® specialty CFLs as outlined in the latest ENERGY STAR® specification.[34] These lamps include reflectors, G-shape lamps, T-shape lamps, B, BA, CA, F G16-1/2, G25, G30, S, or M14 lamps.

These ENERGY STAR® specialty CFLs are the equivalent of the specialty incandescent or halogen lamps being replaced. The high-efficiency condition is the wattage of the lamp installed.

[33] http://www.gelighting.com/LightingWeb/na/resources/legislation/2009-department-of-energy-regulations/ http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/58.
[34] http://www.energystar.gov/products/certified-products/detail/light-bulbs.

See the ENERGY STAR® website for more information on the specification in effect: http://www.energystar.gov/products/certified-products/detail/light-bulbs.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Wattage reduction is defined as the difference between the wattage of a specialty baseline lamp and the wattage of a comparable CFL.

For new construction projects, programs should calculate savings using the methodology in this section for all efficient lamps installed in the home. The program should claim savings for the percentage of installed high-efficacy lamps that exceed the minimum required by code, which is currently 75% of lamps. For example, if a new home is built with high-efficacy lamps in 85% of the permanently-installed fixtures, the program would claim 10% of the total calculated savings.

Energy Savings

For EISA-affected lamps only, annual energy (kWh) savings are calculated as follows.

$$\Delta kWh = \frac{\left(W_{base,FT} - W_{post}\right)}{1000} \times HOU \times ISR \times IEF_E$$

Equation 8

For EISA- exempt lamps and reflectors (both DOE-ruling-exempt and DOE-ruling-affected), annual energy (kWh) savings are calculated as follows.

$$\Delta kWh = \frac{\left(W_{base} - W_{post}\right)}{1000} \times HOU \times ISR \times IEF_E$$

Equation 9

Where:

$W_{base,FT}$ = *First-tier EISA baseline wattage corresponding with the lumen output of the purchased CFL lamp for the year purchased/installed. First-tier EISA baseline lamp wattage provided in Table 11 under the column "Incandescent Equivalent 1st Tier EISA 2007."*

W_{base} = *EISA-exempt specialty lamp or a DOE-ruling-exempt reflector, use the nameplate wattage (see Table 12 and Table 14). If a DOE-ruling-affected IRL, use the wattages provided in Table 13.*

W_{post} = *Actual wattage of CFL purchased/installed*

HOU	=	*Average hours of use per year = 803 hours for interior/exterior applications calculated based on an average daily usage of 2.2 hours per day[35])*
IEF_E	=	*Interactive Effects Factor to account for cooling energy savings and heating energy penalties associated with lighting power reductions (see Table 15)*
ISR	=	*In-service Rate, the percentage of incentivized units that are installed and in use (rather than removed, stored, or burnt-out) to account for units incentivized but not operating = 0.97* [36]

Table 15: ENERGY STAR® Specialty CFLs—Interactive Effects Factor for Cooling Energy Savings and Heating Energy Penalties[37]

	IEF_E				
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas Heat with AC	1.06	1.13	1.17	1.15	1.12
Gas Heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat Pump	0.91	1.00	1.05	1.11	0.97
Electric Resistance Heat with AC	0.65	0.80	0.90	1.00	0.75
Electric Resistance Heat with no AC	0.57	0.69	0.76	0.83	0.65
No heat with AC	1.06	1.13	1.17	1.15	1.12
Unconditioned Space	1.00	1.00	1.00	1.00	1.00
Heating/Cooling Unknown[39]	0.88	0.98	1.04	1.07	0.95

* IEF for homes with no AC are most appropriate for customers with evaporative cooling or room air conditioners.

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[35] The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

[36] Dimetrosky, S., Parkinson, K., and Lieb, N. "Residential Lighting Evaluation Protocol – The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures." January 2015. ISR for upstream programs, including storage lamps installed within four years of purchase. http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf.

[37] Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: $1 + HVAC_{savings}/Lighting_{savings}$.

[38] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

[39] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Demand Savings

Summer and winter demand savings are determined by applying a coincidence factor associated with each season. However, summer demand savings should not be claimed for outdoor lamps.

$$\Delta kW_{summer} = \frac{\left(W_{base,FT} - W_{post}\right)}{1000} \times CF_{summer} \times ISR \times IEF_{D,summer}$$

Equation 10

$$\Delta kW_{winter} = \frac{\left(W_{base,FT} - W_{post}\right)}{1000} \times CF_{winter} \times ISR \times IEF_{D,winter}$$

Equation 11

For EISA- exempt lamps and reflectors (both DOE-ruling-exempt and DOE-ruling-affected), peak demand (kW) savings are calculated as follows.

$$\Delta kW_{summer} = \frac{\left(W_{base} - W_{post}\right)}{1000} \times CF_{summer} \times ISR \times IEF_{D,summer}$$

Equation 12

$$\Delta kW_{winter} = \frac{\left(W_{base} - W_{post}\right)}{1000} \times CF_{winter} \times ISR \times IEF_{D,winter}$$

Equation 13

Where:

CF = *Coincidence Factor (see Table 16)*

IEF_D = *Interactive Effects Factor to account for cooling demand savings or heating demand penalties associated with lighting power reductions (see Table 17)*

Table 16: ENERGY STAR® CFLs—Coincidence Factors[40]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.060	0.053	0.063	0.059	0.032
Winter	0.275	0.232	0.199	0.263	0.358

Table 17: ENERGY STAR® CFLs—Interactive Effects Factor for Cooling Demand Savings and Heating Demand Penalties[41]

$IEF_{D,summer}$

[40] See Volume 1, Appendix B.

[41] Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens

Heating/Cooling Type*	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Gas heat with AC	1.45	1.33	1.68	1.23	1.44
Gas heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat pump	1.45	1.33	1.68	1.23	1.44
Electric resistance heat with AC	1.45	1.33	1.68	1.23	1.44
Electric resistance heat with no AC	1.00	1.00	1.00	1.00	1.00
No heat with AC	1.45	1.33	1.68	1.23	1.44
Unconditioned space	1.00	1.00	1.00	1.00	1.00
Heating/cooling unknown[42]	1.39	1.28	1.58	1.20	1.38
$IEF_{D,winter}$					
Heating/Cooling Type*	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Gas heat with AC	0.98	0.98	0.98	0.98	0.98
Gas heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat pump	0.71	0.67	0.65	0.74	0.81
Heating/Cooling Type*	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Electric resistance heat with AC	0.44	0.36	0.38	0.42	0.52
Electric resistance heat with no AC	0.44	0.36	0.38	0.42	0.52
No heat with AC	0.98	0.98	0.98	0.98	0.98
Unconditioned space	1.00	1.00	1.00	1.00	1.00
Heating/cooling unknown[43]	0.76	0.72	0.73	0.75	0.80

* IEF for homes with no AC is most appropriate for customers with evaporative cooling or room air conditioners.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: 1 + $HVAC_{savings}/Lighting_{savings}$.

[42] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

[43] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

Historically, the average measure life is based upon the rated lamp life of the specialty CFL shown in the following table. The measure life assumes an average daily use of 2.2 hours per day based on blended usage for indoor/outdoor applications and applies a 0.85 degradation factor to indoor/outdoor CFLs.

$$EUL_{Total} = \frac{Rated\ Life \times DF}{HOU \times 365.25}$$

Equation 14

$$EUL_{Tier1} = 2021 - Purchase\ Year$$

Equation 15

$$EUL_{Tier2} = EUL_{Total} - EUL_{Tier1}$$

Equation 16

Where:

$Rated\ Life$	=	*10,000 hours, 12,000 hours, 15,000 hours, or 20,000 hours, as specified by the manufacturer. If unknown, assume a 10,000-hour lifetime.*[44]
DF	=	*0.85 degradation factor*[45]

[44] Minimum lifetime requirement under ENERGY STAR® Lamps Specification V1.1, effective 9/30/2014. http://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V1%201_Specification.pdf

[45] ENERGY STAR® CFL Third Party Testing and Verification Off-the-Shelf CFL Performance: Batch 3. Figure 27, p. 47.

HOU = 2.2 hours per day[46]

Where:

$Rated\ Life$ = *10,000 hours, 12,000 hours, 15,000 hours, or 20,000 hours, as specified by the manufacturer. If unknown, assume a 10,000-hour lifetime.*[47]

DF = *0.85 degradation factor*[48]

HOU = *2.2 hours per day*[49]

EISA Compliant Lamps

To account for a rapidly changing market, standard practice dictates that measure life assumptions be reduced to approximate the point at which the residential lighting market has been fully transformed to high-efficiency lamps. Due to market uncertainty in response to a recent rule issued by the Department of Energy, a simplified approach to claim half of the more conservative 16-year EUL will be implemented during the 2020 program year, resulting in an 8-year EUL. This assumption will be reviewed annually to account for current market trends.

Based on an expected delay in market adoption among certain customer bases, this measure life will be extended to 2030 for programs targeting low-income and hard-to-reach customers, resulting in a 10-year EUL.

These reductions do not apply to specialty lamps.

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46 The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

47 Minimum lifetime requirement under ENERGY STAR® Lamps Specification V1.1, effective 9/30/2014. http://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V1%201_Specification.pdf.

48 ENERGY STAR® CFL Third Party Testing and Verification Off-the-Shelf CFL Performance: Batch 3. Figure 27, p. 47.

49 The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

Table 18: ENERGY STAR® Specialty CFLs—Estimated Useful Life

Range of Rated Measure Life (Hours)	Assumed Rated Measure Life (Hours)	Specialty Measure Life (Years)	If EISA Compliant:	
			Standard Baseline Measure Life (Years)	Low-income Baseline Measure Life (Years)
10,000–11,000	10,000	11	8	10
11,001–13,500	12,000	13	8	10
13,501–17,500	15,000	16	8	10
≥ 17,501	20,000	20*	8	10

* Measure life capped at 20 or 10 years depending on the applicable baseline. EUL may be deemed at 11 or 8 years in lieu of collecting manufacturer rated life or documenting customer baseline for EISA compliant lamps.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of CFLs installed
- ANSI C79.1-2002 nomenclature of CFL installed (G40, PAR, etc.)
- Wattage of each installed CFL
- Lumen output of each installed CFL
- Wattage of replaced lamp
- Manufacturer-rated lifetime of each installed CFL in hours
- Heating system type (gas, electric resistance, heat pump) for each home in which a CFL is installed
- Location of installed lamp (conditioned, unconditioned, or outdoor); only required when not assuming default weighting
- Program type (direct install, retail)
- Baseline calculation methodology (replaced lamp nameplate wattage, EISA-affected non-reflector, EISA-exempt non-reflector, DOE-ruling-affected reflector, DOE-ruling-exempt reflector, manufacturer-rated equivalent incandescent wattage, or default wattage)
- Proof of purchase – with date of purchase and quantity
    - Alternative: representative photos of installed units or another pre-approved method of installation verification
- ENERGY STAR® certificate matching installed model number
    - Alternative: another pre-approved method of certification

- For new construction projects only, these data points must be gathered for all permanently-installed fixtures in the home in order to document the percent that are high-efficacy.

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

- Energy Independence and Security Act of 2007
- Energy Conservation Program: Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps, Energy Efficiency and Renewable Energy Office (EERE), 2009
- ENERGY STAR® specifications for CFL lamps.

Document Revision History

Table 19: Residential Specialty Compact Fluorescent Lamps Revision History

TRM Version	Date	Description of Change
v3.0	4/10/2015	TRM v3.0 origin.
v3.1	11/05/2015	TRM v3.1 update. Modification of in-service rate, revision of interactive effects factors to reflect indoor-specific values for additional heating and cooling equipment types. Consolidated default input assumptions for upstream lighting programs. Restricted estimated measure life to several discrete values.
v3.1	3/28/2016	TRM v3.1 March revision. Updated summer and winter coincidence factors.
v4.0	10/10/ 2016	TRM v4.0 update. Updated IEF values and useful life estimates.
v5.0	10/2017	TRM v5.0 update. Updated useful life estimates.
v6.0	11/2018	TRM v6.0 update. Updated useful life estimates. Updated interactive effects factors.
v7.0	10/2019	TRM v7.0 update. Removed dual baseline and updated useful life estimates. Added invoice and certificate requirements. Added option for new construction savings.

2.1.3 ENERGY STAR® Omni-directional LED Lamps Measure Overview

TRM Measure ID: R-LT-OD

Market Sector: Residential

Measure Category: Lighting

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit; new construction

Program Delivery Type(s): Prescriptive and direct install

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure provides a method for calculating savings for the replacement of an incandescent lamp with an omni-directional LED[50] in a residential application. Using ANSI C79.1-2002 nomenclature, the applicable omni-directional LED lamp types are A, BT, P, PS, S, and T.

Eligibility Criteria

Customer eligibility to be awarded these deemed savings is at the discretion of the utility for different program and customer types. See program-specific manuals to determine customer eligibility.

These savings values rely on usage patterns specific to both indoor and outdoor applications. In lieu of collecting lamp location, a default weighting of 90.5% indoor and 9.5% outdoor may be assumed.[51]

[50] According to ENERGY STAR® omni-directional LED products "…shall have an even distribution of luminous intensity (candelas) within the 0° to 135° zone (vertically axially symmetrical). Luminous intensity at any angle within this zone shall not differ from the mean luminous intensity for the entire 0° to 135° zone by more than 20 percent. At least 5 percent of total flux (lumens) must be emitted in the 135°-180° zone. Distribution shall be vertically symmetrical as measured in three vertical planes at 0°, 45°, and 90°." http://www.energystar.gov/ia/partners/product_specs/program_reqs/Integral_LED_Lamps_Program_Requirements.pdf.

[51] 2015 U.S. Lighting Market Characterization, Department of Energy. November 2017. Table 4.11. https://www.energy.gov/sites/prod/files/2017/12/f46/lmc2015_nov17.pdf.

New homes must exceed the lighting equipment requirements of the current state building code (IECC 2015) to be eligible for prescriptive lighting savings.

Baseline Condition

The baseline is assumed to be the first-tier Energy Independence and Security Act of 2007 (EISA)-mandated maximum wattage for a general service or standard incandescent or halogen lamp (see Table 2). Baseline wattages should be adjusted as EISA regulations dictate higher efficiency standards. A potential second-tier EISA baseline adjustment was scheduled to go into effect beginning January 2020. At that time, general service lamps would need to comply with a 45 lumen-per-watt efficacy standard. However, the Department of Energy (DOE) issued a definition for general service lamps on September 5, 2019, concluding that "no backstop energy conservation has been imposed."[52] Therefore, no additional baseline adjustment will be imposed starting in 2020. However, standard practice must also be considered in determining an appropriate baseline for this measure. To account for a rapidly changing market, measure life assumptions have been reduced as described later in this measure.

Table 20: ENERGY STAR® Omni-directional LEDs—EISA Baselines[53]

Minimum Lumens	Maximum Lumens	Incandescent Equivalent Wattage Pre-EISA 2007	1st Tier EISA 2007 (W_{Base})
310	749	40	29
750	1,049	60	43
1,050	1,489	75	53
1,490	2,600	100	72

New construction applications use the same baselines; however savings can only be claimed for efficient lighting installed above the minimum amount required by code.

High-efficiency Condition

LEDs must be ENERGY STAR®-qualified for the relevant lamp shape being removed as outlined in the latest ENERGY STAR® specification.[54] Using ANSI C79.1-2002 nomenclature, the applicable omni-directional LED lamp types are A, BT, P, PS, S, and T.

The high-efficiency condition is the wattage of the lamp installed.

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[52] "Energy Conservation Program: Definition for General Service Lamps", Department of Energy. 9/5/2019. https://www.federalregister.gov/documents/2019/09/05/2019-18940/energy-conservation-program-definition-for-general-service-lamps.

[53] In new ENERGY STAR® lighting standards effective September 2014, lumen bins associated with incandescent wattages have been assigned that do not align with those set out in EISA 2007. Due to the likelihood of continuing sell-through of existing ENERGY STAR® lighting and the on-going use of the EISA bin definitions, this TRM maintains the EISA lumen bins for assigning baseline wattage. Future iterations of the Texas TRM, however, may incorporate these new ENERGY STAR® lumen bins for baseline wattage estimates.

[54] http://www.energystar.gov/products/certified-products/detail/light-bulbs.

See the ENERGY STAR® website for more information on the specification in effect: http://www.energystar.gov/products/certified-products/detail/light-bulbs.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Wattage reduction is defined as the difference between the wattage of a standard baseline lamp, according to EISA 2007 (see Table 20) and the wattage of a comparable omni-directional LED. An LED is considered comparable to the baseline lamp if they are aligned on the lumen output ranges set out in EISA 2007.

For new construction projects, programs should calculate savings using the methodology in this section for all efficient lamps installed in the home. The program should claim savings for the percentage of installed high-efficacy lamps that exceed the minimum required by code, which is currently 75% of lamps. For example, if a new home is built with high-efficacy lamps in 85% of the permanently-installed fixtures, the program would claim 10% of the total calculated savings.

Energy Savings

Annual energy (kWh) savings are calculated as follows.

$$\Delta kWh = \frac{\left(W_{base,FT} - W_{post}\right)}{1000} \times Hours \times ISR \times IEF_E$$

Where:

$W_{base,FT}$ = *First-tier EISA baseline wattage corresponding with the lumen output of the purchased LED lamp for the year purchased/installed. First-tier EISA baseline lamp wattage provided in Table 20 under the column "Incandescent Equivalent 1st Tier EISA 2007" (if unknown, see Table 21 for 1st Tier EISA 2007default wattages)*

Table 21: ENERGY STAR® Omni-directional LEDs—Default Equivalent Wattages if Lumen Output Unknown

Wattage Range of Installed LED[55]	5–8 W	8.5–12 W	12.5–16 W	17–23 W
If Unknown: Default Installed LED Wattage[56]	7 W	10 W	12 W	17 W
1st Tier EISA 2007 Default Baseline	29 W	43 W	53 W	72 W

W_{post} = *Actual wattage of LED purchased/installed*

[55] Wattage ranges from ENERGY STAR® light bulb savings calculator. Updated June 2015. http://www.energystar.gov/products/certified-products/detail/light-bulbs.

[56] ENERGY STAR® Certified Light Bulbs. https://www.energystar.gov/productfinder/download/certified-light-bulbs/. Accessed October 6, 2015. Mean wattages of omnidirectional, general purpose replacement LED lamps by incandescent wattage equivalent.

HOU = *Average hours of use per year = 803 hours (for interior/exterior applications calculated based on an average daily usage of 2.2 hours per day[57])*

IEF_E = *Interactive Effects Factor to account for cooling energy savings and heating energy penalties associated with lighting power reductions (see Table 22)*

ISR = *In-service Rate, the percentage of incentivized units that are installed and in use (rather than removed, stored, or burnt-out) to account for units incentivized but not operating = 0.97 [58]*

Table 22: ENERGY STAR® Omni-directional LEDs Interactive Effects for Cooling Energy Savings and Heating Energy Penalties[59]

	IEF_E				
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas heat with AC	1.06	1.13	1.17	1.15	1.12
Gas heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat pump	0.91	1.00	1.05	1.11	0.97
Electric resistance heat with AC	0.65	0.80	0.90	1.00	0.75
Electric resistance heat with no AC	0.57	0.69	0.76	0.83	0.65
No heat with AC	1.06	1.13	1.17	1.15	1.12
Unconditioned space	1.00	1.00	1.00	1.00	1.00
Heating/cooling unknown[60]	0.88	0.98	1.04	1.07	0.95

* IEF for homes with no AC is most appropriate for customers with evaporative cooling or room air conditioners.

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[57] The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

[58] Dimetrosky, S., Parkinson, K. and Lieb, N., "Residential Lighting Evaluation Protocol – The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures." January 2015. ISR for upstream programs, including storage lamps installed within four years of purchase. http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf.

[59] Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: $1 + HVAC_{savings}/Lighting_{savings}$.

[60] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Demand Savings

Summer and winter demand savings are determined by applying a coincidence factor associated with each season.

$$\Delta kW summer = \frac{\left(W_{base,FT} - W_{post}\right)}{1000} \times CF_{summer} \times ISR \times IEF_{D,summer}$$

Equation 17

$$\Delta kW winter = \frac{\left(W_{base,FT} - W_{post}\right)}{1000} \times CF_{winter} \times ISR \times IEF_{D,winter}$$

Equation 18

Where:

CF = *Coincidence Factor (see Table 23)*

IEF_D = *Interactive Effects Factor to account for cooling demand savings or heating demand penalties associated with lighting power reductions (see Table 24)*

Table 23: ENERGY STAR® LEDs—Coincidence Factors[61]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.060	0.053	0.063	0.059	0.032
Winter	0.275	0.232	0.199	0.263	0.358

[61] See Volume 1, Appendix B.

Table 24: ENERGY STAR® Omni-directional LEDs—Interactive Effects Factor for Cooling Demand Savings and Heating Demand Penalties[62]

$IEF_{D,summer}$					
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas heat with AC	1.45	1.33	1.68	1.23	1.44
Gas heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat pump	1.45	1.33	1.68	1.23	1.44
Electric resistance heat with AC	1.45	1.33	1.68	1.23	1.44
Electric resistance heat with no AC	1.00	1.00	1.00	1.00	1.00
No heat with AC	1.45	1.33	1.68	1.23	1.44
Unconditioned space	1.00	1.00	1.00	1.00	1.00
Heating/cooling unknown[63]	1.39	1.28	1.58	1.20	1.38
$IEF_{D,winter}$					
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas heat with AC	0.98	0.98	0.98	0.98	0.98
Gas heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat pump	0.71	0.67	0.65	0.74	0.81
Electric resistance heat with AC	0.44	0.36	0.38	0.42	0.52
Electric resistance heat with no AC	0.44	0.36	0.38	0.42	0.52
No heat with AC	0.98	0.98	0.98	0.98	0.98
Unconditioned space	1.00	1.00	1.00	1.00	1.00
Heating/cooling unknown[64]	0.76	0.72	0.73	0.75	0.80

* IEF for homes with no AC is most appropriate for customers with evaporative cooling or room air conditioners.

[62] Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: $1 + HVAC_{savings}/Lighting_{savings}$.

[63] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

[64] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

Historically, the average measure life is based upon the rated lamp life of the LED. The measure life assumes an average use of 2.2 hours per day based on blended usage for indoor/outdoor applications and applies a 0.85 degradation factor to indoor/outdoor LEDs.

$$EUL_{Total} = \frac{Rated\ Life \times DF}{HOU \times 365.25}$$

Equation 19

Where:

$Rated\ Life$ = *10,000 hours, 12,000 hours, 15,000 hours, or 20,000 hours, as specified by the manufacturer. If unknown, assume a 10,000-hour lifetime.*[65]

DF = *0.85 degradation factor*[66]

[65] Minimum lifetime requirement under ENERGY STAR® Lamps Specification V1.1, effective September 30, 2014. http://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V1%201_Specification.pdf.

[66] ENERGY STAR® CFL Third Party Testing and Verification Off-the-Shelf CFL Performance: Batch 3. Figure 27, p. 47.

$HOU \quad = \quad$ *2.2 hours per day*[67]

However, to account for a rapidly changing market, standard practice dictates that measure life assumptions be reduced to approximate the point at which the residential lighting market has been fully transformed to high-efficiency lamps. Due to market uncertainty in response to a recent rule issued by the Department of Energy, a simplified approach to claim half of the more conservative 16-year EUL will be implemented during the 2020 program year, resulting in an 8-year EUL. This assumption will be reviewed annually to account for current market trends.

Based on an expected delay in market adoption among certain customer bases, this measure life will be extended to 2030 for programs targeting low-income and hard-to-reach customers, resulting in a 10-year EUL.

Table 25: ENERGY STAR® Omni-directional LEDs—Estimated Useful Life

Range of Rated Measure Life (Hours)	Assumed Rated Measure Life (Hours)	Rated Product Lifetime (Years)	Standard Baseline Measure Life (Years)	Low-income Baseline Measure Life (Years)
≤ 17,500	15,000	16	8	10
> 17,500	20,000	20*	8	10

* Measure life capped at 20 years. EUL may be deemed at 8 years in lieu of documenting the customer baseline.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of LEDs installed
- Wattage of each installed LED
- Lumen output of each installed LED
- Wattage of replaced lamp
- Manufacturer-rated lifetime of each installed LED in hours
- Heating system type (gas, electric resistance, heat pump) for each home in which an LED is installed
- Location of installed lamp (conditioned, unconditioned, or outdoor); only required when not assuming default weighting
- Proof of purchase – with date of purchase and quantity
    - Alternative: representative photos of installed units or another pre-approved method of installation verification

[67] The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

- ENERGY STAR® certificate matching installed model number
    - Alternative: another pre-approved method of certification
- For new construction projects only, these data points must be gathered for all permanently-installed fixtures in the home in order to document the percentage that are high-efficacy.

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

- Energy Independence and Security Act of 2007
- ENERGY STAR® specifications for LED lamps

Document Revision History

Table 26: Residential Omni-directional LED Lamps Revision History

TRM Version	Date	Description of Change
v3.0	4/10/2015	TRM v3.0 origin.
v3.1	11/05/2015	TRM v3.1 update. Modification of in-service rate, revision of interactive effects factors to reflect indoor-specific values for additional heating and cooling equipment types. Provided default input assumptions for upstream lighting programs. Capped estimated measure life.
v3.1	3/28/2016	TRM v3.1 March revision. Updated summer and winter coincidence factors.
v4.0	10/10/2016	TRM v4.0 update. Updated IEF values and useful life estimates.
v5.0	10/2017	TRM v5.0 update. Updated EUL algorithm to account for baseline change beginning in 2021. Included language to deem EUL.
v6.0	11/2018	TRM v6.0 update. Updated useful life estimates. Updated interactive effects factors.
v7.0	10/2019	TRM v7.0 update. Removed dual baseline and updated useful life estimates. Added invoice and certificate requirements. Added option for new construction savings.

2.1.4 ENERGY STAR® Specialty and Directional LED Lamps Measure Overview

TRM Measure ID: R-LT-SD

Market Sector: Residential

Measure Category: Lighting

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit; new construction

Program Delivery Type(s): Prescriptive and direct install

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure provides a method for calculating savings for replacement of an incandescent or halogen reflector or decorative lamp with an ENERGY STAR® -qualified LED lamp. These lamps include reflectors, G-shape lamps, T-shape lamps, B, BA, CA, F G16-1/2, G25, G30, S, or M14 lamps.[68]

Eligibility Criteria

Customer eligibility to be awarded these deemed savings is at the discretion of the utility for different program and customer types. See program-specific manuals to determine customer eligibility.

These savings values rely on usage patterns specific to both indoor and outdoor applications. In lieu of collecting lamp location, a default weighting of 90.5% indoor and 9.5% outdoor may be assumed.[69]

New homes must exceed the lighting equipment requirements of the current state building code (IECC 2015) to be eligible for prescriptive lighting savings.

[68] http://www.energystar.gov/products/certified-products/detail/light-bulbs.

[69] 2015 U.S. Lighting Market Characterization, Department of Energy. November 2017. Table 4.11. https://www.energy.gov/sites/prod/files/2017/12/f46/lmc2015_nov17.pdf.

Baseline Condition

The baseline wattage will be determined based on the bulb shape of the installed lamp, as outlined below. New construction applications use the same baselines; however, savings can only be claimed for efficient lighting installed above the minimum amount required by code.

Some baseline conditions for specialty LEDs are affected by EISA and/or a DOE 2009 ruling on incandescent reflector lamps (IRLs). Based on the shape, lumen output, and/or wattage-equivalent of the installed lamp, the appropriate baseline shall be determined from one of the following categories:

- Non-reflector lamps, affected by EISA 2007
- Non-reflector lamps, not affected by EISA 2007
- Reflector lamps affected by the DOE ruling in 2009 on IRLs
- Reflector lamps not affected by the DOE ruling in 2009 on IRLs

Appropriate baseline wattages are presented in Table 29 through Table 32. If a baseline cannot be determined using these tables, the following guidelines may be used to determine appropriate default baseline wattage:

- Non-reflector lamps, affected by EISA 2007: using the exact or range of the installed wattage, determine the appropriate First-tier EISA baseline default wattage in Table 27

Table 27: ENERGY STAR® Specialty LEDs—Default Equivalent Wattages if Lumen Output Unknown

Wattage Range of Installed LED[70]	5–8 W	8.5–12 W	12.5–16 W	17–23 W
If Unknown: Default Installed LED Wattage[71]	7 W	10 W	12 W	17 W
1st Tier EISA 2007 Default Baseline	29 W	43 W	53 W	72 W

- Non-reflector lamps, not affected by EISA 2007: 60 watts[72]
- Reflector lamps affected by the DOE ruling in 2009 on IRLs: 60 watts[73]
- Reflector lamps not affected by the DOE ruling in 2009 on IRLs: the appropriate default baseline may be determined using Table 28

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70 Wattage ranges from ENERGY STAR® light bulb savings calculator. Updated June 2015. http://www.energystar.gov/products/certified-products/detail/light-bulbs.

71 ENERGY STAR® Certified Light Bulbs. https://www.energystar.gov/productfinder/download/certified-light-bulbs. Accessed October 6, 2015. Mean wattages of omnidirectional, general purpose replacement LED lamps by incandescent wattage equivalent.

72 A 2006-2008 California Upstream Lighting Evaluation found an average incandescent wattage of 61.7 Watts (KEMA, Inc., The Cadmus Group, Itron, Inc., PA Consulting Group, Jai J. Mitchell Analytics, Draft Evaluation Report: Upstream Lighting Program. Prepared for the California Public Utilities Commission, Energy Division. December 10, 2009)

73 Ibid.

Table 28: DOE-ruling Exempt Reflectors—Default Wattages

Lamp Type	W_{Base}
BR30 (65 W)	65 W
BR40 (65 W)	
ER40 (65 W)	
R20 (≤ 45 W)	45 W
BR30 (≤ 50 W)	50 W
BR40 (≤ 50 watt)	
ER30 (≤ 50 watt)	
ER40 (≤ 50 watt)	
Indeterminate	60 W[74]

EISA Standards: Baseline for Non-reflector Lamps

EISA-Affected

EISA-affected bulbs are:

- G-shape lamps with a diameter less than 5 inches
- T-shape lamps greater than 40 watts or a length of 10 inches or less
- B, BA, CA, F G16-1/2, G25, G30, S, or M14 lamps greater than 40 watts[75]

Baseline wattages should be adjusted as EISA regulations dictate higher efficiency standards.

Table 29: EISA-Affected Specialty LED Baselines (Non-reflectors)[76]

Lamp Type	Minimum Lumens	Maximum Lumens	Incandescent Equivalent 1st Tier EISA 2007 ($W_{Base,FT}$)
	310	749	29

[74] Ibid.
[75] https://www.lightingfacts.com/Library/Content/FAQs/EISA.
[76] Ibid.

Lamp Type	Minimum Lumens	Maximum Lumens	Incandescent Equivalent 1st Tier EISA 2007 ($W_{Base,FT}$)
• G-shape lamps with a diameter less than 5 inches • T-shape lamps greater than 40 watts or a length of 10 inches or less • B, BA, CA, F G16-1/2, G25, G30, S, or M14 lamps greater than 40 watts	750	1,049	43
	1,050	1,489	53
	1,490	2,600	72

EISA-Exempt

EISA-exempt bulbs are:

- Appliance lamps, black light lamps, bug lamps, colored lamps, infrared lamps, left-hand thread lamps, marine lamps, marine signal service lamps, mine service lamps, plant light lamps, reflector lamps, rough service lamps, shatter-resistant lamps, sign service lamps, silver bowl lamps, showcase lamps, 3-way incandescent lamps, and vibration service lamps
- G-shape lamp with a diameter of 5 inches or more
- T-shape lamp of 40 watts or less or a length of more than 10 inches
- B, BA, CA, F, G16-1/2, G25, G30, S, or M14 lamp of 40 watts or less[77]

[77] https://www.lightingfacts.com/Library/Content/FAQs/EISA

Table 30: EISA-exempt Specialty LED Baselines (Non-reflectors)

Lamp Type	Minimum Lumens	Maximum Lumens	W_{Base}
• Appliance lamps, black light lamps, bug lamps, colored lamps, infrared lamps, left-hand thread lamp, marine lamp, marine signal service lamp, mine service lamp, plant light lamp, reflector lamp, rough service lamp, shatter-resistant lamp, sign service lamp, silver bowl lamp, showcase lamp, 3-way incandescent lamp, vibration service lamp • G-shape lamp with a diameter of 5 inches or more • T-shape lamp of 40 watts or less or a length of more than 10 inches • B, BA, CA, F, G16-1/2, G25, G30, S, or M14 lamp of 40 watts or less	Nameplate wattage on the removed product. If unknown, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer if available. Otherwise, use 60 watts.[78]		

DOE Standards for Incandescent Reflector Lamps (IRLs): Baseline for Reflector Lamps

DOE-ruling-affected

Certain types of incandescent reflector bulbs are affected by a DOE 2009 ruling on reflector lamps. Products affected by the IRL ruling are:

- R, PAR, ER, BR, BPAR lamps
- BR and ER lamps rated at more than 50 watts
- Reflector lamps between 2.25" (R18) and 2.75" (R22) in diameter
- 40-205 Watt incandescent PAR lamps[79]

Where available, the nameplate wattage of the removed lamp should be used as the baseline. Otherwise, the baseline wattage can be determined according to the lumen range of the installed lamp (see Table 21).

[78] A 2006-2008 California Upstream Lighting Evaluation found an average incandescent wattage of 61.7 Watts (KEMA, Inc., The Cadmus Group, Itron, Inc., PA Consulting Group, Jai J. Mitchell Analytics, Draft Evaluation Report: Upstream Lighting Program. Prepared for the California Public Utilities Commission, Energy Division. December 10, 2009)

[79] http://www.gelighting.com/LightingWeb/na/resources/legislation/2009-department-of-energy-regulations/
http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/58
http://www.bulbrite.com/eisa.php

Table 31: DOE IRL Ruling-affected Specialty LED Baselines (Reflectors)[80,81]

Lamp Type	Lumen Range	W_{Base}
BR19	300-500	50
BR30	600-800	75
	801-1000	85
BR38	600-900	75
	901-1400	150
BR40	600-700	75
	701-900	85
	901-950	100
	951-1300	120
	1301-1700	125
	1701-2000	150
	2001-2400	200
ER30	300-450	50
	451-701	75
ER40	1000-1300	120
PAR20	300-450	50
	451-550	40
	551-650	50
PAR30	450-550	35
	551-600	40
	601-850	50
	851-950	60
	951-1200	75
PAR38	550-750	65
	751-1100	75
	1101-1300	100
	1301-1600	120
	1601-2500	150
	2501-3500	175
R20	401-500	50
	501-600	75
	601-1000	100

[80] Wattage values and lumen ranged from a review of GE, Osram Sylvania, and Philips catalogs in January 2015, as well as the Illinois TRM 2014.

[81] Table 31 is based on manufacturers' lumen and wattage data for the most commonly used reflector lamps. However, other manufacturers' ratings may differ from this list. Where available, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer.

Lamp Type	Lumen Range	W_{Base}
R30	700-800	75
	801-950	110
	951-1100	125
R40	1300-1900	125

DOE-ruling-exempt

The DOE 2009 ruling standards do not apply to the following types of IRLs:

- IRLs rated at 50 watts or less that are ER30, BR30, BR40, or ER40 lamps
- IRLs rated at 65 watts that are BR30, BR40, or ER40 lamps
- R20 IRLs rated 45 watts or less.[82]

Table 32: DOE-ruling Exempt Reflectors

Lamp Type	W_{Base}
BR30 (65 watts)	Nameplate wattage on the removed product. If unknown, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer if available. Otherwise, use 65 watts.
BR40 (65 watts)	
ER40 (65 watts)	
R20 (≤ 45 watts)	Nameplate wattage on the removed product. If unknown, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer if available. Otherwise, use 45 watts.
BR30 (≤ 50 watts)	Nameplate wattage on the removed product. If unknown, utilities may rely on the rated incandescent wattage equivalent of the newly installed lamp as provided by the manufacturer if available. Otherwise, use 50 watts.
BR40 (≤ 50 watts)	
ER30 (≤ 50 watts)	
ER40 (≤ 50 watts)	

High-efficiency Condition

LEDs must be ENERGY STAR®-qualified for the relevant lamp shape being removed as outlined in the latest ENERGY STAR® specification.[83] These lamps include reflectors, G-shape lamps, T-shape lamps, B, BA, CA, F G16-1/2, G25, G30, S, or M14 lamps.

The high-efficiency condition is the wattage of the lamp installed.

See the ENERGY STAR® website for more information on the specification in effect: http://www.energystar.gov/products/certified-products/detail/light-bulbs.

[82] http://www.gelighting.com/LightingWeb/na/resources/legislation/2009-department-of-energy-regulations/. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/58.

[83] http://www.energystar.gov/products/certified-products/detail/light-bulbs

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Wattage reduction is defined as the difference between the wattage of a specialty baseline lamp and the wattage of a directional or specialty LED.

For new construction projects, programs should calculate savings using the methodology in this section for all efficient lamps installed in the home. The program should claim savings for the percentage of installed high-efficacy lamps that exceed the minimum required by code, which is currently 75% of lamps. For example, if a new home is built with high-efficacy lamps in 85% of the permanently-installed fixtures, the program would claim 10% of the total calculated savings.

Energy Savings

For EISA-affected lamps only, annual energy (kWh) savings are calculated as follows,

$$\Delta kWh = \frac{\left(W_{base,FT} - W_{post}\right)}{1000} \times HOU \times ISR \times IEF_E$$

Equation 20

For EISA-exempt lamps and reflectors (both DOE-ruling-exempt and DOE-ruling-affected), annual energy (kWh) savings are calculated as follows.

$$\Delta kWh = \frac{\left(W_{base} - W_{post}\right)}{1000} \times HOU \times ISR \times IEF_E$$

Equation 21

Where:

$W_{base,FT}$ = *First-tier EISA baseline wattage corresponding with the lumen output of the purchased LED lamp for the year purchased/installed. First-tier EISA baseline lamp wattage provided in Table 29 under the column "Incandescent Equivalent 1st Tier EISA 2007."*

W_{base} = *EISA-exempt specialty lamp or a DOE-ruling-exempt reflector, use the nameplate wattage (see Table 30 and Table 32. If a DOE-ruling-affected IRL, use the wattages provided in Table 31.*

W_{post} = *Actual wattage of LED purchased/installed*

HOU = *Average hours of use per year = 803 hours (for interior/exterior applications calculated based on an average daily usage of 2.2 hours per day*[84]*)*

IEF_E = *Interactive Effects Factor to account for cooling energy savings and heating energy penalties associated with lighting power reductions (see Table 33).*

ISR = *In-service Rate, the percentage of incentivized units that are installed and in use (rather than removed, stored or burnt-out) to account for units incentivized but not operating = 0.97* [85]

Table 33: ENERGY STAR® Specialty and Directional LEDs—Interactive Effects for Cooling Energy Savings and Heating Energy Penalties[86]

	IEF_E				
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas Heat with AC	1.06	1.13	1.17	1.15	1.12
Gas Heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat Pump	0.91	1.00	1.05	1.11	0.97
Electric Resistance Heat with AC	0.65	0.80	0.90	1.00	0.75
Electric Resistance Heat with no AC	0.57	0.69	0.76	0.83	0.65

84 The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

85 Dimetrosky, S., Parkinson, K. and Lieb, N. "Residential Lighting Evaluation Protocol – The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures." January 2015. ISR for upstream programs, including storage lamps installed within four years of purchase. http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter21-residential-lighting-evaluation-protocol.pdf.

86 Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: $1 + HVAC_{savings}/Lighting_{savings}$.

IEF_E					
Heating/Cooling Type*	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
No heat with AC	1.06	1.13	1.17	1.15	1.12
Unconditioned Space	1.00	1.00	1.00	1.00	1.00
Heating/Cooling Unknown[87]	0.88	0.98	1.04	1.07	0.95

* IEF for homes with no AC is most appropriate for customers with evaporative cooling or room air conditioners.

Demand Savings

Summer and winter demand savings are determined by applying a coincidence factor associated with each season.

$$\Delta kW_{summer} = \frac{(W_{base,FT} - W_{post})}{1000} \times CF_{summer} \times ISR \times IEF_{D,summer}$$

Equation 22

$$\Delta kW_{winter} = \frac{(W_{base,FT} - W_{post})}{1000} \times CF_{winter} \times ISR \times IEF_{D,winter}$$

Equation 23

For EISA-exempt lamps and reflectors (both DOE-ruling-exempt and DOE-ruling-affected), peak demand (kW) savings are not calculated using the two-tiered system. Instead, peak demand (kW) savings are calculated using one algorithm, depending on the season of the savings.

$$\Delta kW_{summer} = \frac{(W_{base} - W_{post})}{1000} \times CF_{summer} \times ISR \times IEF_{D,summer}$$

Equation 24

$$\Delta kW_{winter} = \frac{(W_{base} - W_{post})}{1000} \times CF_{winter} \times ISR \times IEF_{D,winter}$$

Equation 25

Where:

CF = *Coincidence Factor (Table 34)*

IEF_D = *Interactive Effects Factor to account for cooling demand savings or heating demand penalties associated with lighting power reductions (see Table 35)*

[87] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Table 34: ENERGY STAR® LEDs—Coincidence Factors[88]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.060	0.053	0.063	0.059	0.032
Winter	0.275	0.232	0.199	0.263	0.358

Table 35: ENERGY STAR® Specialty and Directional LEDs—Interactive Effects Factor for Cooling Demand Savings and Heating Demand Penalties[89]

$IEF_{D,summer}$					
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas Heat with AC	1.45	1.33	1.68	1.23	1.44
Gas Heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat Pump	1.45	1.33	1.68	1.23	1.44
Electric Resistance Heat with AC	1.45	1.33	1.68	1.23	1.44
Electric Resistance Heat with no AC	1.00	1.00	1.00	1.00	1.00
No heat with AC	1.45	1.33	1.68	1.23	1.44
Unconditioned Space	1.00	1.00	1.00	1.00	1.00
Heating/Cooling Unknown[90]	1.39	1.28	1.58	1.20	1.38
$IEF_{D,winter}$					
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Gas Heat with AC	0.98	0.98	0.98	0.98	0.98
Gas Heat with no AC	1.00	1.00	1.00	1.00	1.00
Heat Pump	0.71	0.67	0.65	0.74	0.81
Electric Resistance Heat with AC	0.44	0.36	0.38	0.42	0.52
Electric Resistance Heat with no AC	0.44	0.36	0.38	0.42	0.52
No heat with AC	0.98	0.98	0.98	0.98	0.98
Unconditioned Space	1.00	1.00	1.00	1.00	1.00
Heating/Cooling Unknown[91]	0.76	0.72	0.73	0.75	0.80

[88] See Volume 1, Appendix B.

[89] Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: $1 + HVAC_{savings}/Lighting_{savings}$.

[90] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

[91] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus.

* IEF for homes with no AC is most appropriate for customers with evaporative cooling or room air conditioners.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

Historically, the average measure life is based upon rated lamp life of the LED. The measure life assumes an average use of 2.2 hours per day based on blended usage for indoor/outdoor applications and applies a 0.85 degradation factor to indoor/outdoor LEDs.

$$EUL_{Total} = \frac{Rated\ Life \times DF}{HOU \times 365.25}$$

Equation 26

Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Where:

$Rated\ Life$	=	*10,000 hours, 12,000 hours, 15,000 hours, or 20,000 hours, as specified by the manufacturer. If unknown, assume a 10,000-hour lifetime.*[92]
DF	=	*0.85 degradation factor*[93]
HOU	=	*2.2 hours per day*[94]

EISA Compliant Lamps

To account for a rapidly changing market, standard practice dictates that measure life assumptions be reduced to approximate the point at which the residential lighting market has been fully transformed to high-efficiency lamps. Due to market uncertainty in response to a recent rule issued by the Department of Energy, a simplified approach to claim half of the more conservative 16-year EUL will be implemented during the 2020 program year, resulting in an 8-year EUL. This assumption will be reviewed annually to account for current market trends.

Based on an expected delay in market adoption among certain customer bases, this measure life will be extended to 2030 for programs targeting low-income and hard-to-reach customers, resulting in a 10-year EUL.

These reductions do not apply to specialty lamps.

Table 36: ENERGY STAR® Specialty LEDs—Estimated Useful Life

Range of Rated Measure Life (Hours)	Assumed Rated Measure Life (Hours)	Specialty Measure Life (Years)	If EISA Compliant:	
			Standard Baseline Measure Life (Years)	Low-income Baseline Measure Life (Years)
$\leq$ 17,500	15,000	16	8	10
> 17,500	20,000	20*	8	10

* Measure life capped at 20 or 10 years depending on the applicable baseline. EUL may be deemed at 16 or 8 years in lieu of collecting manufacturer rated life or documenting customer baseline for EISA compliant lamps.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program

[92] Minimum lifetime requirement under ENERGY STAR® Lamps Specification V1.1, effective September 30, 2014. http://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V1%201_Specification.pdf.

[93] ENERGY STAR® CFL Third Party Testing and Verification Off-the-Shelf CFL Performance: Batch 3. Figure 27, p. 47.

[94] The average daily usage of 2.2 hours per day is a blended value for indoor and outdoor lamps. Source: Evaluation of 2008 Texas 'Make Your Mark' Statewide CFL Program Report. Frontier Associates. June 2009.

database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of LEDs installed
- ANSI C79.1-2002 nomenclature of LED installed (G40, PAR, etc.)
- Wattage of each installed LED
- Lumen output of each installed LED
- Wattage of replaced lamp
- Manufacturer-rated lifetime of each installed LED in hours
- Heating system type (gas, electric resistance, heat pump) for each home in which a LED is installed
- Location of installed lamp (conditioned, unconditioned, or outdoor); only required when not assuming default weighting
- Baseline calculation methodology (replaced lamp nameplate wattage, EISA-affected non-reflector, EISA-exempt non-reflector, DOE-ruling-affected reflector, DOE-ruling-exempt reflector, manufacturer-rated equivalent incandescent wattage, or default wattage)
- Proof of purchase – with date of purchase and quantity
    - Alternative: representative photos of installed units or other pre-approved method of installation verification
- ENERGY STAR® certificate matching installed model number
    - Alternative: other pre-approved method of certification
- For new construction projects only, these data points must be gathered for all permanently-installed fixtures in the home in order to document the percent that are high-efficacy.

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

- Energy Independence and Security Act of 2007
- Energy Conservation Program: Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps, Energy Efficiency and Renewable Energy Office (EERE), 2009
- ENERGY STAR® specifications for LED lamps

Document Revision History

Table 37: Residential Specialty and Directional LED Lamps Revision History

TRM Version	Date	Description of Change
v3.0	4/10/2015	TRM v3.0 origin.
v3.1	11/05/2015	TRM v3.1 update. Modification of in-service rate, revision of interactive effects factors to reflect indoor-specific values for additional heating and cooling equipment types. Consolidated default input assumptions for upstream lighting programs. Capped estimated measure life.
v3.1	3/28/2016	TRM v3.1 March revision. Updated summer and winter coincidence factors.
v4.0	10/10/2016	TRM v4.0 update. Updated IEF values.
v5.0	10/2017	TRM v5.0 update. Updated useful life estimates.
v6.0	11/2018	TRM v6.0 update. Updated useful life estimates. Updated interactive effects factors.
v7.0	10/2019	TRM v7.0 update. Removed dual baseline and updated useful life estimates. Added invoice and certificate requirements. Added option for new construction savings.

2.2 RESIDENTIAL: HEATING, VENTILATION, AND AIR CONDITIONING

2.2.1 Air Conditioner or Heat Pump Tune-ups Measure Overview

TRM Measure ID: R-HV-TU

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure applies to central air conditioners (AC) and heat pumps (HP) of any configuration where all applicable actions from the checklist below are completed. An AC tune-up involves checking, cleaning, adjusting, and resetting the equipment to factory conditions in the understanding that such measures restore operating efficiencies, on average, closer to as-new performance. This measure applies to all residential applications.

For this measure, the service technician must complete the following tasks according to industry best practices. To properly assess and adjust the refrigerant charge level, the unit must be operating under significant (i.e., normal) cooling load conditions. Therefore, this measure may only be performed for energy savings reporting purposes when the outdoor ambient dry bulb temperature is above 75˚F, and the indoor return air dry bulb temperature is above 70˚F.

Air conditioner inspection and tune-up checklist[95]

- Tighten all electrical connections and measure voltage and current on motors
- Lubricate all moving parts, including motor and fan bearings
- Inspect and clean the condensate drain
- Inspect controls of the system to ensure proper and safe operation. Check the

[95] Based on ENERGY STAR® HVAC Maintenance Checklist. www.energystar.gov/index.cfm?c=heat_cool.pr_maintenance.

startup/shutdown cycle of the equipment to assure the system starts, operates, and shuts off properly.

- Clean evaporator and condenser coils
- Clean indoor blower fan components
- Inspect and clean or change air filters; replacement preferred best practice
- Measure airflow via static pressure across the cooling coil and adjust to manufacturers specifications
- Check refrigerant level and adjust to manufacturer specifications
- Check capacitor functionality and capacitance and compare to OEM specifications

Eligibility Criteria

All residential customers are eligible for this measure if they have refrigerated air conditioning 65,000 Btu/hr or less in cooling capacity that has not been serviced in the last 5 years.

Baseline Condition

The baseline is a system with some or all of the following issues:

- Dirty condenser coil
- Dirty evaporator coil
- Dirty blower wheel
- Dirty filter
- Improper airflow
- Incorrect refrigerant charge

The baseline system efficiency should be calculated using the following formulas:

$$EER_{pre} = (1 - EL) \times EER_{post}$$

Equation 27

$$HSPF_{pre} = (1 - EL) \times HSPF_{post}$$

Equation 28

Where:

EER_{pre} = *Efficiency of the cooling equipment before tune-up*

EL = *Efficiency loss due to dirty coils, blower, filter, improper airflow, and/or incorrect refrigerant charge = 0.05*

EER_{post} = *Deemed cooling efficiency of the equipment after tune-up = 11.2 EER*

$HSPF_{pre}$ = *Heating efficiency of the air source heat pump before tune-up*

$HSPF_{post}$ = *Deemed heating efficiency of air source heat pumps after tune-up = 7.7 HSPF*

High-efficiency Condition

After the tune-up, the equipment must be clean with airflows and refrigerant charges adjusted as appropriate and set forth above, with the added specification that refrigerant charge adjustments must be within +/- 3 degrees of target sub-cooling for units with thermal expansion valves (TXV) and +/- 5 degrees of target super heat for units with fixed orifices or capillary tubes.

The efficiency standard, or efficiency after the tune-up, is deemed to be the manufacturer specified energy efficiency ratio (EER) of the existing central air conditioner or heat pump, which has been determined using the following logic and standards. The useful life of an AC unit is 19 years. The useful life of a heat pump is 16 years. Therefore, it is conservatively thought that the majority of existing, functioning units were installed under the federal standard in place between January 23, 2006 and January 1, 2015, which set a baseline of 13 SEER and 7.7[96] HSPF. A 13 SEER is equivalent to approximately 11.2 EER[97] using the conversion developed by Lawrence Berkeley Lab and US DOE: EER = -0.02 x SEER^2 + 1.12 x SEER.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Savings are based on an assumed efficiency loss factor of 5 percent due to dirty coils, dirty filters, improper airflow, and/or incorrect refrigerant charge.[98]

Energy Savings Algorithms

Heating energy savings are only applicable to heat pumps.

$$Energy\ Savings\ [kWh_{savings}] = kWh_{Savings,C} + kWh_{Savings,H}$$

Equation 29

$$\boldsymbol{Energy\ (Cooling)\ [kWh_{Savings,C}] = Capacity \times \left(\frac{1}{EER_{pre}} - \frac{1}{EER_{post}}\right) \times EFLH_C \times \frac{1\ kW}{1,000\ W}}$$

Equation 30

[96] Code specified HSPF from federal standard effective January 23, 2006 through January 1, 2015.

[97] Code specified 13 SEER from federal standard effective January 23, 2006 through January 1, 2015, converted to EER using EER = -0.02 x SEER^2 + 1.12 x SEER. National Renewable Energy Laboratory (NREL). "Building America House Simulation Protocols." U.S. Department of Energy. Revised October 2010. http://www.nrel.gov/docs/fy11osti/49246.pdf.

[98] Energy Center of Wisconsin, May 2008; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research."

$$\boldsymbol{Energy\ (Heating)\ [kWh_{Savings,H}] = Capacity \times \left(\frac{1}{HSPF_{pre}} - \frac{1}{HSPF_{post}}\right) \times EFLH_H \times \frac{1\ kW}{1{,}000\ W}}$$

Equation 31

Where:

Capacity	=	*Rated cooling capacity of the equipment based on model number [Btuh] (1 ton = 12,000 Btuh)*
EER_{pre}	=	*Cooling efficiency of the equipment pre-tune-up using Equation 27 [Btuh/W]*
EER_{post}	=	*Cooling efficiency of the equipment after the tune-up [Btuh/W]. Assume 11.2.*
$HSPF_{pre}$	=	*Heating efficiency of the equipment pre-tune-up using Equation 28 [Btuh/W]*
$HSPF_{post}$	=	*Heating efficiency of the equipment after the tune-up [Btuh/W]. Assume 7.7.*
$EFLH_{C/H}$	=	*Cooling/heating equivalent full-load hours for appropriate climate zone [hours]*

Table 38: Equivalent Full Load Cooling/Heating Hours[99]

Climate Zone	$EFLH_C$	$EFLH_H$
Climate Zone 1: Panhandle	1,142	1,880
Climate Zone 2: North	1,926	1,343
Climate Zone 3: South	2,209	1,127
Climate Zone 4: Valley	2,958	776
Climate Zone 5: West	1,524	1,559

[99] ENERGY STAR® Central AC/HP Savings Calculator. https://www.energystar.gov/products/certified-products/detail/heat-pumps-air-source.

Demand Savings Algorithms

$$\boldsymbol{Summer\ Peak\ Demand\ [kW_{Savings,C}] = Capacity \times \left(\frac{1}{EER_{pre}} - \frac{1}{EER_{post}}\right) \times DF_C \times \frac{1\ kW}{1,000\ W}}$$

Equation 32

$$\boldsymbol{Winter\ Peak\ Demand\ [kW_{Savings,H}] = Capacity \times \left(\frac{1}{HSPF_{pre}} - \frac{1}{HSPF_{post}}\right) \times DF_H \times \frac{1\ kW}{1,000\ W}}$$

Equation 33

Summer and winter demand savings are determined by applying a coincidence factor for each season. Winter peak demand savings are only applicable to heat pumps.

Where:

DF_C = *Cooling demand factor*[100] *= 0.87*

DF_H = *Heating demand factor = 0.83 (heat pumps, default)*[101]

Deemed Energy Savings Tables

Applying the above algorithms results in the deemed energy savings per ton in Table 39. Heating savings are only applicable for heat pumps.

Table 39: Deemed Energy Savings per Ton

Climate Zone	Cooling kWh Saved per Ton	Heating kWh Saved per Ton
Climate Zone 1: Panhandle	64.40	154.20
Climate Zone 2: North	108.61	110.16
Climate Zone 3: South	124.57	92.44
Climate Zone 4: Valley	166.80	63.65
Climate Zone 5: West	85.94	127.87

100 Air Conditioning Contractors of America (ACCA) Manual S recommends that residential air conditioners be sized at 115 percent of the maximum cooling requirement of the house. Assuming that the house's maximum cooling occurs during the hours 4 to 5 PM, the guideline leads to a coincidence factor for residential HVAC measures of 1.0/1.15 = 0.87.

101 Air Conditioning Contractors of America (ACCA) Manual S recommends that residential heat pumps be sized at 115 percent of the maximum cooling requirement of the house (for cooling dominated climates). Based on AHRI data for 1.5 to 5-ton HVAC systems, the average ratio of rated heating capacity to cooling capacity is 0.96. Assuming that the house's maximum cooling occurs during the hours 4 to 5 PM and adjusting for the average ratio of heating to cooling capacity, the guideline leads to a coincidence factor for residential heat pumps of 0.96/1.15 = 0.83.

Deemed Summer Demand Savings Tables

Applying the above algorithms results in the deemed summer demand savings per ton in Table 40.

Table 40: Deemed Summer Demand Savings per Ton

Climate Zone	Summer Peak Demand kW Savings per Ton
All Zones	0.04906

Deemed Winter Demand Savings Tables

Applying the above algorithms results in the deemed winter demand savings per ton in Table 41. Winter peak demand savings are only applicable for heat pumps.

Table 41: Deemed Winter Demand Savings per Ton

Climate Zone	Winter Peak Demand kW Savings per Ton
All Zones	0.06808

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for a tune-up is five years.[102]

According to the 2014 California Database for Energy Efficiency Resources (DEER), the estimated useful life of cleaning condenser and evaporator coils is three years[103], and the estimated useful life of refrigerant charge adjustment is ten years.[104] The other parts of the tune-up checklist are not listed in DEER, therefore five years, as referenced by the Measure Life Report, is used as the best representation of the entire tune-up.

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102 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group; Page 1-3, Table 1.

103 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/files/DEER2013codeUpdate/download/DEER2014-EUL-table-update_2014-02-05.xlsx.

104 ibid

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone or county
- Manufacturer
- Model Number
- Cooling capacity of the installed unit (tons)
- Type of unit (i.e., air conditioner, air source heat pump)
- Serial number
- Refrigerant type
- Target superheat or subcooling
- Post tune-up superheat or subcooling
- Amount of refrigerant added or removed
- Static pressures before and after tune-up
- Return and supply dry bulb and wet bulb temperatures
- Before and after tune-up pictures of components illustrating condition change due to cleanings (Note: pictures that include well-placed familiar objects like hand tools often provide a sense of scale and a reference for color/shading comparisons. Pictures of equipment name plates are useful).

References and Efficiency Standards

This section is not applicable.

Petitions and Rulings

This section is not applicable.

Document Revision History

Table 42: Residential Air Conditioner or Heat Pump Tune-ups Revision History

TRM Version	Date	Description of Change
v4.0	10/10/2015	TRM v4.0 origin.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.

2.2.2 Duct Sealing Measure Overview

TRM Measure ID: R-HV-DS

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

This measure involves sealing leaks in supply and return ducts of the HVAC distribution systems in homes or converted residences with central air conditioning. The standard approach to estimate savings in this measure is based on the results obtained via pre- and post-leakage testing as defined in this measure. In lieu of leakage testing, savings for eligible duct sealing projects may be claimed using the alternate approach specified in this measure.

Eligibility Criteria

All residential customers with refrigerated air conditioning or evaporative cooling are eligible to claim cooling savings for this measure. Customers must have central heating with either a furnace (gas or electric resistance) or a heat pump to claim heating savings.

For the standard approach with leakage testing, duct leakage should be assessed following the Building Performance Institute (BPI) standards. Duct leakage testing should not be conducted in homes where either evidence of asbestos or mold is present or suspected due to the age of the home.[105]

[105] The Building Performance Institute, Inc. (BPI) Standard Reference: Building Performance Institute Technical Standards for the Building Analyst Professional, v2/28/05mda, Page 1 of 17, states: "Health and Safety: Where the presence of asbestos, lead, mold and/or other potentially hazardous material is known or suspected, all relevant state and federal (EPA) guidelines must be followed to ensure technician and occupant safety. Blower door depressurization tests may not be performed in homes *where there is a risk of asbestos becoming airborne and being drawn into the dwelling."*

Utility program manuals should be consulted for health and safety considerations related to the implementation of duct efficiency measures and/or testing procedures.

Duct sealing is a residential retrofit measure only and does not apply to new construction.

Baseline Condition

The savings calculation methods for this measure (when implemented with duct leakage testing) are valid up to a maximum pre-installation leakage rate of 35 percent of total fan flow.[106] For homes with an initial leakage rate greater than 35 percent of total fan flow, savings will be awarded with respect to this cap rather than the initial leakage. Data from nearly 28,000 single-family and mobile home duct blaster tests conducted for duct efficiency improvements in Texas between 2003 and 2006 show that more than 70 percent of all pre-retrofit leakage rates fall below 38 percent total leakage.[107]

Engineering calculations show that the interior temperature in those settings that exceed 38 percent total leakage would be above the thermally acceptable comfort levels published by ASHRAE in its 2009 Fundamentals publication. The proposed pre-installation leakage limits will help ensure that the deemed savings are an accurate reflection of the program's impacts and that the program focuses its efforts on scenarios where leakage conditions are likely to persist if unaddressed for several years.

Low-income customers[108] are exempt from the cap limiting the maximum pre-installation leakage rate to 35 percent of total fan flow.

While these baseline criteria were applied in deriving the deemed savings for the alternate approach (without duct leakage testing), it is not necessary to determine the pre-installation leakage rate for projects claiming the alternate deemed savings.

High-efficiency Condition

Materials used should be long-lasting materials, such as mastics, UL 181A or UL 181B approved foil tape or aerosol-based sealants. Fabric-based duct tape is not allowed.

The selected methodology for estimating duct sealing deemed savings according to the standard approach requires duct leakage-to-outside testing using a combination duct pressurization and house pressurization.

Duct Leakage Testing (Standard Approach)

Measurements to determine pre-installation and post-installation leakage rates must be performed in accordance with utility-approved procedures. For this measure, leakage-to-outside must be directly measured. The project sponsor shall use the Combination Duct Blaster™ (or equivalent) and blower door method. Prior to beginning any installations, the project sponsor

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[106] $Total\ Fan\ Flow = Cooling\ Capacity\ (tons) \times 400\ cfm/ton$

[107] Based on data collected by Frontier Associates, LLC for investor-owned utilities in Texas.

[108] Low-income customers are income-eligible customers served through a targeted low-income energy efficiency program as described in 25.181(r). This may also apply to income-eligible customers served through a hard-to-reach program that is also delivered following the guidelines in 25.181(r).

must submit the intended method(s) and may be required to provide the utility with evidence of competency, such as Home Energy Rating System (HERS) or North American Technician Excellence (NATE) certification. Leakage rates must be measured and reported at the average air distribution system operating pressure (25 Pa).[109]

Categorizing Achieved Duct Leakage Reduction (Absent Leakage Testing)

Participating energy efficiency service providers (EESPs) electing not to perform leakage testing should nevertheless provide an estimate of the expected outcome of the leakage reduction work performed: projects should be characterized according to contractor estimation of whether the work required should result in a ***low***, ***average***, or ***high reduction*** in duct system leakage. EESPs should take the following considerations into account in assessing the likely leakage reduction achieved in a given project:

- The number and size of repaired leaks
- Leak location: a leak in an attic joint will cause more energy loss than a joint that leaks to conditioned space
- Supply/return: supply-side leaks, particularly in the return air plenum and near the air handling unit can be especially problematic, as they tend to draw additional unconditioned air into the system.

Systems that were not initially very leaky and in which few joints and supply vents were sealed should be characterized as low reduction. Jobs with a typical number of supply vents and joints sealed, and in which the supply air return or the return air plenum were sealed, should be characterized as average reduction. Jobs requiring significant interventions to eliminate large or numerous leaks should be considered high reduction.

The following table provides a guideline for selecting an appropriate leakage category. How the category is determined may fluctuate on a per-home basis.

[109] See RESNET Technical Committee, Proposed Amendment: Chapter 8 RESNET Standards, 800 RESNET Standard for Performance Testing and Work Scope: Enclosure and Air Distribution Leakage Testing; Section 803.2 and Table 803.1.

Table 43: Leakage Categorization Guide[110]

Category	Duct Location	Duct Insulation Value	Leakage Characteristics[111]
Low	> 90% Conditioned	> R7	Some observable leaks
			Substantial leaks
		R4 - R7	Some observable leaks
			Substantial leaks
		< R4	Some observable leaks
			Substantial leaks
	50-90% Conditioned	> R7	Some observable leaks
		R4 - R7	Some observable leaks
		< R4	Some observable leaks
Average	> 90% Conditioned	> R7	Catastrophic leaks
		R4 - R7	Catastrophic leaks
		< R4	Catastrophic leaks
	50-90% Conditioned	> R7	Substantial leaks
			Catastrophic leaks
		R4 - R7	Substantial leaks
		< R4	Substantial leaks
	< 50% Conditioned	> R7	Some observable leaks
		R4 - R7	Some observable leaks
		< R4	Some observable leaks
High	50-90% Conditioned	R4 - R7	Catastrophic leaks
		< R4	Catastrophic leaks
	< 50% Conditioned	R4 - R7	Substantial leaks
		> R7	Catastrophic leaks
		R4 - R7	Substantial leaks
			Catastrophic leaks
		< R4	Substantial leaks
			Catastrophic leaks

Energy and Demand Savings Methodology

Savings may be claimed according to either the standard approach (with duct leakage testing) or the alternate approach, according to the following sections.

[110] Based on typical distribution efficiency assumptions from the Building Performance Institute (BPI) Technical Standards for the Heating Professional, November 20, 2007, page 7.

[111] Catastrophic leaks are defined by BPI as disconnected ducts, missing end-caps, and other catastrophic holes.

Savings Algorithms and Input Variables

Calibrated simulation modeling was used to develop these deemed savings, which are expressed as linear functions of the reduction in duct leakage achieved (in CFM_{25}). Specifically, these deemed savings estimates were developed using BEopt 2.6, running EnergyPlus 8.4 as the underlying simulation engine. To model this measure, the prototype home models for each climate zone were modified as follows: the base case duct leakage rate was set to 8 CFM_{25} per 100 square feet. Results from running the base case model provide estimated hourly energy use for the prototypical home prior to treatment. Post-treatment conditions were simulated by setting the leakage rate to 6 CFM_{25} per 100 square feet. Results from running the change case model provide estimated hourly energy use for the prototypical home after treatment. A comparison of these two runs provides the deemed savings estimates.

Deemed savings are presented as a function of the CFM_{25} reduction achieved, as demonstrated by leakage to outside testing using the Combination Duct Blaster™ (or equivalent) and Blower Door method. The kWh and kW per CFM_{50} values represented by the V_E, V_S, and V_W coefficients are derived by taking the difference between annual energy use and summer and winter peak demand, as estimated by the two model runs and normalizing to the CFM_{25} reduction achieved.

Standard Approach (with Duct Leakage Testing)

The annual energy and summer and winter peak demand savings to be claimed according to the standard approach for this measure shall be calculated as a function of the reduction in duct leakage achieved, using the energy and demand savings coefficients from Table 44 through Table 46 for the climate zone in which the project was implemented and the type of heating equipment in the project home.

Deemed Energy Savings Tables

Table 44 presents the annual energy savings per CFM_{25} reduction for a residential duct sealing project. The following formula shall be used to calculate annual energy savings for duct leakage reduction:

$$\boldsymbol{Deemed\ Energy\ Savings\ (kWh) = \left(DL_{pre} - DL_{post}\right) \times V_E}$$

Equation 34

Where:

$\mathrm{DL_{pre}}$	=	*Pre-improvement duct leakage at 25 Pa (cu. ft./min)*
$\mathrm{DL_{post}}$	=	*Post-improvement duct leakage at 25 Pa (cu. ft./min)*
$V_{E,C}$	=	*Cooling Energy Savings Coefficient in Table 44*
$V_{E,H}$	=	*Heating Energy Savings Coefficient in Table 44*

Table 44: Energy Savings V_E per CFM_{25} Reduction

Region	$V_{E,C}$: Cooling Savings		$V_{E,H}$: Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
Zone 1: Panhandle	0.82	0.21	0.07	2.75	0.71
Zone 2: North	1.05	N/A	0.03	1.19	0.31
Zone 3: South	1.23	N/A	0.02	0.85	0.26
Zone 4: Valley	1.46	N/A	0.01	0.61	0.19
Zone 5: West	1.20	0.38	0.03	1.44	0.37

Deemed Summer Demand Savings Tables

Table 45 presents the summer peak demand savings per CFM_{25} reduction for a residential duct sealing project. The following formula shall be used to calculate deemed summer demand savings for duct leakage reduction:

$$\boldsymbol{Deemed\ Summer\ Demand\ Savings\ (kW) = \left(DL_{pre} - DL_{post}\right) \times V_S}$$

Equation 35

Where:

DL_{pre} = *Pre-improvement duct leakage at 25 Pa (cu. ft./min)*

DL_{post} = *Post-improvement duct leakage at 25 Pa (cu. ft./min)*

V_S = *Summer Demand Savings Coefficient in* Table 45

Table 45: Summer Demand Savings V_S per CFM_{25} Reduction

Region	Summer kW Impact per CFM_{25} Reduction	
	Refrigerated Air	Evaporative Cooling
Climate Zone 1: Panhandle	9.28E-04	2.29E-04
Climate Zone 2: North	8.47E-04	N/A
Climate Zone 3: South	1.06E-03	N/A
Climate Zone 4: Valley	6.72E-04	N/A
Climate Zone 5: West	7.66E-04	1.86E-04

Deemed Winter Demand Savings Tables

Table 46 presents the winter peak demand savings per CFM_{25} reduction for a residential duct sealing project. The following formula shall be used to calculate deemed winter demand savings for duct leakage reduction:

$$\textit{Deemed Winter Demand Savings}\ (kW) = \left(DL_{pre} - DL_{post}\right) \times V_W$$

Equation 36

Where:

DL_{pre} = *Pre-improvement duct leakage at 25 Pa (cu. ft./min)*

DL_{post} = *Post-improvement duct leakage at 25 Pa (cu. ft./min)*

V_W = *Winter Demand Savings Coefficient in Table 46*

Table 46: Winter Demand Savings V_W per CFM_{25} Reduction

Region	kWh Impact per CFM_{25} Reduction		
	Gas	Resistance	Heat Pump
Climate Zone 1: Panhandle	4.38E-06	8.49E-04	1.46E-04
Climate Zone 2: North	1.22E-06	9.96E-04	6.98E-04
Climate Zone 3: South	8.60E-06	8.61E-04	5.02E-04
Climate Zone 4: Valley	1.18E-05	6.71E-04	4.06E-04
Climate Zone 5: West	6.68E-06	2.81E-04	6.69E-05

Alternate Approach (No Duct Leakage Testing)

The following savings tables are provided for projects implemented without performing leakage testing, accounting for the application of pre-retrofit leakage caps to not hard-to-reach (HTR) projects. The annual energy and summer and winter peak demand savings to be claimed according to the alternate approach for this measure shall be taken from Table 44 through Table 46 for the climate zone in which the project was implemented and the type of heating equipment in the project home.

While savings for multiple duct systems are additive for the standard approach, the following savings are specified per home when using the alternate approach and should not be multiplied by the number of treated duct systems.

NOTE: This approach is only available to programs with an incentive structure that varies by leakage category. Additionally, energy efficiency service providers (EESPs) should not alternate between the standard and alternative approaches during the same program year. Utilities should either restrict all participants within an individual program to one approach or the other, or they should restrict individual EESPs to one approach or the other across all program types.

Hard-to-reach (HTR) and Targeted Low-income Programs

Deemed Energy Savings Tables (Alternate Approach)

Climate Zone 1: Panhandle Region

Table 47: Climate Zone 1: Panhandle Region—Deemed Annual Energy Savings for Duct Efficiency, HTR Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	204	52	17	685	177
2	Average	323	83	28	1,083	280
3	High	514	132	44	1,725	445

Climate Zone 2: North Region

Table 48: Climate Zone 2: North Region—Deemed Annual Energy Savings for Duct Efficiency, HTR Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	262	N/A	7	297	77
2	Average	413	N/A	12	468	122
3	High	659	N/A	19	746	194

Climate Zone 3: South Region

Table 49: Climate Zone 3: South Region—Deemed Annual Energy Savings for Duct Efficiency, HTR Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	307	N/A	5	212	65
2	Average	484	N/A	8	335	102
3	High	771	N/A	13	533	163

Climate Zone 4: Valley Region

Table 50: Climate Zone 4: Valley Region—Deemed Annual Energy Savings for Duct Efficiency, HTR Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	364	N/A	2	152	47
2	Average	575	N/A	4	240	75
3	High	916	N/A	6	383	119

Climate Zone 5: West Region

Table 51: Climate Zone 5: West Region—Deemed Annual Energy Savings for Duct Efficiency, HTR Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	299	95	7	359	92
2	Average	472	150	12	567	146
3	High	753	238	19	903	232

Deemed Summer Demand Savings Tables (Alternate Approach)

Climate Zone 1: Panhandle Region

Table 52: Climate Zone 1: Panhandle Region—Deemed Summer Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.23	0.06
Average	0.37	0.09
High	0.58	0.14

Climate Zone 2: North Region

Table 53: Climate Zone 2: North Region—Deemed Summer Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.21	N/A
Average	0.33	N/A
High	0.53	N/A

Climate Zone 3: South Region

Table 54: Climate Zone 3: South Region—Deemed Summer Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.26	N/A
Average	0.42	N/A
High	0.66	N/A

Climate Zone 4: Valley Region

Table 55: Climate Zone 4: Valley Region—Deemed Summer Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.17	N/A
Average	0.26	N/A
High	0.42	N/A

Climate Zone 5: West Region

Table 56: Climate Zone 5: West Region—Deemed Summer Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.19	0.05
Average	0.30	0.07
High	0.48	0.12

Deemed Winter Demand Savings Tables (Alternate Approach)

Climate Zone 1: Panhandle Region

Table 57: Climate Zone 1: Panhandle Region—Deemed Winter Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.21	0.04
Average	0.00	0.33	0.06
High	0.00	0.53	0.09

Climate Zone 2: North Region

Table 58: Climate Zone 2: North Region—Deemed Winter Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.25	0.17
Average	0.00	0.39	0.27
High	0.00	0.62	0.44

Climate Zone 3: South Region

Table 59: Climate Zone 3: South Region—Deemed Winter Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.21	0.13
Average	0.00	0.34	0.20
High	0.01	0.54	0.31

Climate Zone 4: Valley Region

Table 60: Climate Zone 4: Valley Region—Deemed Winter Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.17	0.10
Average	0.00	0.26	0.16
High	0.01	0.42	0.25

Climate Zone 5: West Region

Table 61: Climate Zone 5: West Region—Deemed Winter Demand Savings for Duct Efficiency, HTR Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.07	0.02
Average	0.00	0.11	0.03
High	0.00	0.18	0.04

All Other Programs

Deemed Energy Savings Tables (Alternate Approach)

Climate Zone 1: Panhandle Region

Table 62: Climate Zone 1: Panhandle Region—Deemed Annual Energy Savings for Duct Efficiency, Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	187	48	16	628	162
2	Average	300	77	26	1,005	259
3	High	428	110	37	1,437	371

Climate Zone 2: North Region

Table 63: Climate Zone 2: North Region—Deemed Annual Energy Savings for Duct Efficiency, Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	240	N/A	7	272	71
2	Average	384	N/A	11	435	113
3	High	549	N/A	16	622	162

Climate Zone 3: South Region

Table 64: Climate Zone 3: South Region—Deemed Annual Energy Savings for Duct Efficiency, Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	281	N/A	5	194	59
2	Average	449	N/A	7	310	95
3	High	643	N/A	10	444	136

Climate Zone 4: Valley Region

Table 65: Climate Zone 4: Valley Region—Deemed Annual Energy Savings for Duct Efficiency, Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	333	N/A	2	139	43
2	Average	533	N/A	4	223	69
3	High	763	N/A	5	319	99

Climate Zone 5: West Region

Table 66: Climate Zone 5: West Region—Deemed Annual Energy Savings for Duct Efficiency, Alternate Approach (kWh)

Category	Assessed Leakiness	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	Low	274	87	7	329	84
2	Average	438	139	11	526	135
3	High	627	199	16	752	193

Deemed Summer Demand Savings Tables (Alternate Approach)

Climate Zone 1: Panhandle Region

Table 67: Climate Zone 1: Panhandle Region—Deemed Summer Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.21	0.05
Average	0.34	0.08
High	0.48	0.12

Climate Zone 2: North Region

Table 68: Climate Zone 2: North Region—Deemed Summer Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.19	N/A
Average	0.31	N/A
High	0.44	N/A

Climate Zone 3: South Region

Table 69: Climate Zone 3: South Region—Deemed Summer Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.24	N/A
Average	0.39	N/A
High	0.55	N/A

Climate Zone 4: Valley Region

Table 70: Climate Zone 4: Valley Region—Deemed Summer Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.15	N/A
Average	0.25	N/A
High	0.35	N/A

Climate Zone 5: West Region

Table 71: Climate Zone 5: West Region—Deemed Summer Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Refrigerated Air	Evaporative Cooling
Low	0.17	0.04
Average	0.28	0.07
High	0.40	0.10

Deemed Winter Demand Savings Tables (Alternate Approach)

Climate Zone 1: Panhandle Region

Table 72: Climate Zone 1: Panhandle Region—Deemed Winter Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.19	0.03
Average	0.00	0.31	0.05
High	0.00	0.44	0.08

Climate Zone 2: North Region

Table 73: Climate Zone 2: North Region—Deemed Winter Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.23	0.16
Average	0.00	0.36	0.25
High	0.00	0.52	0.36

Climate Zone 3: South Region

Table 74: Climate Zone 3: South Region—Deemed Winter Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.20	0.11
Average	0.00	0.31	0.18
High	0.00	0.45	0.26

Climate Zone 4: Valley Region

Table 75: Climate Zone 4: Valley Region—Deemed Winter Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.15	0.09
Average	0.00	0.25	0.15
High	0.01	0.35	0.21

Climate Zone 5: West Region

Table 76: Climate Zone 5: West Region—Deemed Winter Demand Savings for Duct Efficiency, Alternate Approach (kW)

Category	Heating System Type		
	Gas	Electric Resistance	Heat Pump
Low	0.00	0.06	0.02
Average	0.00	0.10	0.02
High	0.00	0.15	0.03

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Example Deemed Savings Calculation

Example 1. Using the **standard approach**, a 1,700 square foot home with a 3.5-ton central air conditioner and a gas furnace in Climate Zone 3 is found to have a pre-retrofit duct leakage rate of 600 CFM_{25}. After sealing leaks, duct leakage is estimated at 100 CFM_{25}. The project is completed in a non-HTR program.

$$Max\ Initial\ Leakage\ Rate\ = \left(400\frac{CFM}{ton} \times 3.5tons\right) \times 35\% = 490\ CFM_{25}$$

$$Reported\ Initial\ Leakage\ = Min(600, 490) = 490\ CFM_{25}$$

$$DL_{pre} - DL_{post} = (490 - 100) = 390\, CFM_{25}$$

$$kWh\ savings = (1.23 + 0.02) \times 390 = 488\, kWh$$

$$Summer\ kW\ savings = 1.06 \times 10^{-3} \times 390 = 0.41\ kW$$

$$Winter\ kW\ savings = 8.60 \times 10^{-6} \times 390 = 0.003\ kW$$

Example 2. Using the **alternate approach**, a duct sealing project is completed on a home of any square footage with a central heat pump of any tonnage in Climate Zone 3. The duct system is categorized as 50-90% in conditioned space with an existing duct insulation value of R4-R7 and substantial leaks. Therefore, that home is categorized as an average leakage home. No leakage testing is performed. The project is completed in an HTR program. All savings are taken directly from deemed savings lookup tables.

$$kWh\ savings = 484 + 102 = 586\ \text{kWh}$$

$$Summer\ kW\ savings = 0.42\ kW$$

$$Winter\ kW\ savings = 0.20\ kW$$

Additional Calculators and Tools

There is a calculator to estimate the energy and demand savings associated with this measure using the algorithms described in the previous subsection.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for a duct sealing measure is 18.0 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[112]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Heating type (gas, resistance heat, heat pump)
- Cooling capacity of home HVAC units (tons)
- EESPs claiming savings according to duct leakage testing:
  - Pre-improvement duct leakage at 25 Pa (cu. ft./min)
  - Post-improvement duct leakage at 25 Pa (cu. ft./min)
- EESPs claiming savings without performing leakage testing should provide:
  - Description of the leakage severity in the home (low, average, or high)
  - Description of location and condition of ducts:
    - Duct location (>90% conditioned, 50-90% conditioned, <50% conditioned)
    - Existing duct insulation value (>R7, R4-R7, <R4)
  - Leakage characteristics (some observable leaks, substantial leaks, catastrophic leaks)
  - Other relevant details that may assist with validating claimed leakage category (recommended)
  - Description and photos of interventions taken (both pre and post condition), such as newly sealed joints, supply vents, and other relevant leaks sealed
  - Incentive rate structure: incentive should be paid per home and should not vary by leakage category to avoid providing an incentive to overstate the

[112] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/23-deer-versions/27-deer-2014

existing leakage category.

References and Efficiency Standards

Petitions and Rulings

- Docket No. 41722. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Sharyland Utilities, L.P., Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company to Approve Revisions to Residential Deemed Savings to Incorporate Winter Peak Demand Impacts and Update Certain Existing Deemed Savings Values. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 77: Residential Duct Efficiency Improvements Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor formatting changes, and language introduced to provide further direction for low-income customers and testing procedure. Contractors now required to track cooling capacity of HVAC equipment. Language added to reflect updates to federal standards for central heat pumps and central air conditioners.
v2.1	1/30/2015	TRM v2.1 update. Addition of language referring contractors to program manuals for information regarding health and safety precautions.
v3.0	4/10/2015	TRM v3.0 update. No revision.
v3.1	11/05/2015	TRM v3.1 update. Update of reference sources for air temperatures and densities, heating degree-days. Cooling demand savings required to be claimed.
v4.0	10/10/2016	TRM v4.0 update. Approach changed from algorithm-based to deemed savings coefficients estimated using building simulation models. Updated energy and demand savings. Added separate savings for homes with evaporative cooling. Updated measure description to eliminate eligibility for homes without a central AC, but with a ducted heating system.
v5.0	10/2017	TRM v5.0 update. Remove PY 2017 option to use energy and demand adjustment factors in combination with algorithm methodology from TRM v3.1. Added alternative approach to bypass the need to complete leakage testing in guidance memo to follow.
v6.0	11/2018	TRM v6.0 update. Added alternative approach to bypass the need to complete leakage testing in guidance memo to follow.
v7.0	10/2019	TRM v7.0 update. Added clarifying language on incentive rate per home.

2.2.3 Ground Source Heat Pumps Measure Overview

TRM Measure ID: R-HV-GH

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure requires the installation of a ground-source heat pump (GSHP) meeting the minimum requirements of ENERGY STAR® Tier 3 geothermal heat pump key product criteria. The deemed savings are dependent upon the energy efficiency rating (EER) and coefficient of performance (COP) of the installed equipment. Savings calculations are presented for systems both with and without desuperheaters.

Eligibility Criteria

The deemed savings apply to units with a capacity of ≤ 65,000 Btu/hour.

Energy savings for desuperheaters only apply if the desuperheater is attached to an electric storage water heater. The electric storage water heating cannot replace a gas water heater in a retrofit installation.

Baseline Condition

The baseline unit is assumed to be an air-source heat pump (ASHP) for new construction, and either an ASHP or an electric resistance furnace for replace-on-burnout projects. New construction baseline efficiency values for ASHPs are compliant with the current federal minimum standard,[113] effective January 1, 2015.

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[113] DOE minimum efficiency standard for residential air conditioners/heat pumps. https://www.energy.gov/eere/femp/incorporate-minimum-efficiency-requirements-heating-and-cooling-products-federal

For replace-on-burnout (ROB) projects, the cooling baseline is reduced to 13.08 SEER. This value incorporates an adjustment to the baseline SEER value to reflect the percentage of current replacements that do not include the installation of an AHRI-matched system.[114] The heating baseline for replace-on-burnout projects is dependent on the heating type of the baseline equipment.

Table 78: Ground Source Heat Pump Baseline Efficiencies

Project Type	Cooling Mode[115]	Heating Mode[116]
New Construction	11.8 EER (14 SEER)	2.4 COP (8.2 HSPF)
ROB—Air Source Heat Pump Baseline	11.4 EER (13.08 SEER)	2.4 COP (8.2 HSPF)
ROB—Electric Resistance Baseline		1 COP (3.41 HSPF)

High-efficiency Condition

Table 79 displays the ENERGY STAR® requirements for eligible Tier 3 geothermal heat pumps as of January 1, 2012. Energy efficiency service providers are expected to comply with the latest ENERGY STAR® requirements.

Table 79: Ground Source Heat Pump ENERGY STAR® Tier 3 Requirements

Product Type	Cooling Mode (EER)	Heating Mode (COP)
Closed Loop Water-to-Air	17.1	3.6
Open Loop Water-to-Air	21.1	4.1
Closed Loop Water-to-Water	16.1	3.1
Open Loop Water-to-Water	20.1	3.5
Direct Geoexchange (DGX)	16.0	3.6

114 Frontier Associates on behalf of the Electric Utility Marketing Managers of Texas (EUMMOT). "Petition to revise Existing Commission-Approved Deemed Savings Values for Central Air Conditioning and Heat Pump Systems: Docket No. 36780." Public Utility Commission of Texas. Approved August 27, 2009. http://interchange.puc.state.tx.us/WebApp/Interchange/application/dbapps/filings/pgSearch.asp. Adapted for new 14 SEER baseline.

115 Code specified EER value converted to SEER using EER = -0.02 x SEER^2 + 1.12 x SEER. National Renewable Energy Laboratory (NREL). "Building America House Simulation Protocols." U.S. Department of Energy. Revised October 2010. http://www.nrel.gov/docs/fy11osti/49246.pdf.

116 Code specified HSPF value converted to COP using COP = HSPF x 1,055 J/Btu ÷ 3,600 J/W-h.

The specifications in the charts above apply to single-stage models. Multi-stage models may be qualified based on:[117]

$$EER = (highest\ rated\ capacity\ EER + lowest\ rated\ capacity\ EER) \div 2$$

Equation 37

$$COP = (highest\ rated\ capacity\ COP + lowest\ rated\ capacity\ COP) \div 2$$

Equation 38

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Peak demand and annual energy savings for GSHP systems should be calculated, as shown below. Where a desuperheater is also installed, please see the Deemed Energy Savings Tables section for additional energy savings and the Deemed Summer Demand Savings Tables for additional demand savings.

Energy and demand savings for desuperheaters were adapted from a 2001 study conducted by Oak Ridge National Laboratory (ORNL) on ground source heat pumps in Texas.[118] Desuperheater savings were calculated for each climate zone by taking the difference in savings between GSHPs with and without desuperheaters and averaging the savings between low and high-efficiency units. Savings for GSHP systems with desuperheaters should be calculated using the algorithms below with an additional energy credit based on the system capacity and efficiency.

The ORNL study draws from a 1998 analysis based on a study conducted at the Fort Polk Joint Readiness Training Center in Leesville, Louisiana. The Fort Polk study used calibrated simulations of 200 multifamily residences in the complex to estimate energy savings attributable to the replacement of air source heat pumps with ground source heat pumps. These estimates were found to be within 5 percent of actual post-retrofit savings. Building models were developed using TRNSYS.[119]

Using the Fort Polk models, the ORNL study assumed a baseline of a 1.5 ton, 10 SEER air source heat pump. Simulations of low-, medium-, and high-efficiency ground source heat pumps with and without desuperheaters were compared against the baseline unit. The models were run using TMY-2 weather profiles for climate zones 1-4. Energy and demand differences between the pre- and post-retrofit models were used to estimate average savings per ton of cooling capacity.

[117] Geothermal Heat Pumps Key Product Criteria, https://www.energystar.gov/index.cfm?c=geo_heat.pr_crit_geo_heat_pumps. Accessed February 2014.

[118] Shonder, J. A., Hughes, P., and Thornton, J. Development of Deemed Energy and Demand Savings for Residential Ground Source Heat Pump Retrofits in the State of Texas. Transactions-American Society of Heating, Refrigerating, and Air Conditioning Engineers. 108, no. 1: 953-961, 2001.

[119] Klein, S. A. TRNSYS Manual: A Transient Simulation Program. Solar Engineering Laboratory, University of Wisconsin-Madison, Version 14.2 for Windows, September 1996.

In the 1998 analysis, low-efficiency GSHPs were assumed to be units with an EER of 12.4 and capacity of 19 kBtuh, while medium-efficiency units had an EER of 16.8 and capacity of 21 kBtuh. High-efficiency units had an EER or 18.3, with a capacity of 22 kBtuh.

These models were used to derive the energy and demand savings associated with installation of a desuperheater along with a ground source heat pump, as shown in Table 82 and Table 83, respectively.

Energy Savings Algorithms

$$kWh_{Savings} = kWh_{Savings,Summer} + kWh_{Savings,Winter} + kWh_{desuperheater}$$

Equation 39

$$kWh_{Savings,C} = CAP_C \times \frac{1\ kW}{1{,}000\ W} \times EFLH_C \times \left(\frac{1}{SEER_{Base}} - \frac{1}{EER_{GSHP}}\right)$$

Equation 40

$$kWh_{Savings,H} = CAP_H \times \frac{1\ kWh}{1{,}000\ Wh} \times EFLH_H \times \left(\frac{1}{HSPF_{Base}} - \frac{1}{3.412 \times COP_{GSHP}}\right)$$

Equation 41

Where:

$kWh_{desuperheater}$ = *Energy savings (kWh) associated with installation of a desuperheater (see Table 82). These savings should only be added if a desuperheater is installed.*

CAP_C = *Rated equipment cooling capacity of the installed GSHP (Btu/hr)*

CAP_H = *Rated equipment heating capacity of the installed GSHP (Btu/hr)*

$EFLH_C$ = *Equivalent full load hours for cooling)*

$EFLH_H$ = *Equivalent full load hours for heating (Table 80)*

$SEER_{Base}$ = *Seasonal Energy Efficiency Ratio of the baseline cooling equipment (Table 78)*

EER_{GSHP} = *Energy Efficiency Ratio of the installed GSHP*

$HSPF_{Base}$ = *Heating Seasonal Performance Factor of the baseline heating equipment (Table 78)*

COP_{GSHP} = *Coefficient of Performance of the installed GSHP*

Table 80: Equivalent Full Load Cooling/Heating Hours[120]

Climate Zone	$EFLH_C$	$EFLH_H$
Climate Zone 1: Panhandle	1,142	1,880
Climate Zone 2: North	1,926	1,343
Climate Zone 3: South	2,209	1,127
Climate Zone 4: Valley	2,958	776
Climate Zone 5: West	1,524	1,559

Demand Savings Algorithms

$$kW_{Savings,C} = CAP_C \times \frac{1\ kW}{1{,}000\ W} \times \left(\frac{1}{EER_{Base}} - \frac{1}{EER_{GSHP}}\right) \times CF_C + kW_{desuperheater}$$

Equation 42

$$kW_{Savings,H} = CAP_H \times \frac{1\ kWh}{3{,}412\ Btu} \times \left(\frac{1}{COP_{Base}} - \frac{1}{COP_{GSHP}}\right) \times CF_H$$

Equation 43

Where:

CAP_C = *Rated equipment cooling capacity of the installed GSHP (Btu/hr)*

CAP_H = *Rated equipment heating capacity of the installed GSHP (Btu/hr)*

EER_{Base} = *Energy Efficiency Ratio of the baseline cooling equipment (Table 78)*

EER_{GSHP} = *Energy Efficiency Ratio of the installed GSHP*

COP_{Base} = *Coefficient of Performance of the baseline heating equipment (Table 78)*

COP_{GSHP} = *Coefficient of Performance of the installed GSHP*

CF_C = *Coincidence Factor = (*Table 81*)*

CF_H = *Coincidence Factor = (*Table 81*)*

$kW_{desuperheater}$ = *Summer demand savings (kW) associated with installation of a desuperheater (see Table 83). These savings should only be added if a desuperheater is installed.*

[120] ENERGY STAR® Central AC/HP Savings Calculator.

Table 81: Ground Source Heat Pumps—Coincidence Factors for GSHPs[121]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.634	0.677	0.626	0.583	0.725
Winter	0.549	0.478	0.515	0.453	0.437

Deemed Energy Savings Tables

Table 82: Energy Savings for Desuperheaters

Climate Zone	kWh/ton
Climate Zone 1: Panhandle	612
Climate Zone 2: North	791
Climate Zone 3: South	802
Climate Zone 4: Valley	847
Climate Zone 5: West	791

Deemed Summer Demand Savings Tables

Table 83: Summer Peak Demand Savings for Desuperheaters

Climate Zone	kW/ton
Climate Zone 1: Panhandle	0.440
Climate Zone 2: North	0.405
Climate Zone 3: South	0.405
Climate Zone 4: Valley	0.410
Climate Zone 5: West	0.405

Deemed Winter Demand Savings Tables

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

[121] See Volume 1, Appendix B.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of a high-efficiency ground source heat pump unit is 20 years.

This value is consistent with the EUL reported in the Department of Energy GSHP guide.[122]

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone
- Decision/action type (new construction, replace-on-burnout)
- Replaced unit type (heat pump, electric resistance)
- Cooling and heating capacity (Btu/hr)
- Energy Efficiency Ratio (EER) of the unit installed
- Coefficient of Performance (COP) of the unit installed
- Whether a desuperheater was also installed or present
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or other pre-approved method of installation verification
- Manufacturer, model, and serial number
    - AHRI certificate matching model number

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- ISO/AHRI 13256-1
- Shonder, J. A., Hughes, P., and Thornton, J. Development of Deemed Energy and Demand Savings for Residential Ground Source Heat Pump Retrofits in the State of Texas. Transactions-American Society of Heating, Refrigerating, and Air Conditioning Engineers. 108, no. 1: 953-961, 2001.
- The applicable version of ENERGY STAR®'s specifications and requirements addressing residential ground source heat pumps.

[122] Department of Energy. "Guide to Geothermal Heat Pumps. February 2011. http://www.energy.gov/sites/prod/files/guide_to_geothermal_heat_pumps.pdf.

Document Revision History

Table 84: Residential Ground Source Heat Pumps Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Updated by Frontier Associates, March 2014, based on new federal standards and alternative methodology.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. No revision.
v3.1	11/05/2015	TRM v3.1 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. Updated peak coincidence factors for compliance with current Texas peak definition. Single coincidence factor replaced with individual factors for each climate zone.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Updates to tracking requirements.

2.2.4 Central Air Conditioner and Heat Pumps Measure Overview

TRM Measure ID: R-HV-CT

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction, early retirement

Program Delivery Type(s): Prescriptive, direct install (early retirement)

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering spreadsheets and estimates

Measure Description

Residential replacement of existing heating and cooling equipment with a new central air-source air conditioner or heat pump in an existing building, or the installation of a new central air conditioner or heat pump in a new residential construction. Downsized systems that are right-sized per heat load calculation are also eligible. A new central system includes an entire packaged unit or a split system consisting of an indoor unit with a matching remote condensing unit. This measure also applies to the installation of dual-fuel heat pumps that meet all existing measure eligibility criteria.

Eligibility Criteria

Newly installed units must have a cooling capacity of less than 65,000 Btu/hour (5.4 tons) to be eligible for these deemed savings. Gas furnaces are not eligible to be awarded savings for replacement through this measure.

Equipment shall be properly sized to dwelling based on ASHRAE or ACCA Manual J standards. Manufacturer datasheets for installed equipment or AHRI reference numbers must be provided. Savings should be calculated using rated capacities whenever possible. Reported system capacities and efficiencies should always match those verified by AHRI as tested under AHRI operating conditions for a specific combination of equipment, including condenser, coil, and furnace (or condenser only for packaged units). Savings should never be calculated using efficiency ratings for individual system components.

For early retirement or rightsizing projects, attempt to determine the rated capacity of the existing unit. The rated capacity may be found on the manufacturer specification sheet for the existing unit if AHRI is not available. If the model number of the existing unit is unobtainable or if the manufacturer specification sheet cannot be found, use nominal tonnage for both the existing and new unit. Never use nominal tonnage for the existing unit in combination with rated tonnage for the new unit, which can lead to overstated savings. Additionally, never use nominal tonnage to determine savings for projects where no early retirement or rightsizing has occurred.

For early retirement projects, in order to receive savings, the unit to be replaced must be functioning at the time of removal with a maximum age of 20 years. Otherwise, claim savings for a replace-on-burnout project.

The replacement of an evaporative cooler with a central system is eligible where the decision to change equipment types predates or is independent of the decision to install efficient equipment and should be claimed against the new construction baseline.

New construction projects are not eligible to receive deemed savings for system rightsizing.[123] For system upsizing, savings should generally be claimed against the new construction baseline. However, when upsizing while going from a single larger capacity system to multiple smaller capacity systems, savings may be claimed against the applicable replace-on-burnout or early retirement baseline if the total pre and post tonnage are within ½ ton.[124] For this scenario, savings must be looked up using the lower pre-tonnage. If the multiple installed units do not share the same efficiency value, savings should be looked up using the most conservative efficiency value.

Additionally, low-income or hard-to-reach programs may use the electric resistance baseline for systems upsized by no more than a half-ton lieu of the new construction baseline. Under this scenario, cooling savings should be claimed against the new construction baseline using the installed (higher) capacity. Heating savings should be claimed against the electric resistance baseline using the existing (lower) capacity. Documentation should be aligned with the rightsizing requirements outlined in this measure.

When replacing a single unit with multiple units where the capacity is the same or has been downsized, savings should be looked up using the total system pre and post capacities. Again, if the multiple installed units do not share the same efficiency value, savings should be looked up using the most conservative efficiency value.

Baseline Condition

New Construction, Replace-on-burnout, or Early Retirement of an Air-Source Air Conditioner or Heat Pump

New construction baseline efficiency values for air conditioners or heat pumps are compliant with the current federal minimum standard,[125] effective January 1, 2015. The baseline is assumed to be a new system with an AHRI-listed SEER rating of 14.0. This baseline is also applicable to central heat pump installations replacing air conditioners with central gas heat,

[123] For projects using a custom baseline see TRMv6.0 Volume 4.
[124] This exception is allowed to account for efficiency improvements due to zoning that are not reflected in the current savings methodology.
[125] DOE minimum efficiency standard for residential air conditioners/heat pumps. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=48&action=viewlive.

evaporative coolers with central, space, or no heating, or room/window air conditioners with central, space, or no heating.

For replace-on-burnout (ROB) projects, the cooling baseline is reduced to 13.08 SEER. This value incorporates an adjustment to the baseline SEER value to reflect the percentage of current replacements that do not include the installation of an AHRI-matched system.[126]

For early retirement (ER) projects, the cooling baseline is reduced to 10 SEER for systems installed before January 23, 2006. For systems installed on or after January 23, 2006, the ER baseline increases to 12.44 SEER.

For ROB projects, heating baseline efficiency values for heat pumps are compliant with the current federal minimum standard, effective January 1, 2015. These standards specify an HSPF of 8.2 for split systems and 8.0 for packaged systems. This baseline reflects updates to federal standards that take effect on January 1, 2015, as defined in the Department of Energy (DOE) energy efficiency standards (10 CFR Part 430).[127] For ER projects where the existing system was installed on or after January 23, 2006, the heating baseline efficiency is assumed to be an HSPF of 7.7 based on the federal minimum standard in effect from January 23, 2006, through December 31, 2014.[128] For ER projects where the existing system was installed before January 23, 2006, the heating baseline efficiency is reduced to 6.8 HSPF based on the federal minimum standard in effect prior to January 23, 2006.

Replace-on-burnout or Early Retirement of an Electric Resistance Furnace

By the nature of the technology, all electric resistance furnaces have the same efficiency with HSPF = 3.41.[129] Projects in which an electric resistance furnace is replaced, either in replace-on-burnout or early retirement scenarios, use this baseline for heating-side savings.

126 Frontier Associates on behalf of the Electric Utility Marketing Managers of Texas (EUMMOT). "Petition to revise Existing Commission-Approved Deemed Savings Values for Central Air Conditioning and Heat Pump Systems: Docket No. 36780." Public Utility Commission of Texas. Approved August 27, 2009. http://interchange.puc.state.tx.us/WebApp/Interchange/application/dbapps/filings/pgSearch.asp. Adapted for new 14 SEER baseline.

127 *10 CFR Part 430.32(c)2. Energy Conservation Program: Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters; Final Rule*. Online. Available: http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-32.pdf. Accessed February 2014.

128 Ibid.

129 COP = HSPF × 1,055 J/BTU / 3,600 J/W-hr. For Electric Resistance, heating efficiency is 1 COP. Therefore, HSPF = 1 × 3,600 / 1,055 = 3.41.

Table 85: Central System Baseline Efficiencies

Project Type	Cooling Mode	Heating Mode
New construction	14 SEER	8.2 HSPF
Replace-on-burnout, heat pump	13.08 SEER	8.2 HSPF
Replace-on-burnout, electric resistance furnace		3.41 HSPF
Early retirement, heat pump (as of 1/23/2006)	12.44 SEER	7.7 HSPF
Early retirement, electric resistance furnace (as of 1/23/2006)		3.41 HSPF
Early retirement, heat pump (before 1/23/2006)	10 SEER	6.8 HSPF
Early retirement, electric resistance furnace (before 1/23/2006)		3.41 HSPF

High-efficiency Condition

Table 86 displays the Consortium for Energy Efficiency (CEE) requirements for eligible Tier 1 heat pumps as of January 1, 2009. Energy efficiency service providers are expected to at least comply with the latest CEE Tier 1 requirements.

No full-load efficiency requirement is specified in the current federal standard. Therefore, systems with qualifying SEER and HSPF energy ratings are permitted to claim cooling energy savings, heating energy savings, and winter demand savings for systems where the EER does not comply with the below requirement.

Table 86: Central System CEE Tier 1 Requirements

SEER	EER	HSPF
14.5	12.0	8.5

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Replace-on-burnout or New Construction

Energy, summer demand, and winter demand savings were estimated using air conditioner and heat pump performance curves developed by the National Renewable Energy Laboratory[130] for typical units in each of the following SEER ranges:

- Baseline units
- 14.5–14.9
- 15.0–15.9

[130] D. Cutler et al. Improved Modeling of Residential Air Conditioners and Heat Pumps for Energy Calculations. National Renewable Energy Laboratory. NREL/TP-5500-56354. January 2013. Tables 12 and 13. http://www.nrel.gov/docs/fy13osti/56354.pdf

- 16.0–16.9
- 17.0–17.9
- 18.0–20.9
- 21.0 and above

14.5–16.9 SEER units were assumed to be single stage. 17.0 and above SEER units were assumed to be multi-stage cooling units.

These performance curves provide the capacity and efficiency of the heat pump operating in cooling mode across a wide range of outside air temperatures. Unit loading was estimated as a function of outside air temperature, and hours of cooling mode operation under different loadings were estimated using bin weather data for each weather zone. In heating mode, predicted HVAC operation was limited to meeting 77 percent of load, using a factor applied in Manual J to correlate design load hours to equivalent full load hours under actual operating conditions. This approach accounts for the observation that heating systems are not always operated even when outdoor conditions indicate they should.

Summer and winter demand savings were estimated according to the expected unit performance under design conditions. For all weather zones, it is assumed that typical HVAC systems are sized to 115 percent of their design cooling load (oversized by 15 percent). Heating mode capacity was related to rated cooling capacity using the rated capacity in the cooling and heating mode of the residential market heat pump products of four major manufacturers according to data exported from AHRI. Data were exported from the AHRI directory, and the average ratio for each equipment size of heating capacity to cooling capacity was multiplied by the rated (cooling side) capacity to estimate the heat pump capacity. Heat pump system output was then compared to its loading under design conditions.

The model used the following set of normalized performance curves to scale the rated performance values as a function of outdoor dry-bulb temperature ranging from 65 to 115 degrees Fahrenheit. The total capacity and Energy Input Ratio (EIR = 1/COP) curves are a function of entering wet-bulb temperature (EWB) and outdoor dry-bulb temperature (ODB) and are both quadratic curve fits of the form:

$$y = a + b \times T_{EWB} + c \times T_{EWB}^2 + d \times T_{ODB} + e \times T_{ODB}^2 + f \times T_{EWB} \times T_{ODB}$$

Equation 44

Table 87: Air Conditioner and Heat Pump Capacity Curve Coefficients[131]

Coeff.	Cooling			Heating		
	Single Stage	Multi-stage/Speed		Single Stage	Multi-stage/Speed	
		Low	High		Low	High
a	3.670270705	3.940185508	3.109456535	0.566333415	0.335690634	0.306358843
b	-0.098652414	-0.104723455	-0.085520461	-0.000744164	0.002405123	0.005376987
c	0.000955906	0.001019298	0.000863238	-0.0000103	-0.0000464	-0.0000579

[131] Using air conditioner capacity curve coefficients for heat pump cooling savings.

Coeff.	Cooling			Heating		
	Single Stage	Multi-stage/Speed		Single Stage	Multi-stage/Speed	
		Low	High		Low	High
d	0.006552414	0.006471171	0.00863049	0.009414634	0.013498735	0.011645092
e	-0.0000156	-0.00000953	-0.000021	0.0000506	0.0000499	0.0000591
f	-0.000131877	-0.000161658	-0.000140186	-0.00000675	-0.00000725	-0.0000203

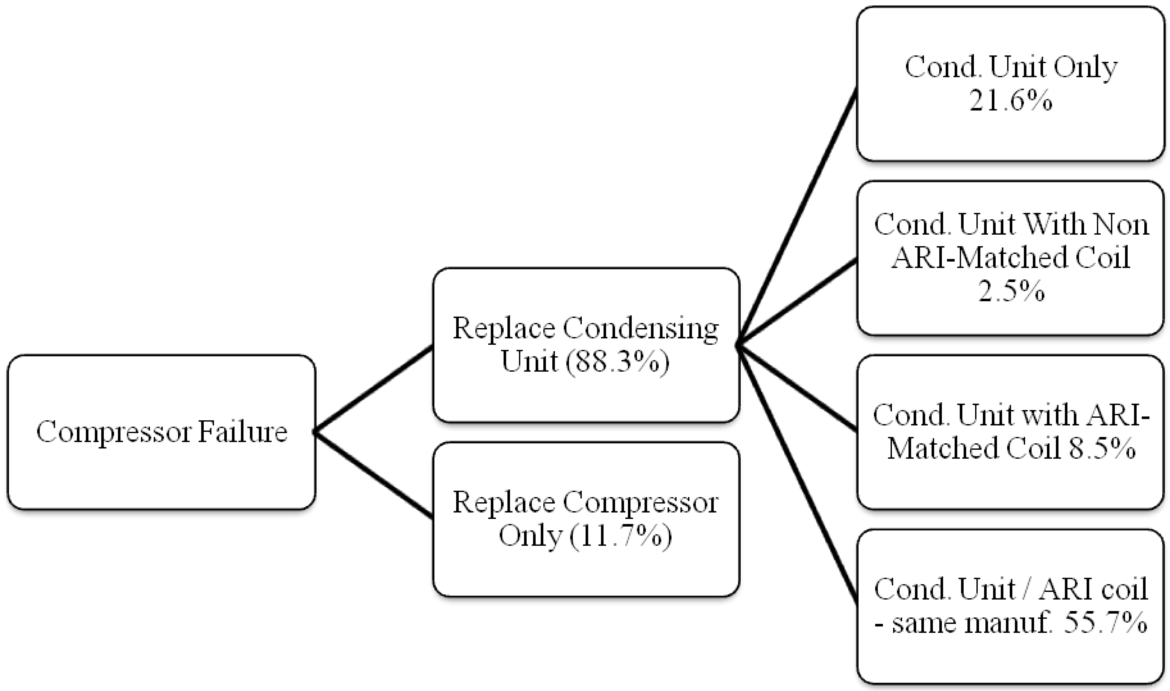
Table 88: Air Conditioner and Heat Pump EIR Curve Coefficients[132]

Coeff.	Cooling			Heating		
	Single Stage	Multi-stage/Speed		Single Stage	Multi-stage/Speed	
		Low	High		Low	High
a	-3.302695861	-3.87752688	-1.990708931	0.718398423	0.36338171	0.981100941
b	0.137871531	0.164566276	0.093969249	0.003498178	0.013523725	-0.005158493
c	-0.001056996	-0.001272755	-0.00073335	0.000142202	0.000258872	0.000243416
d	-0.012573945	-0.019956043	-0.009062553	-0.005724331	-0.009450269	-0.005274352
e	0.000214638	0.000256512	0.000165099	0.00014085	0.000439519	0.000230742
f	-0.000145054	-0.000133539	-0.0000997	-0.000215321	-0.000653723	-0.000336954

To estimate the baseline SEER value for retrofit installations, Texas A&M's Energy Systems Laboratory (ESL) surveyed dealers across the State to determine installation practices. The research found that in the event of a compressor failure out of warranty, dealers replaced the compressor 11.7 percent of the time, and replaced the condensing unit 88.3 percent of the time. Further, the condensing unit replacements consist of condensing unit-only replacements, replacements with mismatched evaporator coils, and replacements with matching evaporator coils. The percentages for these installations are as follows:

132 Using air conditioner capacity EIR coefficients for heat pump cooling savings.

Figure 1: Unit Replacement Percentages upon Compressor Failure



Source: Docket No. 36780

To calculate a weighted average SEER for these installations, ESL assumed that a compressor-only replacement resulted in no increase in SEER and that the SEER of a condensing unit installed without a matching coil would be 85 percent of the SEER value for a matched system. The ESL estimate of the baseline SEER for replacement AC units is given by the following equation:

$$\begin{aligned} SEER_{Base} = &\left(SEER_{Compressor\ Replacement}\right) \times (Actual\ \%\ Compressor\ Replacement) \\ &+ \left(SEER_{Condenser\ Replacement}\right) \times (Actual\ \%\ Condenser\ Replacement) \\ &+ \left(SEER_{System\ Replacement}\right) \times (Actual\ \%\ System\ Replacement) \end{aligned}$$

Equation 45

Substituting ESL SEER estimates and survey data provides the following baseline SEER estimate:

$$SEER_{Base} = (9.5) \times (11.7\%) + (11.05) \times (24.1\%) + (13.5) \times (64.2\%) = 12.44$$

Adjusting for the increased 14 SEER baseline:

$$SEER_{Base} = (10.5) \times (11.7\%) + (11.9) \times (24.1\%) + (14) \times (64.2\%) = 13.08$$

In new construction, there is no possibility of a partial system (e.g., condensing unit-only) change out, so the 13.08 baseline would not be appropriate. Therefore, the baseline for new construction installations is set at the federal government's minimum efficiency standard of 14 SEER.

Early Retirement

Annual energy (kWh) and summer peak demand (kW) savings must be calculated separately for two time periods:

1. The estimated remaining life of the equipment that is being removed, designated the remaining useful life (RUL), and
2. The remaining time in the EUL period (15—RUL)

Annual energy and summer peak demand savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

Where:

RUL = *Remaining Useful Life (see* Table 89 *or* Table 90*) or if unknown, assume the age of the replaced unit is equal to the EUL resulting in a default RUL of 7.0 (ACs) or 6.0 years (HPs). If individual system components were installed at separate times, use the condenser age as a proxy for the entire system. Default RUL may be used exclusively if applied consistently for all projects. Otherwise, the default should only be used when a project is reported and documented as having a nameplate that is illegible. For heat pumps replacing an air conditioner with an electric resistance furnace, use the RUL table from the Central Air conditioner measure instead.*

EUL = *Estimated Useful Life = 18 years (AC); 15 years (HP)*

Table 89: Remaining Useful Life of Replaced Air Conditioner

Age of Replaced Unit (Years)	Remaining Useful Life (Years)	Age of Replaced Unit (Years)	Remaining Useful Life (Years)
1	16.8	14	8.6
2	15.8	15	8.2
3	14.9	16	7.9
4	14.1	17	7.6
5	13.3	18	7.0
6	12.6	19	6.0
7	11.9	20	5.0
8	11.3	21	4.0
9	10.8	22	3.0
10	10.3	23	2.0
11	9.8	24	1.0

Age of Replaced Unit (Years)	Remaining Useful Life (Years)	Age of Replaced Unit (Years)	Remaining Useful Life (Years)
12	9.4	25[133,134]	0.0
13	9.0		

Table 90: Remaining Useful Life of Replaced Heat Pump

Age of Replaced Unit (years)	Remaining Useful Life (years)	Age of Replaced Unit (years)	Remaining Useful Life (years)
1	13.7	12	7.9
2	12.7	13	7.6
3	12.0	14	7.0
4	11.3	15	6.0
5	10.7	16	5.0
6	10.2	17	4.0
7	9.7	18	3.0
8	9.3	19	2.0
9	8.9	20	1.0
10	8.5	21[135,136]	0.0
11	8.2		

Derivation of RULs

Central air conditioners have an estimated useful life of 18 years, and central heat pumps have an estimated useful life of 15 years. This estimate is consistent with the age at which approximately 50 percent of the central air conditioners and heat pumps installed in a given year will no longer be in service, as described by the survival function Figure 2 and Figure 3.

133 RULs are capped at the 75th percentile of equipment age, 25 years, as determined based on DOE survival curves (see Figure 2). Systems older than 25 years should use the ROB baseline. See the January 2015 memo, "Considerations for early replacement of residential equipment," for further detail.

134 Ward, B., Bodington, N., Farah, H., Reeves, S., and Lee, L. "Considerations for early replacement of residential equipment." Prepared by the Evaluation, Measurement, and Verification (EM&V) team for the Electric Utility Marketing Managers of Texas (EUMMOT). January 2015. This document has been made available to Texas investor-owned utilities through the EM&V team's SharePoint.

135 RULs are capped at the 75th percentile of equipment age, 21 years, as determined based on DOE survival curves (Figure 3). Systems older than 21 years should use the ROB baseline. See the January 2015 memo, "Considerations for early replacement of residential equipment," for further detail.

136 Ward, B., Bodington, N., Farah, H., Reeves, S., and Lee, L. "Considerations for early replacement of residential equipment." Prepared by the Evaluation, Measurement, and Verification (EM&V) team for the Electric Utility Marketing Managers of Texas (EUMMOT). January 2015. This document has been made available to Texas investor-owned utilities through the EM&V team's SharePoint.

Figure 2: Survival Function for Central Air Conditioners[137]

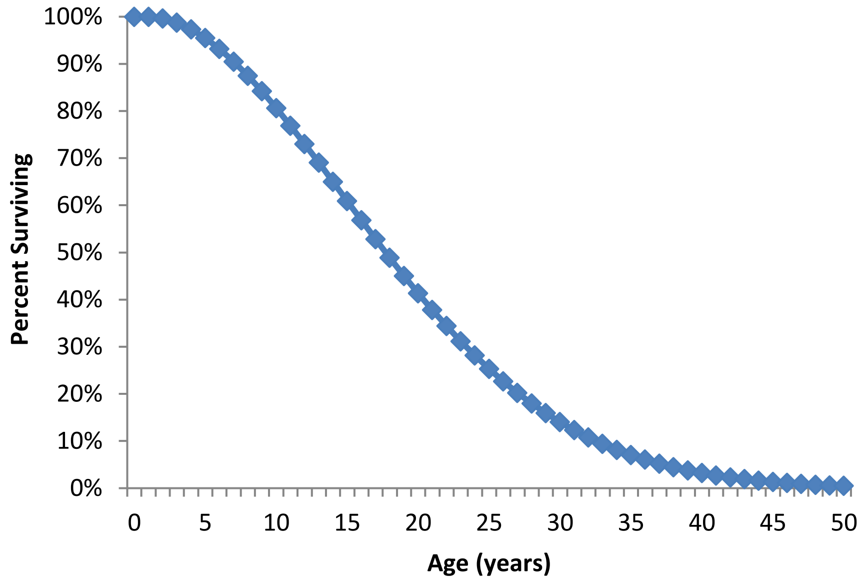
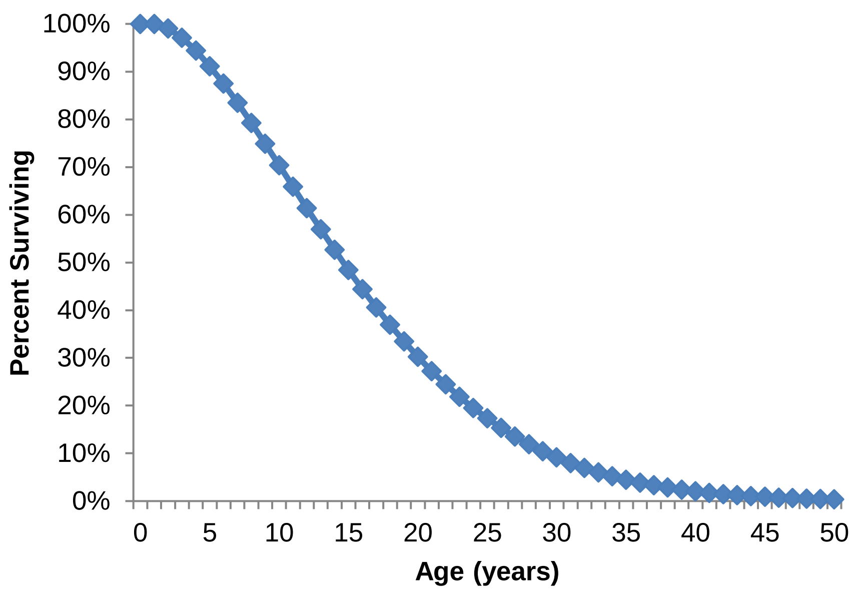


Figure 3: Survival Function for Central Heat Pumps[138]



[137] Department of Energy, Federal Register, 76 FR 37408, Technical Support Document: 8.2.3.5 Lifetime. June 2011. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0011-0012.

[138] Department of Energy, Federal Register, 76 FR 37408, Technical Support Document: 8.2.3.5 Lifetime. June 2011. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0011-0012.

The method for estimating the remaining useful life (RUL) of a replaced system uses the age of the existing system to re-estimate the projected unit lifetime based on the survival function shown in Figure 3. The age of the central system being replaced is found on the horizontal axis, and the corresponding percentage of surviving system is determined from the chart. The surviving percentage value is then divided in half, creating a new estimated useful lifetime applicable to the current unit age. The age (year) that corresponds to this new percentage is read from the chart. RUL is estimated as the difference between that age and the current age of the system being replaced.

Deemed Energy Savings Tables[139]

Due to the high volume of tables associated with this measure, deemed savings tables are provided in an appendix at the end of this volume.[140]

Deemed Summer Demand Savings Tables[141]

Due to the high volume of tables associated with this measure, deemed savings tables are provided in an appendix at the end of this volume.[142]

Deemed Winter Demand Savings Tables[143]

Due to the high volume of tables associated with this measure, deemed savings tables are provided in an appendix at the end of this volume.[144]

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

[139] Rated capacity ranges are specified based on normal rounding convention between capacity categories (values at and above the midpoint round up, while values below the midpoint round down).

[140] Savings tables are also provided in Excel format at the Texas Efficiency website. http://texasefficiency.com/index.php/regulatory-filings/deemed-savings.

[141] Rated capacity ranges are specified based on normal rounding convention between capacity categories (values at and above the midpoint round up, while values below the midpoint round down).

[142] Savings tables are also provided in Excel format at the Texas Efficiency website. http://texasefficiency.com/index.php/regulatory-filings/deemed-savings.

[143] Rated capacity ranges are specified with a 5 percent tolerance in accordance with AHRI Standard 210/240 to account for systems that are rated slightly below the applicable nominal capacity. AHRI Standard 210/240. Table J1. http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_210-240_2017.pdf.

[144] Savings tables are also provided in Excel format at the Texas Efficiency website. http://texasefficiency.com/index.php/regulatory-filings/deemed-savings.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 18 years for a central air conditioner and 15 years for a central heat pump unit based on the current DOE Final Rule standards for central air conditioners and heat pumps.[145]

This value is consistent with the EUL reported in the Department of Energy 76 Final Rule 37408 Technical Support Document for Energy Conservation Standards for Air Conditioners and Heat Pumps.[146]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Decision/action type (early retirement, replace-on-burnout, new construction)
- Cooling capacity of the newly installed unit (tons)
- Seasonal Energy Efficiency Ratio (SEER) and Energy Efficiency Ratio (EER) of the newly installed unit
- Heating Seasonal Performance Factor (HSPF) of the newly installed heat pump
- Type of unit replaced (e.g., electric resistance furnace, air source heat pump)
- Age of the replaced unit (early retirement only)
- Retired unit model number, serial number, manufacturer, and cooling capacity (early retirement or rightsizing)
- Photograph of retired unit nameplate (early retirement or rightsizing)
  - If a photograph of the retired unit nameplate is unavailable or not legible, provide a photo and/or description documenting the reason why the nameplate photo was unobtainable (early retirement only)
  - If a photograph of the retired unit nameplate is unavailable or not legible, provide estimated square footage of conditioned area served by the retired unit (rightsizing only)
- Photograph demonstrating functionality of existing equipment and/or customer responses to survey questionnaire documenting the condition of the replaced unit and their motivation for measure replacement for early retirement eligibility determination (early retirement only)

[145] Final Rule: Standards, Federal Register, 76 FR 37408 (June 27, 2011) and associated Technical Support Document. Accessed 10/21/2014. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0011-0012.

[146] Department of Energy, Federal Register, 76 FR 37408, Technical Support Document: 8.2.3.5 Lifetime. June 2011.

- If replacing an evaporative cooler, application should include a statement that the customer decision to change equipment types predates or is independent of the decision to install efficient equipment
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or other pre-approved method of installation verification
- Manufacturer, model, capacity, and serial number of newly installed unit
    - AHRI certificate matching manufacturer and model number

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- ASHRAE 90.1-1999 (Residential Buildings)
- ACCA Manual J Residential Load Calculation (8^{th} Edition).

Document Revision History

Table 91: Residential Central Heat Pumps Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Low-income and hard-to-reach Market Transformation section merged with main measure as "early retirement" option. Updated by Frontier Associates, March 2014, based on new federal standards.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. early retirement savings may be claimed through any appropriately designed program in accordance with EM&V team's memo, "Considerations for early replacement of residential equipment." Remaining useful lifetimes updated.
v3.1	11/05/2015	TRM v3.1 update. Revision of cooling savings to reflect heat-pump-specific performance curves. Extension of early retirement cooling savings tables to higher SEER values. Clarification around summer demand savings for single-stage and two-stage units.
v4.0	10/10/2016	TRM v4.0 update. Added RUL value for units with an age of one year. Added a default RUL value for when the age of the unit is unknown. Eliminated the eligibility requirement of the existing unit to have a minimum age of five years. Updated savings for 15.0-15.9 SEER range.
v5.0	10/2017	TRM v5.0 update. Switched to air conditioner capacity and EIR curve coefficients for estimated heat pump cooling savings. Updated energy savings to use TMY3 temperature bin hours. Updated demand savings for compliance with current peak definition. Added 12.44 SEER and 6.8 HSPF baseline savings tables previously referencing earlier version of TRM. Updated baseline to include replacing air conditioners with gas heat.
v6.0	11/2018	TRM v6.0 update. Updated baseline and eligibility requirements. Added rightsizing savings for replace on burnout in winter demand tables. Added language clarifying use of rated capacity vs nominal and updated the deemed savings tables to show rated Btuh. Clarified required documentation for early retirement.
v7.0	10/2019	TRM v7.0 update. Consolidated central air conditioner and heat pump measures. Moved deemed savings tables to Appendix A. Updated eligibility for low-income and hard-to-reach.

2.2.5 Mini-split Air Conditioners and Heat Pumps Measure Overview

TRM Measure ID: R-HV-MS

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction, early retirement

Program Delivery Type(s): Prescriptive, direct Install (early retirement)

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering spreadsheets and estimates

Measure Description

Residential replacement of existing heating and cooling equipment with a new mini-split air conditioner or heat pump in an existing building, or the installation of a new mini-split air conditioner or heat pump in a new residential construction. Downsized systems that are right-sized per a heat load calculation are also eligible. This measure also applies to the installation of DC inverter systems that meet all existing measure eligibility criteria.

Additional savings may be available for duct removal in combination with the installation of a ductless mini-split. In these cases, refer to the Duct Sealing measure and follow the savings methodology (standard approach) using a value of 0 CFM as the post-improvement duct leakage. Leakage testing must be performed on the existing ductwork in order to claim savings for duct removal.

Eligibility Criteria

Newly installed units must have a cooling capacity of less than 65,000 Btu/hour (5.4 tons) to be eligible for these deemed savings. Gas furnaces are not eligible to be awarded savings for replacement through this measure.

Equipment shall be properly sized to dwelling based on ASHRAE or ACCA Manual J standards. Manufacturer datasheets for installed equipment or AHRI reference numbers must be provided. Savings should be calculated using rated capacities whenever possible. Reported system capacities and efficiencies should always match those verified by AHRI as tested under AHRI operating conditions for a specific combination of equipment, including condenser, coil, and furnace (or condenser only for packaged units). Savings should never be calculated using efficiency ratings for individual system components.

For early retirement or rightsizing projects, attempt to determine the rated capacity of the existing unit. The rated capacity may be found on the manufacturer specification sheet for the existing unit if AHRI is not available. If the model number of the existing unit is unobtainable or if the manufacturer specification sheet cannot be found, use nominal tonnage for both the existing and new unit. Never use nominal tonnage for the existing unit in combination with rated tonnage for the new unit, which can lead to overstated savings. Additionally, never use nominal tonnage to determine savings for projects where no early retirement or rightsizing has occurred.

For early retirement projects, in order to receive savings, the unit to be replaced must be functioning at the time of removal with a maximum age of 20 years. Otherwise, claim savings for a replace on burnout project.

Replacement of an evaporative cooler with a mini-split system is eligible where the decision to change equipment types predates or is independent of the decision to install efficient equipment and should be claimed against the new construction baseline.

New construction projects are not eligible to receive deemed savings for system rightsizing.[147] For system upsizing, savings should generally be claimed against the new construction baseline. However, when upsizing while going from a single larger capacity system to multiple smaller capacity systems, savings may be claimed against the applicable replace-on-burnout or early retirement baseline if the total pre and post tonnage are within ½ ton.[148] For this scenario, savings must be looked up using the lower pre-tonnage. If the multiple installed units do not share the same efficiency value, savings should be looked up using the most conservative efficiency value.

Additionally, low-income or hard-to-reach programs may use the electric resistance baseline for systems upsized by no more than a half-ton lieu of the new construction baseline. Under this scenario, cooling savings should be claimed against the new construction baseline using the installed (higher) capacity. Heating savings should be claimed against the electric resistance baseline using the existing (lower) capacity. Documentation should be aligned with the rightsizing requirements outlined in this measure.

When replacing a single unit with multiple units where the capacity is the same or has been downsized, savings should be looked up using the total system pre and post capacities. Again, if the multiple installed units do not share the same efficiency value, savings should be looked up using the most conservative efficiency value.

Baseline Condition

New Construction, Replace-on-burnout, or Early Retirement of an Air-Source Air Conditioner or Heat Pump

New construction baseline efficiency values for air conditioners or heat pumps are compliant

[147] For projects using a custom baseline see TRMv6.0 Volume 4.
[148] This exception is allowed to account for efficiency improvements due to zoning that are not reflected in the current savings methodology.

with the current federal minimum standard,[149] effective January 1, 2015. The baseline is assumed to be a new system with an AHRI-listed SEER rating of 14.0. This baseline is also applicable to central heat pump installations replacing air conditioners with central gas heat, evaporative coolers with central, space, or no heating, or room/window air conditioners with central, space, or no heating.

For replace-on-burnout (ROB) projects, the cooling baseline is reduced to 13.08 SEER. This value incorporates an adjustment to the baseline SEER value to reflect the percentage of current replacements that do not include the installation of an AHRI-matched system.[150]

For early retirement (ER) projects, the cooling baseline is reduced to 10 SEER for systems installed before January 23, 2006. For systems installed on or after January 23, 2006, the ER baseline increases to 12.44 SEER.

For ROB projects, heating baseline efficiency values for heat pumps are compliant with the current federal minimum standard, effective January 1, 2015. These standards specify an HSPF of 8.2 for split systems, or 8.0 for packaged systems. This baseline reflects updates to federal standards that took effect on January 1, 2015, as defined in the Department of Energy (DOE) energy efficiency standards (10 CFR Part 430).[151] For ER projects where the existing system was installed on or after January 23, 2006, the heating baseline efficiency is assumed to be an HSPF of 7.7 based on the federal minimum standard in effect from January 23, 2006, through December 31, 2014.[152] For ER projects where the existing system was installed before January 23, 2006, the heating baseline efficiency is reduced to 6.8 HSPF based on the federal minimum standard in effect prior to January 23, 2006.

Replace-on-burnout or Early Retirement of an Electric Resistance Furnace

By the nature of the technology, all electric resistance furnaces have the same efficiency with HSPF = 3.41.[153] Projects in which an electric resistance furnace is replaced, either in replace-on-burnout or early retirement scenarios, use this baseline for heating-side savings.

For ROB projects, cooling savings are the same as for new construction and ROB of an air-source heat pump. For early retirement (ER) projects, the cooling baseline is reduced to 10 SEER for systems installed before January 23, 2006. For systems installed on or after January 23, 2006, the ER baseline increases to 12.44 SEER.

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149 DOE minimum efficiency standard for residential air conditioners/heat pumps. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=48&action=viewlive.

150 Frontier Associates on behalf of the Electric Utility Marketing Managers of Texas (EUMMOT). “Petition to revise Existing Commission-Approved Deemed Savings Values for Central Air Conditioning and Heat Pump Systems: Docket No. 36780.” Public Utility Commission of Texas. Approved August 27, 2009. http://interchange.puc.state.tx.us/WebApp/Interchange/application/dbapps/filings/pgSearch.asp. Adapted for new 14 SEER baseline.

151 *10 CFR Part 430.32(c)2. Energy Conservation Program: Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters; Final Rule*. Online. Available: https://www.govinfo.gov/content/pkg/CFR-2016-title10-vol3/xml/CFR-2016-title10-vol3-part430.xml

152 Ibid.

153 COP = HSPF × 1,055 J/BTU / 3,600 J/W-hr. For Electric Resistance, heating efficiency is 1 COP. Therefore, HSPF = 1 × 3,600 / 1,055 = 3.41.

Table 92: Central System Baseline Efficiencies

Project Type	Cooling Mode	Heating Mode
New construction	14 SEER	8.2 HSPF
Replace-on-burnout, heat pump	13.08 SEER	8.2 HSPF
Replace-on-burnout, electric resistance furnace		3.41 HSPF
Early retirement, heat pump (as of 1/23/2006)	12.44 SEER	7.7 HSPF
Early retirement, electric resistance furnace (as of 1/23/2006)		3.41 HSPF
Early retirement, heat pump (before 1/23/2006)	10 SEER	6.8 HSPF
Early retirement, electric resistance furnace (before 1/23/2006)		3.41 HSPF

High-efficiency Condition

Table 86 displays the Consortium for Energy Efficiency (CEE) requirements for eligible Tier 1 systems as of January 1, 2009. Energy efficiency service providers are expected to at least comply with the latest CEE Tier 1 requirements.

No full-load efficiency requirement is specified in the current federal standard. Therefore, systems with qualifying SEER and HSPF energy ratings are permitted to claim cooling energy savings, heating energy savings, and winter demand savings for systems where the EER does not comply with the below requirement.

Table 93: Central System CEE Tier 1 Requirements

SEER	EER	HSPF
14.5	12.0	8.5

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Replace-on-burnout or New Construction

Energy, summer demand, and winter demand savings were estimated using the air conditioner and heat pump performance curves developed by the National Renewable Energy Laboratory[154] for typical units in each of the following SEER ranges:

- Baseline units
- 14.5–14.9
- 15.0–15.9

[154] D. Cutler et al. Improved Modeling of Residential Air Conditioners and Heat Pumps for Energy Calculations. National Renewable Energy Laboratory. NREL/TP-5500-56354. January 2013. Tables 12 and 13. http://www.nrel.gov/docs/fy13osti/56354.pdf

- 16.0–16.9
- 17.0–17.9
- 18.0–20.9
- 21.0 and above

14.5–16.9 SEER units were assumed to be single stage. 17.0 and above SEER units were assumed to be multi-stage cooling units.

These performance curves provide the capacity and efficiency of the air conditioners and heat pumps operating in cooling mode across a wide range of outside air temperatures. Unit loading was estimated as a function of outside air temperature, and hours of cooling mode operation under different loadings were estimated using bin weather data for each weather zone. In heating mode, predicted HVAC operation was limited to meeting 77 percent of load, using a factor applied in Manual J to correlate design load hours to equivalent full load hours under actual operating conditions. This approach accounts for the observation that heating systems are not always operated even when outdoor conditions indicate they should.

Summer and winter demand savings were estimated according to the expected unit performance under design conditions. For all weather zones, it is assumed that typical HVAC systems are sized to 115 percent of their design cooling load (oversized by 15 percent). Heating mode capacity was related to rated cooling capacity using the rated capacity in the cooling and heating mode of the residential market heat pump products of four major manufacturers according to data exported from AHRI. Data was exported from the AHRI directory, and the average ratio for each equipment size of heating capacity to cooling capacity was multiplied by the rated (cooling side) capacity to estimate the heat pump capacity. Heat pump system output was then compared to its loading under design conditions.

The model uses the following set of normalized performance curves to scale the rated performance values as a function of outdoor dry-bulb temperature ranging from 65 to 115 degrees Fahrenheit. The total capacity and Energy Input Ratio (EIR = 1/COP) curves are a function of entering wet-bulb temperature (EWB) and outdoor dry-bulb temperature (ODB) and are both quadratic curve fits of the form:

$$y = a + b \times T_{EWB} + c \times T_{EWB}^2 + d \times T_{ODB} + e \times T_{ODB}^2 + f \times T_{EWB} \times T_{ODB}$$

Equation 46

Table 94: Air Conditioner and Heat Pump Capacity Curve Coefficients[155]

Coeff.	Cooling			Heating		
	Single Stage	Multi-stage/Speed		Single Stage	Multi-stage/Speed	
		Low	High		Low	High
a	3.670270705	3.940185508	3.109456535	0.566333415	0.335690634	0.306358843
b	-0.098652414	-0.104723455	-0.085520461	-0.000744164	0.002405123	0.005376987
c	0.000955906	0.001019298	0.000863238	-0.0000103	-0.0000464	-0.0000579
d	0.006552414	0.006471171	0.00863049	0.009414634	0.013498735	0.011645092
e	-0.0000156	-0.00000953	-0.000021	0.0000506	0.0000499	0.0000591
f	-0.000131877	-0.000161658	-0.000140186	-0.00000675	-0.00000725	-0.0000203

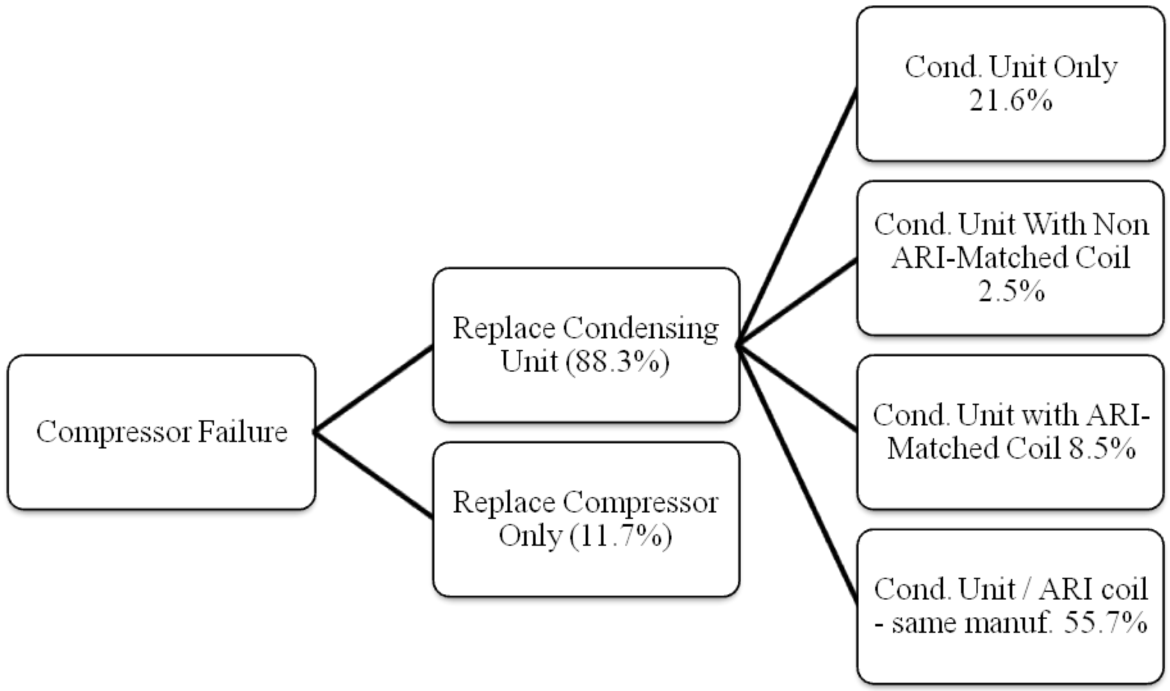
Table 95: Air Conditioner and Heat Pump EIR Curve Coefficients[156]

Coeff.	Cooling			Heating		
	Single Stage	Multi-stage/Speed		Single Stage	Multi-stage/Speed	
		Low	High		Low	High
a	-3.302695861	-3.87752688	-1.990708931	0.718398423	0.36338171	0.981100941
b	0.137871531	0.164566276	0.093969249	0.003498178	0.013523725	-0.005158493
c	-0.001056996	-0.001272755	-0.00073335	0.000142202	0.000258872	0.000243416
d	-0.012573945	-0.019956043	-0.009062553	-0.005724331	-0.009450269	-0.005274352
e	0.000214638	0.000256512	0.000165099	0.00014085	0.000439519	0.000230742
f	-0.000145054	-0.000133539	-0.0000997	-0.000215321	-0.000653723	-0.000336954

To estimate the baseline SEER value for retrofit installations, Texas A&M's Energy Systems Laboratory (ESL) surveyed dealers across the State to determine installation practices. The research found that in the event of a compressor failure out of warranty, dealers replaced the compressor 11.7 percent of the time, and replaced the condensing unit 88.3 percent of the time. Further, the condensing unit replacements consist of condensing unit-only replacements, replacements with mismatched evaporator coils, and replacements with matching evaporator coils. The percentages for these installations are as follows:

155 Using air conditioner capacity curve coefficients for heat pump cooling savings.
156 Using air conditioner capacity EIR coefficients for heat pump cooling savings.

Figure 4: Unit Replacement Percentages upon Compressor Failure



Source: Docket No. 36780

To calculate a weighted average SEER for these installations, ESL assumed that a compressor-only replacement resulted in no increase in SEER and that the SEER of a condensing unit installed without a matching coil would be 85 percent of the SEER value for a matched system. The ESL estimate of the baseline SEER for replacement AC units is given by the following equation:

$$\begin{aligned} SEER_{Base} = &\left(SEER_{Compressor\ Replacement}\right) \times (Actual\ \%\ Compressor\ Replacement) \\ &+ \left(SEER_{Condenser\ Replacement}\right) \times (Actual\ \%\ Condenser\ Replacement) \\ &+ \left(SEER_{System\ Replacement}\right) \times (Actual\ \%\ System\ Replacement) \end{aligned}$$

Equation 47

Substituting ESL SEER estimates and survey data provides the following baseline SEER estimate:

$$SEER_{Base} = (9.5) \times (11.7\%) + (11.05) \times (24.1\%) + (13.5) \times (64.2\%) = 12.44$$

Adjusting for the increased 14 SEER baseline:

$$SEER_{Base} = (10.5) \times (11.7\%) + (11.9) \times (24.1\%) + (14) \times (64.2\%) = 13.08$$

In new construction, there is no possibility of a partial system (e.g., condensing unit-only) change out, so the 13.08 baseline would not be appropriate. Therefore, the baseline for new construction installations is set at the federal government's minimum efficiency standard of 14 SEER.

Early Retirement

Annual energy (kWh) and summer peak demand (kW) savings must be calculated separately for two time periods:

1. The estimated remaining life of the equipment that is being removed, designated the remaining useful life (RUL), and
2. The remaining time in the EUL period (15—RUL)

Annual energy and summer peak demand savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

Where:

RUL = *Remaining Useful Life (see Table 96 or Table 97); if unknown, assume the age of the replaced unit is equal to the EUL, resulting in a default RUL of 7.0 (ACs) or 6.0 years (HPs). If individual system components were installed at separate times, use the condenser age as a proxy for the entire system. Default RUL may be used exclusively if applied consistently for all projects. Otherwise, the default should only be used when a project is reported and documented as having a nameplate that is illegible. For heat pumps replacing an air conditioner with an electric resistance furnace, use the RUL table from the Central Air conditioner measure instead.*

EUL = *Estimated Useful Life = 18 years (AC); 15 years (HP)*

Table 96: Remaining Useful Life of Replaced Air Conditioners

Age of Replaced Unit (Years)	Remaining Useful Life (Years)	Age of Replaced Unit (Years)	Remaining Useful Life (Years)
1	16.8	14	8.6
2	15.8	15	8.2
3	14.9	16	7.9
4	14.1	17	7.6
5	13.3	18	7.0
6	12.6	19	6.0
7	11.9	20	5.0
8	11.3	21	4.0
9	10.8	22	3.0
10	10.3	23	2.0
11	9.8	24	1.0

Age of Replaced Unit (Years)	Remaining Useful Life (Years)	Age of Replaced Unit (Years)	Remaining Useful Life (Years)
12	9.4	25[157,158]	0.0
13	9.0		

Table 97: Remaining Useful Life of Replaced Heat Pumps

Age of Replaced Unit (years)	Remaining Useful Life (years)	Age of Replaced Unit (years)	Remaining Useful Life (years)
1	13.7	12	7.9
2	12.7	13	7.6
3	12.0	14	7.0
4	11.3	15	6.0
5	10.7	16	5.0
6	10.2	17	4.0
7	9.7	18	3.0
8	9.3	19	2.0
9	8.9	20	1.0
10	8.5	21[159,160]	0.0
11	8.2		

Derivation of RULs

Central air conditioners have an estimated useful life of 18 years, and central heat pumps have an estimated useful life of 15 years. This estimate is consistent with the age at which approximately 50 percent of the central air conditioners and heat pumps installed in a given year will no longer be in service, as described by the survival function in Figure 5 and Figure 6.

157 RULs are capped at the 75th percentile of equipment age, 25 years, as determined based on DOE survival curves (see Figure 5). Systems older than 25 years should use the ROB baseline. See the January 2015 memo, “Considerations for early replacement of residential equipment,” for further detail.

158 Ward, B., Bodington, N., Farah, H., Reeves, S., and Lee, L. “Considerations for early replacement of residential equipment.” Prepared by the Evaluation, Measurement, and Verification (EM&V) team for the Electric Utility Marketing Managers of Texas (EUMMOT). January 2015. This document has been made available to Texas investor-owned utilities through the EM&V team’s SharePoint.

159 RULs are capped at the 75th percentile of equipment age, 21 years, as determined based on DOE survival curves (Figure 6). Systems older than 21 years should use the ROB baseline. See the January 2015 memo, “Considerations for early replacement of residential equipment,” for further detail.

160 Ward, B., Bodington, N., Farah, H., Reeves, S., and Lee, L. “Considerations for early replacement of residential equipment.” Prepared by the Evaluation, Measurement, and Verification (EM&V) team for the Electric Utility Marketing Managers of Texas (EUMMOT). January 2015. This document has been made available to Texas investor-owned utilities through the EM&V team’s SharePoint.

Figure 5: Survival Function for Central Air Conditioners[161]

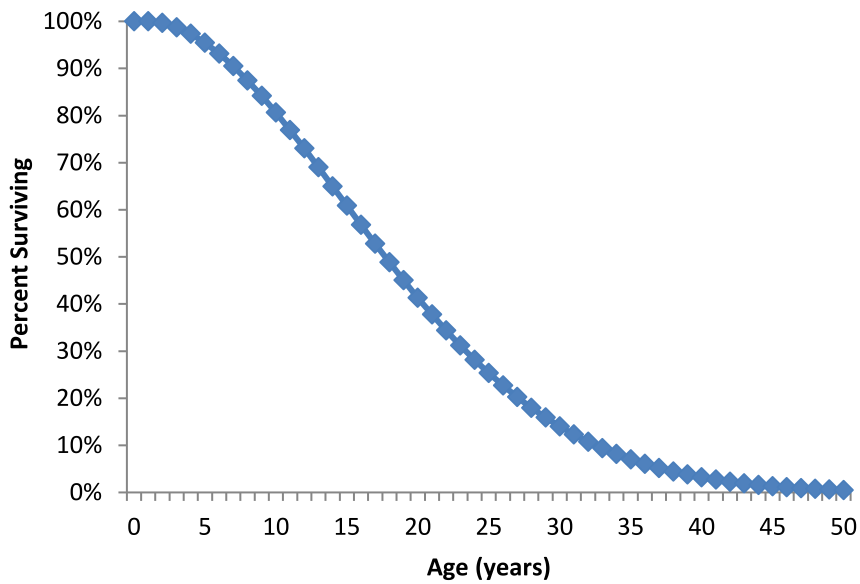
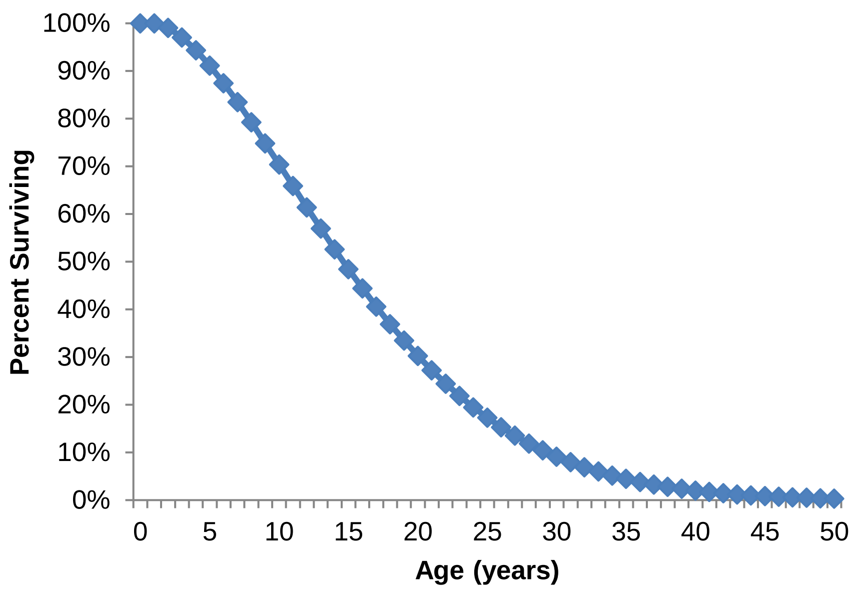


Figure 6: Survival Function for Central Heat Pumps[162]



The method for estimating the remaining useful life (RUL) of a replaced system uses the age of the existing system to re-estimate the projected unit lifetime based on the survival function

[161] Department of Energy, Federal Register, 76 FR 37408, Technical Support Document: 8.2.3.5 Lifetime. June 2011. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0011-0012.

[162] Department of Energy, Federal Register, 76 FR 37408, Technical Support Document: 8.2.3.5 Lifetime. June 2011. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0011-0012.

shown in Figure 5 and Figure 6. The age of the central system being replaced is found on the horizontal axis, and the corresponding percentage of surviving systems is determined from the chart. The surviving percentage value is then divided in half, creating a new estimated useful lifetime applicable to the current unit age. The age (year) that corresponds to this new percentage is read from the chart. RUL is estimated as the difference between that age and the current age of the system being replaced.

Deemed Energy Savings Tables[163]

Due to the high volume of tables associated with this measure, deemed savings tables are provided in an appendix at the end of this volume.[164]

Deemed Summer Demand Savings Tables[165]

Due to the high volume of tables associated with this measure, deemed savings tables are provided in an appendix at the end of this volume.[166]

Deemed Winter Demand Savings Tables[167]

Due to the high volume of tables associated with this measure, deemed savings tables are provided in an appendix at the end of this volume.[168]

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 18 years for a central air conditioner and 15 years for a central heat pump unit based on the current DOE Final Rule standards for central air

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163 Rated capacity ranges are specified based on normal rounding convention between capacity categories (values at and above the midpoint round up, while values below the midpoint round down).

164 Savings tables are also provided in Excel format at the Texas Efficiency website. http://texasefficiency.com/index.php/regulatory-filings/deemed-savings.

165 Rated capacity ranges are specified based on normal rounding convention between capacity categories (values at and above the midpoint round up, while values below the midpoint round down).

166 Savings tables are also provided in Excel format at the Texas Efficiency website. http://texasefficiency.com/index.php/regulatory-filings/deemed-savings.

167 Rated capacity ranges are specified with a 5 percent tolerance in accordance with AHRI Standard 210/240 to account for systems that are rated slightly below the applicable nominal capacity. AHRI Standard 210/240. Table J1. http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_210-240_2017.pdf.

168 Savings tables are also provided in Excel format at the Texas Efficiency website. http://texasefficiency.com/index.php/regulatory-filings/deemed-savings.

conditioners and heat pumps.[169]

This value is consistent with the EUL reported in the Department of Energy 76 Final Rule 37408 Technical Support Document for Energy Conservation Standards for Air Conditioners and Heat Pumps.[170]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Decision/action type (early retirement, replace-on-burnout, new construction)
- Cooling capacity of the installed unit (tons)
- Seasonal Energy Efficiency Ratio (SEER) and Energy Efficiency Ratio (EER) of the installed unit
- Heating Seasonal Performance Factor (HSPF) of the installed unit (HPs only)
- Type of unit replaced (air conditioner with gas furnace; air conditioner with electric resistance furnace, air source heat pump)
- Type of unit installed (mini-split air conditioner, mini-split heat pump, DC inverter air conditioner, DC inverter heat pump)
- Age of the replaced unit (early retirement only)
- Retired unit model number, serial number, manufacturer, and cooling capacity (early retirement or rightsizing)
- Photograph of retired unit nameplate (early retirement or rightsizing)
    - If a photograph of the retired unit nameplate is unavailable or not legible, provide a photo and/or description documenting the reason why the nameplate photo was unobtainable (early retirement only)
    - If a photograph of the retired unit nameplate is unavailable or not legible, provide estimated square footage of conditioned area served by the retired unit (rightsizing only)
- Photograph demonstrating functionality of existing equipment and/or customer responses to survey questionnaire documenting the condition of the replaced unit and their motivation for measure replacement for early retirement eligibility determination (early retirement only)
- If replacing an evaporative cooler, application should include a statement that the customer decision to change equipment types predates or is independent of the

[169] Final Rule: Standards, Federal Register, 76 FR 37408 (June 27, 2011) and associated Technical Support Document. Accessed 10/21/2014. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0011-0012.

[170] Department of Energy, Federal Register, 76 FR 37408, Technical Support Document: 8.2.3.5 Lifetime. June 2011.

decision to install efficient equipment

- When claiming savings for duct removal in combination with the installation of a ductless mini-split:
    - Pre-improvement duct leakage at 25 Pa (cu. ft./min)
    - Pre and post photos demonstrating removal of existing ductwork

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- ASHRAE 90.1-1999 (Residential Buildings)
- ACCA Manual J Residential Load Calculation (8th Edition).[171]

Document Revision History

Table 98: Residential Large Capacity AC/HPs Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

[171] https://www.acca.org/store/product.php?pid=172.

2.2.6 Large Capacity Split System and Single-package Air Conditioners and Heat Pumps Measure Overview

TRM Measure ID: R-HV-LC

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex, multifamily, manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure applies to the installation of a split/packaged air conditioner (AC) or heat pump (HP) with a capacity exceeding that of a typical residential system (greater than or equal to 65,000 Btu/hr) in a retrofit or new construction application. This measure also applies to the installation of ground-source heat pumps (GSHP) with a capacity exceeding 65,000 Btu/hr.

Eligibility Criteria

- The deemed savings apply to central AC/HPs with a capacity of 65,000-240,000 Btu/hr (5.4-20 tons) and GSHPs with a capacity of 65,000-135,000 Btu/hr (5.4-11.3 tons).
- Equipment shall be properly sized to dwelling based on ASHRAE or ACCA Manual J standards.
- Manufacturer datasheets on installed equipment or AHRI reference numbers must be provided.

Baseline Condition

New construction and replace-on-burnout baseline efficiency levels are provided in Table 99 and Table 100. These baseline efficiency levels reflect the latest minimum efficiency requirements from the current federal manufacturing standard, IECC 2015, and ASHRAE 90.1-2013.

Table 99: Large Capacity AC/HPs – Baseline Efficiency Levels for NC and ROB for AC/HP[172]

System Type	Capacity [Tons]	Heating Section Type	Baseline Efficiencies	Source[173]
Air conditioners	> 5.4 to < 11.3	None or Electric Resistance	11.2 EER 12.8 IEER	DOE Standards/ IECC 2015
		All Other	11.0 EER 12.6 IEER	
	≥ 11.3 to ≤ 20	None or Electric Resistance	11.0 EER 12.4 IEER	
		All Other	10.8 EER 12.2 IEER	
		All Other	9.8 EER 11.4 IEER	
		All Other	9.5 EER 11.0 IEER	
Heat Pump (cooling)[174]	5.4 to < 11.3	Heat Pump	11.0 EER 12.0 IEER	DOE Standards/ IECC 2015
	≥ 11.3 to ≤ 20		10.6 EER 11.6 IEER	
Heat Pump (heating)[175]	5.4 to < 11.3	Heat Pump	3.3 COP	DOE Standards/ IECC 2015
	≥ 11.3 to ≤ 20		3.2 COP	

[172] IECC 2015 Table C403.2.3(1) and C403.2.3(2).

[173] These baseline efficiency standards noted as "DOE Standards" are cited in the Code of Federal Regulations, 10 CFR 431.97. http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec431-97.pdf.

[174] ASHRAE 90.1-2010 Table 6.8.1B. These systems larger than 5.4 tons, the minimum efficiency levels provided in this table are based on systems with heating type "No Heating or Electric Resistance Heating", excluding systems with "All Other Types of Heating".

[175] Heat pump retrofits must also exceed the baseline efficiency levels for heating efficiencies.

Table 100: Large Capacity AC/HPs – Baseline Efficiency Levels for NC and ROB for GSHPs[176]

System Type	Capacity (Btuh)	Cooling EWT Rating Condition	Minimum Cooling EER	Heating EWT Rating Condition	Minimum Heating COP
Water to air (water loop)	≥ 65,000 and < 135,000	86°F	13.0	68°F	4.3
Water to air (groundwater)		59°F	18.0	50°F	3.7
Brine to air (ground loop)		77°F	14.1	32°F	3.2
Water to water (water loop)		86°F	10.6	68°F	3.7
Water to water (groundwater)		59°F	16.3	50°F	3.1
Brine to water (ground loop)		77°F	12.1	32°F	2.5

High-efficiency Condition

Package and split-systems must exceed the minimum efficiencies specified in Table 99 and Table 100.

For reference, both ENERGY STAR® and the Consortium for Energy Efficiency (CEE) offer suggested guidelines for high-efficiency equipment.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

$$Energy\ Savings\ [kWh_{savings}] = kWh_{Savings,C} + kWh_{Savings,H}$$

Equation 48

$$Energy\ (Cooling)\ [kWh_{Savings,C}] = Cap_C \times \left(\frac{1}{\eta_{baseline,C}} - \frac{1}{\eta_{installed,C}}\right) \times EFLH_C \times \frac{1\ kW}{1{,}000\ W}$$

Equation 49

$$Energy\ (Heating)\ [kWh_{Savings,H}] = Cap_H \times \left(\frac{1}{\eta_{baseline,H}} - \frac{1}{\eta_{installed,H}}\right) \times EFLH_H \times \frac{1\ kWh}{3{,}412\ Btu}$$

Equation 50

[176] Values from ASHRAE 90.1-2013.

$$Peak\ Demand\ [kW_{Savings,C}] = Cap_C \times \left(\frac{1}{\eta_{baseline,C}} - \frac{1}{\eta_{installed,C}}\right) \times CF_C \times \frac{1\ kW}{1{,}000\ W}$$

Equation 51

$$Peak\ Demand\ [kW_{Savings,H}] = Cap_H \times \left(\frac{1}{\eta_{baseline,H}} - \frac{1}{\eta_{installed,H}}\right) \times CF_H \times \frac{1\ kW}{3{,}412\ Btuh}$$

Equation 52

Where:

$Cap_{C/H}$ = Rated equipment cooling/heating capacity of the installed equipment at AHRI standard conditions (Btu/hr); 1 ton = 12,000 Btu/hr

$\eta_{baseline,C}$ = Cooling efficiency of standard equipment (Btuh/W)

$\eta_{installed,C}$ = Rated cooling efficiency of the newly installed equipment (Btuh/W)

$\eta_{baseline,H}$ = Heating efficiency of standard equipment (Btuh/W or COP)

$\eta_{installed,H}$ = Rated heating efficiency of the newly installed equipment (Btuh/W or COP)

Note: Use EER for cooling kW and COP for heating kW and kWh savings calculations. SEER/IEER should be used to calculate cooling kWh for central ACs and HPs. EER should be used to calculate cooling kWh for GSHPs. Heating efficiencies expressed as HSPF will be approximated as a seasonal COP and should be converted using the following equation:

$$COP = \frac{HSPF}{3.412}$$

Equation 53

$CF_{C/H}$ = Seasonal peak coincidence factor (Table 101)

$EFLH_{C/H}$ = Cooling/heating equivalent full-load hours (Table 102)

Table 101: Large Capacity AC/HPs – Coincidence Factors by Climate Zone[177]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.634	0.677	0.626	0.583	0.725
Winter	0.549	0.478	0.515	0.453	0.437

[177] See Volume 1, Appendix B.

Table 102: Large Capacity AC/HPs – Equivalent Full Load Cooling/Heating Hours[178]

Climate Zone	$EFLH_C$	$EFLH_H$
Climate Zone 1: Panhandle	1,142	1,880
Climate Zone 2: North	1,926	1,343
Climate Zone 3: South	2,209	1,127
Climate Zone 4: Valley	2,958	776
Climate Zone 5: West	1,524	1,559

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 18 years for a large-capacity air conditioner and 15 years for a large capacity heat pump based on the current DOE Final Rule standards for central heat

[178] ENERGY STAR® Central AC/HP Savings Calculator. http://www.energystar.gov/certified-products/detail/heat_pumps_air_source.

pumps.[179] The EUL of a high-efficiency ground source heat pump unit is 20 years, consistent with the EUL reported in the DOE GSHP guide.[180]

These values are consistent with the EULs reported in the Department of Energy 76 Final Rule 37408 Technical Support Document for Energy Conservation Standards for Air conditioners and Heat Pumps.[181]

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone
- Decision/action type (new construction, retrofit)
- Cooling and heating capacity (Btu/hr)
- Full-load efficiency rating (EER) of the installed unit
- Part-load efficiency rating (SEER/IEER) of the installed unit (if applicable)
- Coefficient of Performance (COP) of the unit installed (heat pumps and GSHPs only)
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or other pre-approved method of installation verification
- Manufacturer, model, capacity, and serial number
- AHRI certificate exactly matching manufacturer and model number

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- ACCA Manual J Residential Load Calculation (8th Edition)[182]

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179 Final Rule: Standards, Federal Register, 76 FR 37408 (June 27, 2011) and associated Technical Support Document. Accessed 10/21/2014. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-STD-0011-0012.

180 Department of Energy. "Guide to Geothermal Heat Pumps. February 2011. http://www.energy.gov/sites/prod/files/guide_to_geothermal_heat_pumps.pdf.

181 Department of Energy, Federal Register, 76 FR 37408, Technical Support Document: 8.2.3.5 Lifetime. June 2011.

182 https://www.acca.org/store/product.php?pid=172.

- 2015 International Energy Conservation Code. Table C403.2.3(1) and Table C403.2.3(2).
- Code of Federal Regulations. Title 10. Part 431—Energy Efficiency Program for Certain Commercial and Industrial Equipment. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/77.

Document Revision History

Table 103: Residential Large Capacity AC/HPs Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Measure removed from TRM.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. No revision.
v3.1	11/05/2015	TRM v3.1 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. Consolidated AC and HP measures and reintroduced to TRM. Extended measure applicability to GSHPs. Updated from deemed savings to algorithm approach.
v7.0	10/2019	TRM v7.0 update. Updated documentation requirements.

2.2.7 Packaged Terminal Heat Pumps Measure Overview

TRM Measure ID: R-HV-PT

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Multifamily

Fuels Affected: Electricity

Decision/Action Type: Replace-on-burnout, early retirement

Program Delivery Type: Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This section presents the deemed savings methodology for the installation of packaged terminal heat pumps (PTHP) replacing packaged terminal air conditioners (PTAC) with electric resistance heat. This document covers assumptions made for baseline equipment efficiencies for early retirement (ER) of PTAC/PTHPs and replace-on-burnout (ROB), based current and previous on efficiency standards. For ER, the actual age of the baseline system should be determined from the equipment nameplate or other physical documentation whenever possible. Default values are provided for when the actual age of the unit is unobtainable.

Applicable efficient measure types are restricted to packaged terminal heat pumps. Both standard and non-standard size equipment types are covered. *Standard size* refers to equipment with wall sleeve dimensions having an external wall opening greater than, equal to 16 inches high or greater than, or equal to 42 inches wide and a cross-sectional area greater than 670 in^2. *Non-standard size* refers to equipment with existing wall sleeve dimensions having an external wall opening of fewer than 16 inches high or fewer than 42 inches wide and a cross-sectional area less than 670 in^2.

Eligibility Criteria

Existing PTAC and installed PTHP must be the primary cooling source in the residence. Installed PTHPs must be compliant with the current commercial code.

ER projects must involve the replacement of a working system before natural burnout. Additionally, the ER approach cannot be used for projects involving a simultaneous renovation where a major structural change or internal space remodel has occurred. A ROB approach should be used for these scenarios.

Baseline Condition

Early Retirement for PTHP Systems

Two baseline condition efficiency values are required for an ER scenario, one for the ER (RUL) period and one for the ROB (EUL-RUL) period. For the ROB period, the baseline efficiency is the same as for a ROB scenario. For the ER period, the baseline efficiency should be estimated according to the capacity, system type (PTAC), and age (based on year of manufacture) of the replaced system.[183] When the system age can be determined (from a nameplate, building prints, equipment inventory list, etc.), the baseline efficiency levels provided in Table 104, reflecting ASHRAE Standard 90.1-2001 through 90.1-2007, should be used. PTHPs replacing PTACs with built-in electric resistance heat should use a baseline heating efficiency of 1.0 COP.

When the system age is unknown, assume 15 years.[184] Default RUL may be used exclusively if applied consistently for all projects. Otherwise, the default should only be used when a project is reported and documented as having a nameplate that is illegible.

Table 104: ER Baseline Efficiency Levels for Standard Size PTACs[185]

Equipment	Cooling Capacity [Btuh]	Baseline Cooling Efficiency [EER]	Baseline Heating Efficiency [COP] (No Built-in Resistance Heat)	Baseline Heating Efficiency [COP] (With Built-in Resistance Heat)
PTAC	< 7,000	11.0	--	1.0
	7,000-15,000	$12.5 - (0.213 \times \mathrm{Cap}/1000)$		
	> 15,000	9.3		

Replace-on-burnout

Table 105 provides minimum efficiency standards for PTAC/PTHP units and reflects the federal standards for packaged terminal air-conditioners and heat pumps effective February 2013 and reflected in 10 CFR 431.

183 The actual age should be determined from the nameplate, building prints, equipment inventory list, etc. and whenever possible the actual source used should be identified in the project documentation.

184 As noted in Docket 40885, page 14-15: Failure probability weights are established by assuming that systems for which age information will be unavailable are likely to be older, setting a minimum age threshold, and using the survival functions for the relevant system type to estimate the likelihood that an operational system is of a given age beyond that threshold. Baseline efficiency for each year of system age is established relative to program year. Baseline efficiency levels can be estimated for the next ten program years, considering increments in efficiency standards that took place in the historical period.

185 ER only applies to standard size units because the minimum efficiency requirements for non-standard systems have never changed, making the ER baseline efficiency the same as for ROB.

Table 105: ROB Minimum Efficiency Levels for PTHPs[186,187]

Equipment	Category	Cooling Capacity [Btuh]	Minimum Cooling Efficiency [EER]	Minimum Heating Efficiency [COP]
PTHP	Standard Size	< 7,000	11.9	3.3
		7,000-15,000	$14.0 - (0.300 \times \text{Cap}/1000)$	$3.7 - (0.052 \times \text{Cap}/1000)$
		>15,000	*9.5*	*2.9*
	Non-Standard Size	<7,000	*9.3*	*2.7*
		7,000-15,000	$10.8 - (0.213 \times \text{Cap}/1000)$	$2.9 - (0.026 \times \text{Cap}/1000)$
		>15,000	*7.6*	*2.5*

High-efficiency Condition

The high-efficiency retrofits must exceed the minimum federal standards found in Table 105.

The high-efficiency retrofits must also meet the following criteria:[188]

- For ER projects only, the installed equipment cooling capacity must be within 80 percent to 120 percent of the replaced electric cooling capacity
- No additional measures are being installed that directly affect the operation of the cooling equipment (i.e., control sequences)

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

$$Peak\ Demand\ [kW_{Savings}] = \left(\frac{Cap_{C,pre}}{\eta_{baseline,C}} - \frac{Cap_{C,post}}{\eta_{installed,C}}\right) \times CF \times \frac{1\ kW}{1{,}000\ W}$$

Equation 54

$$Total\ Energy\ [kWh_{Savings}] = kWh_{Savings,C} + kWh_{Savings,H}$$

Equation 55

$$Energy\ (Cooling)\ [kWh_{Savings,C}] = \left(\frac{Cap_{C,pre}}{\eta_{baseline,C}} - \frac{Cap_{C,post}}{\eta_{installed,C}}\right) \times EFLH_C \times \frac{1\ kW}{1{,}000\ W}$$

Equation 56

186 IECC 2015 Table C403.2.3(3).

187 Cap refers to the rated cooling capacity in Btuh. If the capacity is less than 7,000 Btuh, use 7,000 Btuh in the calculation. If the capacity is greater than 15,000 Btuh, use 15,000 Btuh in the calculation.

188 Modified from PUCT Docket #41070 for TRMv3 to limit replacement of only smaller-sized units and extend early retirement to cover PTAC/PTHP.

$$Energy\ (Heating)\ [kWh_{Savings,H}] = \left(\frac{Cap_{H,pre}}{\eta_{baseline,H}} - \frac{Cap_{H,post}}{\eta_{installed,H}}\right) \times EFLH_H \times \frac{1\ kWh}{3{,}412\ Btu}$$

Equation 57

Where:

$Cap_{C/H,pre}$ = *Rated equipment cooling/heating*[189] *capacity of the existing equipment at AHRI standard conditions [BTUH]; 1 ton = 12,000 Btuh*

$Cap_{C/H,post}$ = *Rated equipment cooling/heating capacity of the newly installed equipment at AHRI standard conditions [Btuh]; 1 ton = 12,000 Btuh*

$\eta_{baseline,C}$ = *Cooling efficiency of existing (ER) or standard (ROB/NC) equipment [EER, Btu/W-h] (Table 104 through Table 105)*

$\eta_{baseline,H}$ = *Heating efficiency of existing (ER) or standard (ROB/NC) equipment [COP] (Table 104 through Table 105)*

$\eta_{installed,C}$ = *Rated cooling efficiency of the newly installed equipment [EER, Btu/W-h] (Must exceed minimum requirements from Table 105)*[190]

$\eta_{installed,H}$ = *Rated heating efficiency of the newly installed equipment [COP] (Must exceed minimum requirements from Table 105)*[191]

CF = *Seasonal peak coincidence factor for appropriate climate zone, building type, and equipment type (Table 106)*

$EFLH_{C/H}$ = *Cooling/heating equivalent full-load hours for newly installed equipment based on appropriate climate zone, building type, and equipment type [hours] (Table 107)*

Table 106: PTHP Coincidence Factors[192]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.634	0.677	0.626	0.583	0.725
Winter	0.549	0.478	0.515	0.453	0.437

[189] Baseline cooling capacity refers to the rated cooling capacity of the existing PTAC. Assume baseline heating capacity is equal to rated heating capacity for newly installed PTHP.

[190] Rated efficiency is commonly reported at both 230V and 208V. Savings calculations should reference efficiency at 230V, as AHRI rating conditions specify that voltage.

[191] Ibid.

[192] See Volume 1, Appendix B.

Table 107: PTHP Cooling/Heating EFLHs[193]

Climate Zone	$EFLH_C$	$EFLH_H$
Climate Zone 1: Panhandle	1,142	1,880
Climate Zone 2: North	1,926	1,343
Climate Zone 3: South	2,209	1,127
Climate Zone 4: Valley	2,958	776
Climate Zone 5: West	1,524	1,559

The first-year savings algorithms in the above equations are used for all HVAC projects, across ROB and ER projects. However, ER projects require weighted savings calculated over both the ER and ROB periods taking the EUL and RUL into account. The ER savings are applied over the remaining useful life (RUL) period, and the ROB savings are applied over the remaining period (EUL-RUL). The final reported savings for ER projects are not actually a "first-year" savings, but an "average annual savings over the lifetime (EUL) of the measure." These savings calculations are explained in Volume 3, Appendix A.

Claimed Peak Demand Savings

A summer peak period value is used for this measure. Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Deemed Energy and Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Measure Life and Lifetime Savings

Effective Useful Life (EUL)

The EUL of PTHP units is 15 years, as specified in DEER 2014.

Remaining Useful Life (RUL) forPTHP Systems

Annual energy (kWh) and summer peak demand (kW) savings must be calculated separately for two time periods:

1. The estimated remaining life of the equipment that is being removed, designated the remaining useful life (RUL), and
2. The remaining time in the EUL period (EUL – RUL)

[193] ENERGY STAR® Central AC/HP Savings Calculator. http://www.energystar.gov/certified-products/detail/heat_pumps_air_source.

Annual energy (kWh) savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

Where:

RUL	=	*Remaining Useful Life (see Table 108); if unknown, assume the age of the replaced unit is equal to the EUL resulting in a default RUL of 2.8 years*
EUL	=	*Estimated Useful Life = 15 years*

Default RUL may be used exclusively if applied consistently for all projects. Otherwise, the default should only be used when a project is reported and documented as having a nameplate that is illegible.

Table 108: Remaining Useful Life of ER PTAC Systems[194]

Age of Replaced System (Years)	PTAC RUL (Years)		Age of Replaced System (Years)	PTAC RUL (Years)
1	14.0		10	5.7
2	13.0		11	5.0
3	12.0		12	4.4
4	11.0		13	3.8
5	10.0		14	3.3
6	9.1		15	2.8
7	8.2		16	2.0
8	7.3		17	1.0
9	6.5		18[195]	0.0

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data is recommended to be specified and tracked by the program database to inform the evaluation and apply the savings properly.

- Decision/Action Type: ROB or ER
- Climate zone

[194] PUCT Docket No. 40083, Attachment A describes the process in which the RUL of replaced systems has been calculated.

[195] RULs are capped at the 75th percentile of equipment age, 18 years, as determined based on DOE survival curves. Systems older than 18 years should use the ROB baseline. See the January 2015 memo, “Considerations for early replacement of residential equipment,” for further detail.

- Equipment configuration category: standard/non-standard
- Baseline equipment rated cooling capacities
- Baseline number of units
- Baseline cooling and heating efficiency rating
- Baseline make and model
- Installed equipment rated cooling and heating capacities
- Installed number of units
- Installed cooling and heating efficiency rating
- Installed make and model
- Baseline age and method of determination (e.g., nameplate, blueprints, customer reported, not available) (early retirement only)
- A representative sample of photographs of retired unit nameplate demonstrating model number, serial number, and manufacturer if blueprints are not provided (early retirement only)
    - If a photograph of the nameplate is unavailable or not legible, provide documentation demonstrating reason why the nameplate photo was unobtainable, including but not limited to a photo or description documenting the reason why the nameplate photo was unobtainable (alternate forms of documentation can be approved at the evaluator's discretion)
- Documentation demonstrating the functionality of existing equipment, including but not limited to photograph demonstrating the functionality of existing equipment or customer responses to survey questionnaire documenting the condition of the replaced unit and their motivation for measure replacement for early retirement eligibility determination (early retirement only)

References and Efficiency Standards

Petitions and Rulings

- PUCT Docket 36779—Provides EUL for HVAC equipment.
- PUCT Docket 40083—Provides incorporation of early retirement savings for existing commercial HVAC SOP designs and updates for baseline equipment efficiency levels for ROB and new construction projects involving package and split systems.
- PUCT Docket 40885—Provides a petition to revise deemed savings values for commercial HVAC replacement measures. This petition updated demand and energy coefficients for all commercial HVAC systems.

Relevant Standards and Reference Sources

- ANSI/ASHRAE/IES Standard 90.1-2001 through ASHRAE 90.1-2007. Energy Standard for Buildings Except Low-Rise Residential Buildings. Table 6.8.1D.
- ANSI/ASHRAE/IES Standard 90.1-2010. Energy Standard for Buildings Except Low-Rise Residential Buildings. Table 6.8.1D.
- Code of Federal Regulations. Title 10. Part 431—Energy Efficiency Program for Certain Commercial and Industrial Equipment. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=46&action=viewcurrent
- 2015 International Energy Conservation Code. Table C403.2.3(3).

Document Revision History

Table 109: Residential Packaged Terminal Heat Pumps Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

2.2.8 Room Air Conditioners Measure Overview

TRM Measure ID: R-HV-RA

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction, early retirement

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

The following deemed savings values are applicable in calculating an incentive for the installation of a high-efficiency room air conditioner in a newly-constructed home or a room air conditioner replaced with a higher efficiency room air conditioner in a dwelling occupied by a residential energy consumer.

Eligibility Criteria

Installed room air conditioners must be compliant with the current ENERGY STAR® specification for room air conditioners.

In order to be awarded early retirement savings, the unit to be replaced must be functioning at the time of removal with a maximum age of 12 years.

Baseline Condition

For new construction and replace-on-burnout, the baseline is assumed to be a new room air conditioning unit with a CEER rating that is compliant with the current federal standard,[196] effective June 1, 2014. The new standard is stated in terms of the Combined Energy Efficiency Ratio (CEER), which accounts for standby/off-mode energy usage. The new standard is stated in terms of the Combined Energy Efficiency Ratio (CEER), which accounts for standby/off-mode energy usage.

[196] DOE minimum efficiency standard for residential room air conditioners. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/41.

For early retirement, the baseline efficiency is assumed to match the minimum federal standard efficiencies in place prior to June 1, 2014.

Table 110: Room Air Conditioner Baseline Efficiencies for ER, ROB, and NC

Reverse Cycle (Yes/No)	Louvered Sides (Yes/No)	Capacity (Btu/hr)	Federal Standard prior to June 1, 2014	Federal Standard as of June 1, 2014
			ER Baseline EER	ROB/NC Baseline CEER
No	Yes	< 8,000	9.7	11.0
		≥ 8,000 and < 14,000	9.8	10.9
		≥ 14,000 and < 20,000	9.7	10.7
		≥ 20,000 and < 25,000	8.5	9.4
		≥ 25,000	8.5	9.0
No	No	< 8,000	9.0	10.0
		≥ 8,000 and < 11,000	8.5	9.6
		≥ 11,000 and < 14,000	8.5	9.5
		≥ 14,000 and < 20,000	8.5	9.3
		≥ 20,000	8.5	9.4
Yes	Yes	< 20,000	9.0	9.8
		≥ 20,000	8.5	9.3
Yes	No	< 14,000	8.5	9.3
		≥ 14,000	8.0	8.7
Casement-only		All capacities	All capacities	9.5
Casement-slider		All capacities	All capacities	10.4

High-efficiency Condition

ENERGY STAR® specifications effective October 30, 2015, are provided in Table 111 as the efficient condition.[197] Energy efficiency service providers are expected to comply with the latest ENERGY STAR® requirements.

[197] ENERGY STAR® Program Requirements Product Specification for Room Air Conditioners: Eligibility Criteria Version 4.0. http://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Final%20Version%204.0%20Room%20Air%20Conditioners%20Specification.pdf. February 20, 2015.

Table 111: Room Air Conditioner Efficient Condition Specifications

Reverse Cycle (Yes/No)	Louvered Sides (Yes/No)	Capacity (Btu/hr)	Minimum CEER as of October 30, 2015
No	Yes	< 8,000	12.1
		≥ 8,000 and < 14,000	12.0
		≥ 14,000 and < 20,000	11.8
		≥ 20,000 and < 25,000	10.3
		≥ 25,000	9.9
No	No	< 8,000	11.0
		≥ 8,000 and < 11,000	10.6
		≥ 11,000 and < 14,000	10.5
		≥ 14,000 and < 20,000	10.2
		≥ 20,000	10.3
Yes	Yes	< 20,000	10.8
		≥ 20,000	10.2
Yes	No	< 14,000	10.2
		≥ 14,000	9.6
Casement-only		All capacities	10.5
Casement-slider		All capacities	11.4

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Peak demand and annual energy savings for room air conditioners should be calculated as shown next.

New Construction or Replace-on-burnout

Energy Savings Algorithms

$$kWh_{Savings,C} = CAP \times \frac{1\ kW}{1{,}000\ W} \times AOH_C \times \left(\frac{1}{CEER_{Base}} - \frac{1}{CEER_{RAC}}\right)$$

Equation 58

Where:

CAP	=	*Rated equipment cooling capacity of the installed room air conditioner (Btu/hr)*
AOH_C	=	*Annual operating hours for cooling (Table 112)*
$CEER_{Base}$	=	*Combined Energy Efficiency Ratio of the baseline cooling equipment (Table 110)*
$CEER_{RAC}$	=	*Combined Energy Efficiency Ratio of the installed room air conditioner*

Table 112: Room Air Conditioner Annual Operating Hours for Cooling[198]

Climate Zone	AOH_C
Climate Zone 1: Panhandle	820
Climate Zone 2: North	1,374
Climate Zone 3: South	1,308
Climate Zone 4: Valley	2,150
Climate Zone 5: West	1,204

Demand Savings Algorithms

$$kW_{Savings} = CAP \times \frac{1\ kW}{1{,}000\ W} \times \left(\frac{1}{CEER_{Base}} - \frac{1}{CEER_{RAC}}\right) \times CF$$

Equation 59

Where:

CAP	=	*Rated equipment cooling capacity of the installed room air conditioner (Btu/hr)*
$CEER_{Base}$	=	*Combined Energy Efficiency Ratio of the baseline cooling equipment (Table 110)*

[198] Association of Home Appliance Manufacturers (AHAM) Room Air Conditioner Cooling Calculator. http://www.cooloff.org/sub_cool.html.

$CEER_{RAC}$ = *Combined Energy Efficiency Ratio of the installed room air conditioner*

CF = *Coincidence Factor = (*Table 113*)*

Table 113: Room Air Conditioners—Coincidence Factors[199]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.977	0.937	0.904	0.833	0.920

Early Retirement

Annual energy (kWh) and summer peak demand (kW) savings must be calculated separately for two time periods:

1. The estimated remaining life of the equipment that is being removed, designated the remaining useful life (RUL), and
2. The remaining time in the EUL period. (8—RUL)

Annual energy (kWh) savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

Where:

RUL = *Remaining Useful Life (see Table 114); if unknown, assume the age of the replaced unit is equal to the EUL resulting in a default RUL of 5.0 years*

EUL = *Estimated Useful Life = 8 years*

[199] See Volume 1, Appendix B.

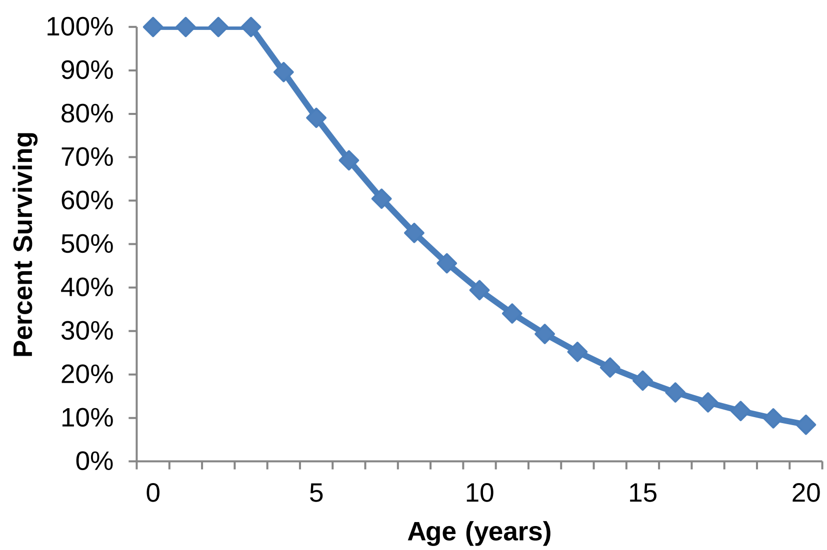
Table 114: Remaining Useful Life (RUL) of Replaced Room Air Conditioner

Age of Replaced Unit (years)	RUL (years)	Age of Replaced Unit (years)	RUL (years)
1	8.0	8	5.0
2	7.2	9	4.0
3	6.2	10	3.0
4	5.2	11	2.0
5	5.2	12	1.0
6	5.2	13[200,201]	0.0
7	5.2		

Derivation of RULs

Room air conditioners have an estimated useful life of 8 years. This estimate is consistent with the age at which approximately 50 percent of the room air conditioners installed in a given year will no longer be in service, as described by the survival function in Figure 7.

Figure 7: Survival Function for Room Air Conditioners[202]



200 RULs are capped at the 75th percentile of equipment age, 13 years, based on DOE survival curves. Systems older than 13 years should use the ROB baseline. See the January 2015 memo, "Considerations for early replacement of residential equipment," for further detail.

201 Ward, B., Bodington, N., Farah, H., Reeves, S., and Lee, L. "Considerations for early replacement of residential equipment." Prepared by the Evaluation, Measurement, and Verification (EM&V) team for the Electric Utility Marketing Managers of Texas (EUMMOT). January 2015. This document has been made available to all Texas investor-owned utilities through the EM&V team's SharePoint.

202 Department of Energy, Federal Register, 76 FR 22454, Technical Support Document: 8.2.2.6 Product Lifetime. April 2011.

The method for estimating the remaining useful life (RUL) of a replaced system uses the age of the existing system to re-estimate the survival function.

Figure 7. The age of the room air conditioner being replaced is found on the horizontal axis, and the corresponding percentage of surviving room air conditioners is determined from the chart. The surviving percentage value is then divided in half, creating a new percentage. Then, the age (year) that corresponds to this new percentage is read from the chart. RUL is estimated as the difference between that age and the current age of the system being replaced.

Energy Savings Algorithms

For the RUL time period:

$$kWh_{savings,ER} = CAP \times \frac{1\ kW}{1{,}000\ W} \times AOH_C \times \left(\frac{1}{EER_{ER}} - \frac{1}{CEER_{RAC}}\right)$$

Equation 60

For The remaining time in the EUL period., calculate annual savings as you would for a replace-on-burnout project:

$$kWh_{savings,ROB} = CAP \times \frac{1\ kW}{1{,}000\ W} \times AOH_C \times \left(\frac{1}{CEER_{ROB}} - \frac{1}{CEER_{RAC}}\right)$$

Equation 61

Where:

CAP	=	*Rated equipment cooling capacity of the installed room air conditioner (Btu/hr)*
AOH_C	=	*Annual operating hours for cooling (Table 112)*
$CEER_{ROB}$	=	*Combined Energy Efficiency Ratio of the replace-on-burnout baseline cooling equipment (Table 110)*
EER_{ER}	=	*Energy Efficiency Ratio of the early retirement baseline cooling equipment (Table 110)*
$CEER_{RAC}$	=	*Combined Energy Efficiency Ratio of the installed room air conditioner*

Summer Demand Savings Algorithms

To calculate demand savings for the early retirement of a room air conditioner, a similar methodology is used as for replace-on-burnout installations, with separate savings calculated for the remaining useful life of the unit, and the remainder of the EUL as outlined in the section above.

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http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/41. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2007-BT-STD-0010-0053.

For the RUL time period:

$$kW_{Savings,ER} = CAP \times \frac{1\ kW}{1{,}000\ W} \times \left(\frac{1}{EER_{ER}} - \frac{1}{EER_{RAC}}\right) \times CF$$

Equation 62

For the remaining time in the EUL period., calculate annual savings as you would for a replace-on-burnout project:

$$kW_{Savings,ROB} = CAP \times \frac{1\ kW}{1{,}000\ W} \times \left(\frac{1}{EER_{ROB}} - \frac{1}{EER_{RAC}}\right) \times CF$$

Equation 63

Deemed Energy Savings Tables

Replace-on-burnout

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Early Retirement

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

Replace-on-burnout

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Early Retirement

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of a room air conditioning unit is 8 years based on the Technical Support Document for the current DOE Final Rule standards for room air conditioners.[203]

This value is consistent with the EUL reported in the Department of Energy 76 Final Rule 52852 Technical Support Document for Energy Conservation Standards for Room Air conditioners.[204]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Decision/action type (early retirement, replace-on-burnout, new construction)
- Cooling capacity of the installed unit (Btu/hr)
- Combined Energy Efficiency Ratio (CEER) of the unit installed
- Age of the replaced unit (early retirement only)
- Photograph of retired unit nameplate (early retirement)
    - If a photograph of the retired unit nameplate is unavailable or not legible, provide a photo and/or description documenting the reason why the nameplate photo was unobtainable (early retirement only)
- Photograph demonstrating functionality of existing equipment and/or customer responses to survey questionnaire documenting the condition of the replaced unit and their motivation for measure replacement for early retirement eligibility determination (early retirement only)
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification.
- Manufacturer, model, capacity, and serial number
- AHRI certificate matching manufacturer and model number

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[203] The median lifetime was calculated using the survival function outlined in the DOE Technical Support Document. Final Rule: Standards, Federal Register, 76 FR 22454 (April 21, 2011) and associated Technical Support Document. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/41. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2007-BT-STD-0010-0053.

[204] Department of Energy, Federal Register, 76 FR 52852, Technical Support Document: 8.2.2.6 Product Lifetime. April 2011. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/41.

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- The applicable version of the ENERGY STAR® specifications and requirements for room air conditioners
- Code of Federal Regulations, 10 CFR 430.32(b)

Document Revision History

Table 115: Residential Room Air Conditioners Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Low-income and hard-to-reach Market Transformation section merged with main measure as “early retirement” option. Updated by Frontier Associates, March 2014, based on new federal standards.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. early retirement savings may be claimed through any appropriately designed program in accordance with EM&V team’s memo, “Considerations for early replacement of residential equipment.” Remaining useful lifetimes updated. Updated EUL to align with median lifetime. New construction permitted to claim savings. New ENERGY STAR® standards incorporated.
v3.1	11/05/2015	TRM v3.1 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. Added RUL values for units with an age of one to three years. Added a default RUL value for when the age of the unit is unknown. Eliminated the eligibility requirement of the existing unit to have a minimum age of five years.
v5.0	10/2017	TRM v5.0 update. Updated peak coincidence factors for compliance with current Texas peak definition. Single coincidence factor replaced with individual factors for each climate zone.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Update to documentation requirements.

2.2.9 ENERGY STAR® Connected Thermostats Measure Overview

TRM Measure ID: R-HV-CT

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering spreadsheets and estimates

Measure Description

Deemed savings are provided for the replacement of a standard or programmable thermostat with an ENERGY STAR® connected thermostat.

Eligibility Criteria

All residential customers with refrigerated air conditioning are eligible to claim cooling savings for this measure. Customers must have electrically-fueled central heating (either an electric resistance furnace or a heat pump) to claim heating savings.

The connected thermostats measure is primarily a residential retrofit measure; savings are presented for the average efficiency ratings of installed HVAC systems. Deemed savings are also presented for new construction efficiency ratings (minimum efficiency set by Federal standards).

Baseline Condition

The baseline condition is a residential central HVAC system controlled by a thermostat that does not meet the criteria for a connected thermostat (see high efficiency condition). For connected thermostats installed in conjunction with an existing HVAC unit, the baseline condition is an HVAC unit controlled by a manual or programmable thermostat with an average efficiency for existing HVAC units in Texas estimated as shown in Table 116.

Table 116. Baseline Efficiency of Existing HVAC Systems

Application	Efficiency Rating	Efficiency
Air conditioner/heat pump cooling mode	SEER	12.2
Heat pump heating mode	HSPF	7.6
Electric resistance heat	COP	3.41

For connected thermostats installed in conjunction with a new HVAC unit (for both retrofit and new construction applications), the baseline condition is an HVAC unit controlled by a manual or programmable thermostat with the baseline HVAC unit efficiency being equal to the efficiency of the installed system. The efficiency ratings of newly-installed HVAC units should meet or exceed minimum values set by the federal manufacturing standards in effect at the time of the installation.

High-efficiency Condition

The high-efficiency condition is an HVAC unit being controlled by an ENERGY STAR® connected thermostat. Details about the ENERGY STAR® connected thermostats specification are available on the program website[205], as is a list of program-certified thermostats.[206]

Energy and Demand Savings Methodology

Energy savings are estimated according to the program requirements established by the ENERGY STAR® program for thermostat service providers seeking certification. In addition to a series of other technical and programmatic requirements, providers must demonstrate that their thermostat services result in significant run-time reductions for the controlled cooling and heating equipment. Specifically, ENERGY STAR® provides the runtime reduction criteria reproduced in Table 117.

The ENERGY STAR runtime reductions are translated to energy savings estimates using the following information:

- Capacity and efficiency curves for HVAC performance under different temperature conditions
- Outdoor dry bulb temperature data (binned TMY3 data) for each TRM climate zone

Energy use under the range of temperature conditions is estimated for each bin in each climate zone. The base case total energy use for a system of given nominal capacity (and efficiency) is estimated by multiplying each bin's energy use estimate by the number of hours of estimated operation in that bin. Energy savings are estimated by applying the runtime reductions in Table 117 uniformly to each bin's energy use.

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[205] ENERGY STAR Certified Products: Connected Thermostats Specification V1.0. Online. Available: https://www.energystar.gov/products/spec/connected_thermostats_specification_v1_0_pd. Accessed: January 26, 2018.

[206] ENERGY STAR Certified Products: ENERGY STAR Certified Smart Thermostats. Online. Available: https://www.energystar.gov/productfinder/product/certified-connected-thermostats/results. Accessed: January 26, 2018.

Demand (kW) savings are not estimated for the connected thermostats measure.

Table 117. Connected Thermostat Runtime Reduction Criteria for Energy Star® Certification

Metric	Statistical Measure	Performance Requirement
Annual Percent Run Time Reduction, Heating (HS)	Lower 95% Confidence Limit of Weighted National Average	≥ 8%
	Weighted National Average of 20th Percentiles	≥ 4%
Annual Percent Run Time Reduction, Cooling (CS)	Lower 95% Confidence Limit of Weighted National Average	≥ 10%
	Weighted National Average of 20th Percentiles	≥ 5%
Average Resistance Heat Utilization for Heat Pump Installations (RU)	National Mean in 5°F Outdoor Temperature Bins from 0 to 60°F	Reporting requirement

Savings Algorithms and Input Variables

Deemed Energy Savings Tables

Savings are presented in kWh per ton of HVAC system capacity. For projects where tonnage is unknown, assume a default of 3.7 tons.[207]

Table 118 presents the annual energy savings for installations in which the connected thermostat is not installed in conjunction with the installation of a new HVAC unit.

Table 118: Energy Savings: Thermostats Installed with Existing HVAC Unit (kWh/ton)

Region	Cooling Savings	Heating Savings	
		ER Heat	Heat Pump
Climate Zone 1: Panhandle	121	485	199
Climate Zone 2: North	196	273	99
Climate Zone 3: South	229	178	62
Climate Zone 4: Valley	254	120	41
Climate Zone 5: West	167	283	98

When a connected thermostat is installed in conjunction with the installation of a new HVAC unit, the deemed savings are a function of the efficiency of the installed system. The deemed savings for connected thermostats installed on new HVAC units are provided in Table 119 and Table 120. The following savings are eligible to be claimed in both new construction programs and retrofit programs where a new HVAC system is installed.

[207] Based on review of average reported cooling capacity for central air conditioners and heat pumps installed in Texas utility programs in previous program years.

Table 119: Cooling Energy Savings: Thermostats Installed with New HVAC Unit (kWh/ton)

Region	SEER						
	14	14.5	15	16	17	18	21
Zone 1: Panhandle	108	103	99	92	81	77	66
Zone 2: North	174	167	161	150	131	124	107
Zone 3: South	204	196	189	175	154	146	126
Zone 4: Valley	226	217	209	194	169	160	138
Zone 5: West	149	143	138	128	112	106	91

Table 120: Heating Energy Savings (HP ONLY): Thermostats Installed with New HVAC Unit (kWh/ton)

Region	Heat Pump HSPF							
	8.2	8.5	8.6	8.7	9.0	9.3	9.5	9.7
Zone 1: Panhandle	188	181	177	177	170	163	159	156
Zone 2: North	93	89	87	87	82	78	77	75
Zone 3: South	57	55	53	53	51	48	47	46
Zone 4: Valley	38	37	36	36	34	32	31	31
Zone 5: West	91	87	85	85	80	76	75	73

The following table describes various equipment replacement scenarios that may be encountered and specifies which baseline should be used in each case. “Existing” corresponds to the savings from Table 118. “New” corresponds to the savings from Table 119 for cooling equipment and Table 120 for heating equipment.

Table 121: Baseline for Various Equipment Replacement Scenarios

Equipment Replacement Scenario	Baseline	
	Cooling	Heating
No HVAC equipment replacement	Existing	Existing
Non-condenser replacements (e.g. coil or furnace ONLY)	Existing	Existing
Air conditioner condenser replacement w/ gas furnace	New	No savings
Air conditioner condenser replacement w/ electric heat	New	Existing
Heat pump condenser replacement	New	New

For upstream programs, assume a heating type weighting of 41.8% gas, 49.3% electric resistance, and 9.0 percent heat pump heat.[208]

[208] Residential Energy Consumption Survey (RECS) 2015: Space heating in homes in the South and West Regions (HC6.8), February 27, 2017. https://www.eia.gov/consumption/residential/data/2015/.

Table 122: Upstream and Midstream Program Energy Savings[209] (kWh/thermostat)

Region	Total Energy Savings
Climate Zone 1: Panhandle	1,397
Climate Zone 2: North	1,256
Climate Zone 3: South	1,192
Climate Zone 4: Valley	1,172
Climate Zone 5: West	1,166

Deemed Summer Demand Savings Tables

Summer demand savings shall not be claimed for the connected thermostats measure.

Deemed Winter Demand Savings Tables

Winter demand savings shall not be claimed for the connected thermostats measure.

Example Deemed Savings Calculation

Example 1. A connected thermostat is installed on an existing 3.5 ton heat pump in climate zone 2.

$$Cooling\ Savings\ = 196\frac{kWh}{ton} \times 3.5tons = 686\ kWh$$

$$Heating\ Savings\ = 99\frac{kWh}{ton} \times 3.5tons = 347\ kWh$$

$$kWh\ savings = 686 + 347 = \mathit{1{,}033}\ kWh$$

$$Summer\ kW\ savings = 0\ kW$$

$$Winter\ kW\ savings = 0\ kW$$

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for a connected thermostat is 11 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[210]

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209 Assuming smart thermostat is installed in conjunction with an existing 3.7 ton HVAC unit.

210 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer2013-update-for-2014-codes.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

All program types:

- Climate zone
- Number of smart thermostats sold/installed
- Smart thermostat manufacturer and model number

Additional requirements for all program types other than upstream/midstream:

- HVAC system type (AC/HP)
- Determine whether HVAC condenser was replaced in conjunction with the thermostat
- HVAC capacity (tons)
- HVAC cooling efficiency (SEER) – only if installed with a new HVAC system
- HVAC heating efficiency (HSPF) – only if installed with a new heat pump
- Heating type (gas, electric resistance, heat pump, none)
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

- Docket No. 48265. Petition of AEP Texas Inc., CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company. Petition to Approve Deemed Savings for New Nonresidential Door Air Infiltration, Nonresidential Door Gaskets, and Residential ENERGY STAR Connected Thermostats. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 123: Residential ENERGY STAR® Connected Thermostats Revision History

TRM Version	Date	Description of Change
v6.0	11/2018	TRM v6.0 origin.
v7.0	10/2019	TRM v7.0 revision. Updated documentation requirement.

2.2.10 Smart Thermostat Load Management Measure Overview

TRM Measure ID: R-HV-TD

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Measurement and verification

Measure Description

Deemed demand savings are provided for calling load management events on smart thermostats[211] in summer afternoons. A load management event is a process through which a utility may optimize available resources by sending a signal to customers' smart thermostats. The signal modifies the smart thermostats temperature setting in order to reduce overall load demand from central refrigerated air conditioning.

Eligibility Criteria

All Texas residential customers with smart thermostats participating in climate zone 5 load management events are eligible to claim demand savings for this measure.

Baseline Condition

The baseline condition is a heating, ventilation, and air conditioning (HVAC) unit operating in the absence of the load management event and subsequent load management activities.

High-efficiency Condition

The high-efficiency condition is an HVAC unit being controlled by a smart thermostat and participating in a load management event.

[211] In this case, smart thermostats are internet-enabled devices that control a home's heating and air conditioning and can be remotely controlled by El Paso Electric Company for load management events.

Energy and Demand Savings Methodology

Demand savings were calculated using the “High 3 of 5 Baseline with Day-of Adjustment” method adopted in the Texas Technical Reference Manual Version 5.0 (TRM 5.0). This method considered the five most recent non-event non-holiday weekdays preceding an event and used data from the three days with the highest load within those five days to establish the baseline. “Day-of” adjustments were used to scale the baseline load estimate to the load conditions on the day of the event using data from the two hours prior to the time on the event day when participants were notified of the pending call for curtailment. In this specific program, customers were likely to experience a pre-cool period lasting up to one hour prior to the event. Therefore, the adjustment period was set as the two-hour period three hours prior to the event.

Interval metering devices were installed on a sample of households to record 15-minute interval kW demand of each house. Consumption data were recorded for a total of 50 homes in Texas. Among these 50 homes, 43 have un-anonymized thermostat run-time data, which allow linking interval consumption data with run-time data for each home. Data for customers in the sample was recorded beginning June 23, 2017. The deemed demand savings presented below were derived from these 43 homes in the summer 2018 data.

Event-level savings are calculated by multiplying kW savings per device by the number of targeted devices and the participating ratio on that event. Those devices which participated no less than 50% time during total event duration are identified as participating devices. The participation ratio is calculated as the percentage of participating devices among all the targeted devices in a certain event. The average of the events’ savings represents the program year savings.

Energy savings are not estimated through this specific measure.

Savings Algorithms and Input Variables

The demand algorithms and associated input variables are listed below:

$$Verified\ Demand\ Savings = Baseline\ Period\ kW - Curtailment\ kW$$

Equation 64

Where:

$Baseline\ Period\ kW$ = *Baseline average demand calculated according to the High 3 of 5 Baseline Method*

$Curtailment\ kW$ = *Average demand measured during the curtailment period*

Deemed Energy Savings Tables

Energy savings shall not be claimed using the methodology described in this measure.

Deemed Summer Demand Savings Tables

Table 124. Deemed kW Savings Per Device

Climate Zone	kW
5	1.45

Deemed Winter Demand Savings Tables

Winter demand savings shall not be claimed for the smart thermostats measure.

Example Deemed Savings Calculation

Example 1. A smart thermostat is installed in a home participating in summer load management events:

$$Summer\ kW\ savings = 1.45\ kW$$

$$Winter\ kW\ savings = 0\ kW$$

$$kWh\ savings = 0\ \text{kWh}$$

Example 2. Suppose 10 events were called in an entire summer with participation counts listed in the table below. The total program year demand savings would be the average of the event-level savings.

Table 125. Example Total Program Year Demand Savings Calculation

Event #	Texas			Event-Level Demand Savings (kW)
	Deemed Savings Per Device (kW)	Targeted Device #	Participating Ratio (%)	
Event 1	1.45	1000	60%	870
Event 2	1.45	1100	61%	973
Event 3	1.45	1200	62%	1,079
Event 4	1.45	1300	63%	1,188
Event 5	1.45	1400	62%	1,259
Event 6	1.45	1500	65%	1,414
Event 7	1.45	1400	59%	1,198
Event 8	1.45	1300	70%	1,320
Event 9	1.45	1200	67%	1,166
Event 10	1.45	1100	64%	1,021
Total Program Year Demand Savings (kW):				1,149

Measure Life and Lifetime Savings

The EUL for this measure is 1 year.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Number of targeted smart thermostats in each event
- Photo of unit installed or another pre-approved method of installation verification.
- Participation:
  - Number of participating thermostats: smart thermostats which participated no less than 50% time during the total event duration
  - Participating ratio: percentage of smart thermostats which participated no less than 50% time during the total event duration

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Not applicable.

Document Revision History

Table 126: Residential Smart Thermostat Load Management Revision History

TRM Version	Date	Description of Change
v6.0	11/2018	TRM v6.0 origin.
v7.0	10/2019	TRM v7.0 update. Updates to calculated savings.

2.2.11 Evaporative Cooling Measure Overview

TRM Measure ID: R-HV-EC

Market Sector: Residential

Measure Category: HVAC

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit and new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculations

Savings Methodology: Engineering algorithms and estimates

Measure Description

The following deemed savings values are applicable in calculating an incentive for the installation of a direct evaporative cooler instead of a refrigerated air system in an existing or newly-constructed home in a dwelling occupied by a residential energy consumer.

Eligibility Criteria

Direct whole-house evaporative cooling systems with a saturation efficiency of 0.85 or greater are eligible for this measure. Portable, window, indirect, and hybrid systems are not eligible.

Baseline Condition

The baseline condition is a new refrigerated air conditioner with a rated efficiency at 14 SEER[212], the federal minimum standard. The system being replaced is likely to be a less efficient evaporative cooling system, but the alternative to the new evaporative cooling unit is a minimally efficient refrigerated air conditioning system.

High Efficiency Condition

The high efficiency condition is a direct evaporative cooling system with a saturation efficiency of at least 0.85.

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[212] DOE minimum efficiency standard for residential air conditioners/heat pumps. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Deemed savings for this measure were derived using a reference metering study of evaporative cooling projects for Xcel Energy.[213] The energy savings from the Xcel study are adjusted for climate using a cooling degree day (CDD) ratio derived from TMY3 weather data. Demand savings are calculated using the coincidence factor for the room air conditioner measure and an EFLH estimation simulated in a calibrated BEopt model that is used for other modeled measures in the Texas TRM.

Energy Savings Algorithms

$$kWh_{Savings} = kWh_{Ref} \times \left(\frac{CDD_{Site}}{CDD_{Ref}}\right)$$

Equation 65

Where:

kWh_{Ref}	=	*Reference kWh savings from Xcel Energy metering evaluation of evaporative cooling project in Grand Junction, CO: 2,041*
CDD_{Ref}	=	*Cooling degree days for the reference location of Grand Junction, CO: 1,452*
CDD_{Site}	=	*Cooling degree days for the project site location, El Paso, TX: 2,446*

Demand Savings Algorithms

$$kW_{Savings} = \frac{kWh_{Savings}}{EFLH_{Site}} \times CF$$

Equation 66

Where:

$EFLH_{Site}$	=	*Equivalent full-load hours of an evaporative cooling system for the project site location, El Paso, TX: 1,288.*[214]
CF	=	*Summer Coincidence Factor: 0.920*[215]

[213] Evaporative Cooling Rebate Program Evaluation by The Cadmus Group, Inc., January 2010, Page 64, Table 23, Savings kWh value for Grand Junction Tier 2. https://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/EvaporativeCoolingProgramEvaluation.pdf. Accessed November 2018.

[214] EFLH are calculated as the total annual kWh divided by the max kW value output by the BEopt model.

[215] Derived using room air conditioner load shape from building simulation model for Room Air Conditioner measure. This factor is only applicable to climate zone 5. See Volume 1, Appendix B.

Deemed Savings Tables

Table 127: Evaporative Cooling Deemed Savings per System

Climate Zone	kWh Savings	Summer kW Savings	Winter kW Savings
5	3,438	2.46	0

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for an evaporative cooling unit is 15 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[216]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Retired system model number and serial number (if applicable)
- Installed evaporative cooler model number and serial number
- Installed evaporative cooler saturation effectiveness
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or other pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

This section is not applicable.

[216] Database for Energy Efficient Resources. http://www.deeresources.com/.

Document Revision History

Table 128: Residential Evaporative Cooling Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

2.3 RESIDENTIAL: BUILDING ENVELOPE

2.3.1 Air Infiltration Measure Overview

TRM Measure ID: R-BE-AI

Market Sector: Residential

Measure Category: Building Envelope

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

This measure involves the implementation of interventions to reduce the rate of air infiltration into residences. Pre- and post-treatment blower door air pressure readings are required to confirm air leakage reduction. The standard approach for estimating savings in this measure is based on the results obtained via pre- and post-leakage testing as defined in this measure.

Eligibility Criteria

Cooling savings in this measure apply to customers with central or mini-split electric refrigerated air conditioning in their homes. Homes must be centrally heated with either a furnace (gas or electric resistance) or a heat pump to claim heating savings. Customers who participate in hard-to-reach (HTR) or low-income (LI) programs are eligible to claim heating savings for homes heated with gas or electric resistance space heaters. Customers participating in HTR or LI programs are also eligible to claim reduced cooling savings for homes cooled by one or more room air conditioners by applying an adjustment to deemed savings that is specified for homes with refrigerated air.

There is an upper limit of 5.2 CFM_{50} per square foot of house floor area for the pre-retrofit infiltration rate on eligible projects. For homes where the pre-retrofit leakage exceeds this limit, savings will be awarded against the leakage cap. At the utility's discretion, this cap may not apply to homes implementing the measure under low-income programs.[217] Utilities may require certification or competency testing of personnel who will perform the blower door tests.

Air leakage should be assessed through testing following Building Performance Institute (BPI) standards. In some limited cases, where testing is not possible or unsafe (e.g., due to potential presence of asbestos), a visual assessment may be satisfactory. The air leakage testing should not be conducted in homes where either evidence of asbestos or mold is present or suspected due to the age of the home.[218]

Utilities' program manuals should be consulted for health and safety considerations related to the implementation of air sealing measures.

Only structures with electric refrigerated air conditioning systems are eligible.

Baseline Condition

The baseline for this measure is the existing leakage rate of the treated residence. The existing leakage rate should be capped to account for the fact that the deemed savings values per CFM_{50} leakage reduction are only applicable up to a point where the existing HVAC equipment would run continuously. Beyond that point, energy use will no longer increase linearly with an increase in leakage.

Baseline assumptions used in the development of these deemed savings are based on a 2013 Lawrence Berkeley National Laboratory (LBNL) analysis of air leakage measurements of US houses.[219] The LBNL study showed that approximately 95 percent of the home infiltration rates were below a normalized leakage rate of 2.0. Normalized leakage can be converted to CFM_{50}/ft^2 using Equation 67 through Equation 69.

$$NL = 1{,}000 \times \frac{ELA_4}{A \times 0.3048^2} \times \left(\frac{H \times 0.3048}{2.5\ m}\right)^{0.3}$$

Equation 67

$$Q_{50} = {ELA_4} \Bigg/ \left(\sqrt{\frac{\rho}{2(4\ Pa)}} \times \left(\frac{4\ Pa}{50\ Pa}\right)^{0.65}\right)$$

Equation 68

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217 Low-income customers are income-eligible customers served through a targeted low-income energy efficiency program as described in 25.181(r). This may also apply to income-eligible customers served through a hard-to-reach program that is also delivered following the guidelines in 25.181(r).

218 The Building Performance Institute, Inc. (BPI) Standard Reference: Building Performance Institute Technical Standards for the Building Analyst Professional, v2/28/05mda, Page 1 of 17, states: "Health and Safety*:* Where the presence of asbestos, lead, mold and/or other potentially hazardous material is known or suspected, all relevant state and federal (EPA) guidelines must be followed to ensure technician and occupant safety. Blower door depressurization tests may not be performed in homes *where there is a risk of asbestos becoming airborne and being drawn into the dwelling."*

219 Chan, W.R., Joh, J., and Sherman, M. H. Analysis of air leakage measurements of US houses. Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory (LBNL), p. 616-625.

$$CFM_{50,pre}/ft^2 = \frac{Q_{50} \times 60 \times 35.3147}{A}$$

Equation 69

Where:

NL	=	*Normalized Leakage = 2.0 from LBNL study*
ELA_4	=	*Area of an orifice that would result in the same air-flow through the building envelope at a pressure difference of 4 Pa (m^2)*
A	=	*Average area of a home in Texas from RECS 2009 (ft^2) = 1,757 ft^2*
H	=	*Ceiling height (ft.) = 8.5 (default)* [220]
0.3048	=	*Constant to convert from feet to meters*
Q_{50}	=	*Leakage rate at 50 Pa (m^3/s)*
ρ	=	*1.2 kg/m^3 from LBNL study*
$CFM_{50,\ pre}/ft^2$	=	*Maximum per-square-foot pre-installation infiltration rate*
60	=	*Constant to convert from minutes to seconds*
35.3147	=	*Constant to convert from cubic meters to cubic feet*

Using the above approach, the maximum per-square-foot pre-installation infiltration rate is 5.2 CFM_{50}/ft^2. Therefore, to avoid incentivizing homes with envelope problems not easily remedied through typical weatherization procedures, or where blower door tests were improperly conducted, these savings should only be applied starting at a baseline CFM_{50}/ft^2 of 5.2 or lower.

High-efficiency Condition

Blower door air pressure measurements must also be used to ensure that post-treatment air infiltration rates are not less than those set forth by the standard in Equation 70, based on floor area and the number of bedrooms.[221] These calculated minimum CFM_{50} values assume two occupants for a one-bedroom dwelling unit and an additional person for each additional bedroom. At the utility's discretion, this minimum CFM_{50} requirement may be enforced as an eligibility requirement. Otherwise, savings may be claimed for projects where the measured final infiltration rate is less than the minimum allowable ventilation rate if the following conditions are met:

- Mechanical ventilation is present or introduced in compliance with ASHRAE 62.2-2013
- Post-treatment infiltration rate is reported as the actual measured CFM_{50} result

[220] Typical ceiling height of 8 feet adjusted to account for greater ceiling heights in some areas of a typical residence.
[221] ASHRAE 62.2-2013. CFM_{Nat} values converted to CFM_{50} values by multiplying by appropriate N factor.

- Savings are calculated using the TRM minimum allowable ventilation rate with no additional savings claimed for CFM reduction below this amount

Where higher occupant densities are known, the minimum rate shall be increased by 7.5 CFM_{Nat} for each additional person. A CFM_{Nat} value can be converted to CFM_{50} by multiplying by the appropriate N factor (Table 129

$$Min\ CFM_{50} = [0.03 \times A_{Floor} + 7.5 \times OCC] \times N$$

Equation 70

Where:

Min CFM_{50} = *Minimum final ventilation rate (CFM_{50})*

A_{Floor} = *Floor area (ft^2)*

OCC = *BR + 1, where BR is the number of bedrooms; if number of home occupants is known to exceed BR + 1, occupancy should be used instead*

N = *N factor (*Table 129*)*

Table 129: N Factors[222]

Shielding	Number of Stories		
	1 Story	2 Story	3+ Stories
Well shielded	22.2	17.8	15.5
Normal	18.5	14.8	13.0
Exposed	16.7	13.3	11.7

The maximum CFM reduction percentage[223] is capped at 40 percent for RSOP homes. It is important to note that the minimum ventilation rate specified earlier in this section still applies for cases where the maximum 40 percent CFM reduction cannot be achieved due to the post CFM value being limited by the minimum allowable post CFM value provisioned for safety reasons.

The TRM stipulates an upper limit of 5.2 CFM_{50} per square foot of house floor area for the pre-retrofit infiltration rate as part of eligibility criteria. For homes where the pre-retrofit leakage exceeds this limit, energy and demand savings must be calculated using the pre-measure-installation leakage cap. Therefore, when the pre-retrofit leakage is capped, energy and demand savings can only be claimed for a 40 percent reduction in CFM compared to the capped pre-CFM value. When the pre-retrofit leakage is not capped, energy and demand savings can only be claimed for a 40 percent reduction in CFM compared to the tested, actual pre-retrofit infiltration rate of the home.

[222] Krigger, J. and Dorsi, C.,“Residential Energy: Cost Savings and Comfort for Existing Buildings”. A-11 Building Tightness Limits, p. 284. Use Zone 2 for Texas climate. http://www.waptac.org/data/files/Website_docs/Technical_Tools/Building%20Tightness%20Limits.pdf.

[223] CFM reduction percentage is calculated as: (pre CFM value – post CFM value) / pre-CFM value

The TRM requires all contractors to provide sufficient evidence (e.g., pictures capturing the scope/type of retrofit implemented and blower door test readings) for all RSOP homes that reach a CFM reduction percentage within the range of 30–40 percent. In the absence of any evidence, the TRM places a cap of 30 percent CFM reduction for calculating energy and demand savings.

At the utility's discretion, the cap of 40 percent CFM reduction and the ceiling of 5.2 CFM_{50} for pre-retrofit infiltration rate may not apply to homes implementing the measure under low-income programs.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Calibrated simulation modeling was used to develop these deemed savings, which are expressed as linear functions of the leakage reduction achieved (in CFM_{50}).[224] Specifically, these deemed savings estimates were developed using BEopt 2.6, running EnergyPlus 8.4 as the underlying simulation engine. To model this measure, the prototype home models for each climate zone were modified as follows: the base case air infiltration rate was set to 20 ACH_{50}. Results from running the base case model provide estimated hourly energy use for the prototypical home prior to treatment. Post-treatment conditions were simulated by setting the leakage rate to 3 ACH_{50}.

Deemed savings are presented as a function of the CFM_{50} reduction achieved, as demonstrated by blower door testing. The kWh and kW per CFM_{50} values represented by the V_E, V_S, and V_W coefficients are derived by taking the difference between annual energy use and summer and winter peak demand as estimated by the two model runs, and normalizing to the CFM_{50} reduction achieved. The pre- and post-treatment ACH_{50} values (20 and 3, respectively) are converted to CFM_{50} by multiplying the pressurized air-change rate by the volume of the model home and dividing by 60 (minutes/hour).

Deemed Energy Savings Tables

Table 130 presents the energy savings per CFM_{50} reduction for a residential air sealing project. The following formula shall be used to calculate deemed energy savings for infiltration efficiency improvements.

$$Deemed\ Energy\ Savings = \Delta CFM_{50} \times \left(V_{E,C} \times CAF + V_{E,H}\right)$$

Equation 71

Where:

ΔCFM_{50} = *Air infiltration reduction in Cubic Feet per Minute at 50 Pascal*

$V_{E,C}$ = *Corresponding cooling savings value in Table 130*

[224] Model testing indicates a straight line relationship between demand and energy savings achieved and CFM50 reductions is appropriate with beginning and ending leakage rates within the ranges permitted by the measure.

CAF	=	*Cooling savings adjustment factor for homes with room air conditioners; set to 1.0 for homes with refrigerated air or set to 0.6 for homes with one or more room air conditioners*
$V_{E,H}$	=	*Corresponding heating savings value in Table 130*

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying $V_{E,C}$ in Table 130 by a factor of 0.6.

Table 130: Energy Savings V_E per CFM_{50} Reduction

Climate Zone	$V_{E,C}$: Cooling Savings	$V_{E,H}$: Heating Savings		
	Refrigerated Air	Gas Heat	Electric Resistance	Heat Pump
Zone 1: Panhandle	0.12	0.09	1.92	0.78
Zone 2: North	0.27	0.04	1.10	0.45
Zone 3: South	0.22	0.02	0.63	0.25
Zone 4: Valley	0.39	0.02	0.55	0.21
Zone 5: West*	0.07	0.03	0.88	0.34

Deemed Summer Demand Savings Tables

Table 131 presents the summer peak demand savings per CFM_{50} reduction for a residential air sealing project. The following formula shall be used to calculate deemed summer demand savings for air infiltration improvements.

$$\boldsymbol{Deemed\ Summer\ Demand\ Savings = \Delta CFM_{50} \times V_S \times CAF}$$

Equation 72

Where:

ΔCFM_{50}	=	*Air infiltration reduction in cubic feet per minute at 50 Pascal*
V_S	=	*Corresponding value in Table 131*
CAF	=	*Cooling savings adjustment factor for homes with room air conditioners; set to 1.0 for homes with refrigerated air or set to 0.6 for homes with one or more room air conditioners*

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying $V_{E,C}$ in Table 131 by a factor of 0.6.

Table 131: Peak Summer Demand Savings V_S per CFM_{50} Reduction

Region	Summer kW Impact per CFM_{50} Reduction
Climate Zone 1: Panhandle	1.64E-04
Climate Zone 2: North	2.10E-04
Climate Zone 3: South	1.90E-04
Climate Zone 4: Valley	2.24E-04
Climate Zone 5: West	9.40E-05

Deemed Winter Demand Savings Tables

Table 132 presents the summer peak demand savings per CFM_{50} reduction for a residential air sealing project. The following formula shall be used to calculate deemed winter demand savings for air infiltration improvement:

$$\boldsymbol{Deemed\ Winter\ Demand\ Savings = \Delta CFM_{50} \times V_W}$$

Equation 73

Where:

ΔCFM_{50} = *Air infiltration reduction in Cubic Feet per Minute at 50 Pascal*

V_W = *Corresponding value in Table 132*

Table 132: Peak Winter Demand Savings V_W per CFM_{50} Reduction

Region	Winter kW Impact per CFM_{50} Reduction	
	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	9.42E-04	5.48E-04
Climate Zone 2: North	1.25E-03	6.93E-04
Climate Zone 3: South	8.61E-04	4.41E-04
Climate Zone 4: Valley	7.81E-04	3.60E-04
Climate Zone 5: West	2.92E-04	1.19E-04

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Example Deemed Savings Calculation

Example 1. A contractor uses a blower door test to estimate 12,000 CFM_{50} of pre-retrofit air leakage in a 2,200 square foot, 2-story, 3 bedroom home in climate zone 4 with a heat pump. The home is located in a well-shielded area. After identifying and sealing leaks, she performs another blower door test and measures 8,000 CFM_{50} of air leakage.

$$Max\ Initial\ Leakage\ Rate\ = 5.2\ \times\ 2{,}200 = 11{,}440\ CFM_{50}$$

$$Reported\ Initial\ Leakage\ = Min(12{,}000, 11{,}400) = 11{,}440\ CFM_{50}$$

$$Capped\ Post\ Retrofit\ Leakage\ = 11{,}400\ \times\ (1 -\ 0.4) = 6{,}864\ CFM_{50}$$

$$Reported\ Post\ Retrofit\ Leakage\ = Max(8{,}000, 6{,}864) = 8{,}000\ CFM_{50}$$

$$Min. Post\ Retrofit\ Leakage\ (safety) = [0.03\ \times\ 2{,}200 + 7.5 \times 4]\ \times\ 14.8 = 1{,}421\ CFM_{50}$$

$$\Delta CFM_{50} = (11{,}440 - 8{,}000) = \mathit{3{,}440}$$

$$kWh\ savings = (0.39 + 0.21)\ \times\ 3{,}440 = \mathit{2{,}064}\ kWh$$

$$Summer\ kW\ savings = 2.24\ \times\ 10^{-4}\ \times\ 3{,}440 = 0.77\ kW$$

$$Winter\ kW\ savings = 3.60\ \times\ 10^{-4}\ \times\ 3{,}440 = 1.24\ kW$$

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

According to the DEER Final Report December 2008, the estimated useful life is 11 years for air infiltration reduction.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Pre-retrofit air infiltration in cubic feet per minute at 50 Pascal
- Post-retrofit air infiltration in cubic feet per minute at 50 Pascal
- Heating type (gas, resistance heat, heat pump)
- Square footage of the house
- Shielding level (well shielded, normal, exposed)
- Number of bedrooms
- Number of stories
- Number of occupants
- Pre- and post-photos of blower door test readings
- Representative photos of leak repairs

References and Efficiency Standards

Petitions and Rulings

- Docket No. 22241, Item 62. Petition by Frontier Associates for Approval of Second Set of Deemed Savings Estimates. Public Utility Commission of Texas.
- Docket No. 27903. Order Adopting New §25.184 as Approved at the August 21, 2003, Open Meeting and Submitted to the Secretary of State. Public Utility Commission of Texas.
- Docket No. 41070. Petition of El Paso Electric Company to Approve Revisions to Residential and Commercial Deemed Savings Based on Climate Data Specific to El Paso, Texas. Public Utility Commission of Texas.
- Docket No. 41722. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Sharyland Utilities, L.P., Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company to Approve Revisions to Residential Deemed Savings to Incorporate Winter Peak Demand Impacts and Update Certain Existing Deemed Savings Values. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 133: Residential Air Infiltration Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor edits to language. Added detail on methodology and model characteristics.
v2.1	1/30/2015	TRM v2.1 update. Addition of language referring contractors to program manuals for information regarding health and safety precautions.
v3.0	4/10/2015	TRM v3.0 update. Revision of minimum ventilation requirements, pre-retrofit cap on infiltration levels, Climate Zone 5 savings values for homes with heat pumps, and tracking number of bedrooms and occupants in a house.
v3.1	11/05/2015	TRM v3.1 update. Provided clarification around effects of occupancy on minimum final ventilation.
v4.0	10/10/2016	TRM v4.0 update. Updated energy and demand savings per new prototype energy simulation models. Introduced new protocols related to maximum CFM reduction percentage and its associated documentation requirements. Added a new example for calculating savings.
v5.0	10/2017	TRM v5.0 update. Added alternative approach to bypass the need to complete leakage testing in guidance memo to follow.
v6.0	11/2018	TRM v6.0 update. Removed alternative approach allowance at this time. Clarified the eligibility of projects where CFM_{post} falls below the minimum ventilation rate requirement.
v7.0	10/2019	TRM v7.0 update. No revision.

2.3.2 Ceiling Insulation Measure Overview

TRM Measure ID: R-BE-CI

Market Sector: Residential

Measure Category: Building Envelope

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

Savings are estimated for insulation improvements to the ceiling area above a conditioned space in a residence.

Eligibility Criteria

Cooling savings in this measure apply to customers with central or mini-split electric refrigerated air conditioning in their homes, or to customers in TRM climate zones 1 and 5 who have evaporative cooling systems. Homes must be centrally heated with either a furnace (gas or electric resistance) or a heat pump to claim heating savings. Customers who participate in hard-to-reach (HTR) or low-income (LI) programs are eligible to claim heating savings for homes heated with gas or electric resistance space heaters. Customers participating in HTR or LI programs are also eligible to claim reduced cooling savings for homes cooled by one or more room air conditioners by applying an adjustment to deemed savings that is specified for homes with refrigerated air.

Baseline Condition

Ceiling insulation levels encountered in existing homes can vary significantly, depending on factors such as the age of the home, type of insulation installed, and level of attic use (equipment, storage, etc.). Deemed savings have been developed based on different levels of encountered (existing) ceiling insulation in participating homes, ranging from no insulation material (R-0) to the equivalent of about 6 inches of fiberglass batt insulation (R-22). The current average ceiling insulation level at participating homes is to be determined and documented by the insulation installer. Degradation due to age and density of the existing insulation should be taken into account.

In the event that existing insulation is or has been removed during measure implementation, the existing R-value for claiming savings shall be based upon the R-value of the existing insulation prior to removal.

For any reported pre-retrofit R-value that falls below R-5, the TRM requires all contractors to provide sufficient evidence including two pictures: 1) a picture showing the entire attic floor, and 2) a close-up picture of a ruler that shows the measurement of the depth of the insulation. In the absence of evidence demonstrating pre-retrofit ceiling insulation below R-5, the lowest level of pre-retrofit ceiling insulation that can be claimed is the R-5 to R-8 range.

In the event there are varying levels of existing insulation, an area-weighted U-factor should be used to find the effective R-value across the treated area. The U-factor should be taken from the existing insulation only. This approach should be used in single attic spaces, and savings should be estimated separately for independent spaces where there are separate heating or cooling methods (e.g., additions).

Area-weighted U-factor Calculation Method

$$U_A = [U_1 \times Area_1 + \mathrm{U}_2 \times \mathrm{Area}_2\ + \ldots]/\,[\mathrm{Area}_1 + \mathrm{Area}_2\ + \ldots]$$

$$Effective\ Rvalue = \frac{1}{U_A}$$

Equation 74

High-efficiency Condition

A ceiling insulation level of R-30 is recommended throughout Texas as prescribed by the Department of Energy. Accordingly, deemed savings are provided for insulating to R-30. Adjustment factors are provided to allow contractors to estimate savings for installation of higher or lower levels of post-retrofit insulation. Contractors should estimate post-retrofit R-values according to the average insulation depth achieved across the area treated and the R per-inch of the insulation material installed.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Calibrated simulation modeling was used to develop these deemed savings values. Specifically, these deemed savings estimates were developed using BEopt 2.6, running EnergyPlus 8.4 as the underlying simulation engine. To model this measure, the prototype home models for each climate zone was modified as follows: the default R-value of ceiling insulation (R-15 in most zones) was set at different levels, ranging from R-0 (no ceiling insulation) to R-22. These modifications are shown in Table 134.

The model runs are used to estimate peak demand and energy use in the modeled home at each of the base case ceiling insulation levels. The change-case models were run with the ceiling insulated to R-30.

Table 134: Residential Ceiling Insulation—Prototypical Home Characteristics

Shell Characteristic	Value	Source
Base Ceiling Insulation	R-0 R1-R4 R5-R8 R9-R14 R15-R22	Existing insulation level
Change Ceiling Insulation	R-30	Efficiency measure—R-30 retrofit insulation level as required by DOE and Texas Department of Housing and Community Affairs programs in Texas

Deemed Energy Savings Tables

Table 135 through Table 139, present the energy savings (kWh) associated with ceiling insulation for the five Texas climate zones. Annual energy savings are the sum of cooling and heating savings for the appropriate equipment types.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying the appropriate cooling value in Table 135 through Table 139 by a factor of 0.6.

Climate Zone 1: Panhandle Region

Table 135: Climate Zone 1: Panhandle Region—Deemed Annual Energy Savings for Residential Ceiling Insulation to R-30 (kWh/sq. ft)

Ceiling Insulation Base R-value	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
R-0	0.75	0.22	0.21	5.48	2.35
R-1 to R-4	0.62	0.18	0.18	4.60	1.97
R-5 to R-8	0.28	0.08	0.08	2.16	0.92
R-9 to R-14	0.15	0.04	0.05	1.17	0.50
R-15 to R-22	0.06	0.02	0.02	0.51	0.22

Climate Zone 2: North Region

Table 136: Climate Zone 2: North Region—Deemed Annual Energy Savings for Residential Ceiling Insulation to R-30 (kWh/sq. ft.)

Ceiling Insulation Base R-value	Cooling Savings	Heating Savings		
		Gas Heat	Electric Resistance	Heat Pump
R-0	1.23	0.12	3.40	1.41
R-1 to R-4	1.01	0.10	2.87	1.18
R-5 to R-8	0.46	0.05	1.34	0.55
R-9 to R-14	0.25	0.03	0.72	0.30
R-15 to R-22	0.11	0.01	0.32	0.13

Climate Zone 3: South Region

Table 137: Climate Zone 3: South Region—Deemed Annual Energy Savings for Residential Ceiling Insulation to R-30 (kWh/sq. ft.)

Ceiling Insulation Base R-value	Cooling Savings	Heating Savings		
		Gas Heat	Electric Resistance	Heat Pump
R-0	1.27	0.09	2.30	0.93
R-1 to R-4	1.04	0.07	1.96	0.79
R-5 to R-8	0.46	0.03	0.92	0.37
R-9 to R-14	0.24	0.02	0.50	0.20
R-15 to R-22	0.10	0.01	0.22	0.09

Climate Zone 4: Valley Region

Table 138: Climate Zone 4: Valley Region—Deemed Annual Energy Savings for Residential Ceiling Insulation to R-30 (kWh/sq. ft.)

Ceiling Insulation Base R-value	Cooling Savings	Heating Savings		
		Gas Heat	Electric Resistance	Heat Pump
R-0	1.00	0.04	1.60	0.62
R-1 to R-4	0.78	0.04	1.35	0.52
R-5 to R-8	0.35	0.02	0.62	0.24
R-9 to R-14	0.18	0.01	0.33	0.13
R-15 to R-22	0.08	0.00	0.14	0.06

Climate Zone 5: West Region

Table 139: Climate Zone 5: West Region—Deemed Annual Energy Savings for Residential Ceiling Insulation to R-30 (kWh/sq. ft.)

Ceiling Insulation Base R-value	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
R-0	1.17	0.38	0.12	3.44	1.43
R-1 to R-4	0.96	0.32	0.10	2.95	1.22
R-5 to R-8	0.43	0.15	0.05	1.40	0.57
R-9 to R-14	0.23	0.08	0.03	0.75	0.31
R-15 to R-22	0.10	0.03	0.01	0.33	0.13

Scale-down/up Factors for Energy Savings: Insulation to Below or Above R-30

The factors presented in this section are to be used when the average post-retrofit insulation depth is providing more or less than R-30 insulation. Scale-down factors are provided for the case when average post-retrofit insulation depth is not sufficient to achieve R-30; scale-up factors are provided for the case when insulating to a level greater than R-30. In either case, the following equation should be applied to scale down or scale up the energy savings.

$$Energy\ Savings\ (kWh) = \left\{R30\ Savings/ft^2 + \left[S_{D/U} \times (R_{Achieved} - 30)\right]\right\} \times A$$

Equation 75

Where:

R30 Savings/ft² = *Sum of project-appropriate deemed cooling and heating energy savings per square feet taken from Table 135 through Table 139*

$S_{D/U}$ = *Project-appropriate scale-down or scale-up factor from either Table 140 or Table 141*

$R_{Achieved}$ = *Achieved R-value of installed insulation (e.g., for R-28, $R_{Achieved}$ = 28)*

A = *Treated area (ft²)*

If the ceiling is insulated to a level less than R-30, the following factors shall be applied to scale down the achieved energy savings per square foot of treated ceiling area.

Table 140: Energy Scale-down Factors: Ceiling Insulation to Less Than R-30 (kWh/sq. ft./ΔR)

Climate Zone	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	4.00E-03	1.16E-03	1.27E-03	3.26E-02	1.38E-02
2	6.66E-03	n/a	7.11E-04	2.00E-02	8.20E-03
3	6.22E-03	n/a	4.67E-04	1.38E-02	5.47E-03
4	4.92E-03	n/a	2.44E-04	9.04E-03	3.47E-03
5	4.00E-03	1.16E-03	1.27E-03	3.26E-02	1.38E-02

If the ceiling is insulated to a level greater than R-30, the following factors shall be applied to scale up the achieved energy savings per square foot of treated ceiling area.

Table 141: Energy Scale-up Factors: Ceiling Insulation to Greater Than R-30 (kWh/sq. ft./ΔR)

Climate Zone	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	2.66E-03	7.63E-04	8.45E-04	2.18E-02	9.18E-03
2	4.45E-03	n/a	4.82E-04	1.33E-02	5.47E-03
3	4.00E-03	n/a	2.97E-04	9.19E-03	3.66E-03
4	3.24E-03	n/a	1.62E-04	5.99E-03	2.30E-03
5	2.66E-03	7.63E-04	8.45E-04	2.18E-02	9.18E-03

Savings Tables

Table 142 through Table 146 present the summer demand savings (kW/sq. ft.) associated with ceiling insulation for the five Texas climate zones.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying the appropriate cooling value in the refrigerated air column in Table 142 through Table 146 by a factor of 0.6.

Climate Zone 1: Panhandle Region

Table 142: Climate Zone 1: Panhandle Region—Residential Ceiling Insulation to R-30 Deemed Summer Demand Savings (kW/sq. ft.)

Ceiling Insulation Base R-value	Refrigerated Air	Evaporative Cooling
R-0	1.15E-03	3.44E-04
R-1 to R-4	9.78E-04	3.04E-04
R-5 to R-8	4.50E-04	1.47E-04
R-9 to R-14	2.33E-04	7.16E-05
R-15 to R-22	1.02E-04	2.87E-05

Climate Zone 2: North Region

Table 143: Climate Zone 2: North Region—Residential Ceiling Insulation to R-30 Deemed Summer Demand Savings (kW/sq. ft.)

Ceiling Insulation Base R-value	Demand Savings (kW/sq. ft.)
R-0	1.27E-03
R-1 to R-4	1.10E-03
R-5 to R-8	5.17E-04
R-9 to R-14	2.67E-04
R-15 to R-22	1.15E-04

Climate Zone 3: South Region

Table 144: Climate Zone 3: South Region—Residential Ceiling Insulation to R-30 Conditioning Deemed Summer Demand Savings (kW/sq. ft.)

Ceiling Insulation Base R-value	Demand Savings (kW/sq. ft.)
R-0	1.44E-03
R-1 to R-4	1.21E-03
R-5 to R-8	5.51E-04
R-9 to R-14	2.87E-04
R-15 to R-22	1.22E-04

Climate Zone 4: Valley Region

Table 145: Climate Zone 4: Valley Region—Residential Ceiling Insulation to R-30 Deemed Summer Demand Savings (kW/sq. ft.)

Ceiling Insulation Base R-value	Demand Savings (kW/sq. ft.)
R-0	8.70E-04
R-1 to R-4	7.16E-04
R-5 to R-8	3.40E-04
R-9 to R-14	1.79E-04
R-15 to R-22	7.95E-05

Climate Zone 5: West Region

Table 146: Climate Zone 5: West Region—Residential Ceiling Insulation to R-30 Deemed Summer Demand Savings (kW)

Ceiling Insulation Base R-value	Refrigerated Air	Evaporative Cooling
R-0	1.18E-03	3.33E-04
R-1 to R-4	1.01E-03	3.25E-04
R-5 to R-8	4.72E-04	1.53E-04
R-9 to R-14	2.38E-04	6.25E-05
R-15 to R-22	1.03E-04	2.09E-05

Scale-down/up Factors: Insulation to Below or Above R-30

If the ceiling is insulated to a level less than R-30, the following factors shall be applied to scale down the achieved summer peak demand savings per square foot of treated ceiling area.

Table 147: Summer Peak Demand Scale-down Factors: Ceiling Insulation to less than R-30 (kWh/sq. ft./ΔR)

Climate Zone	Refrigerated Air	Evaporative Cooling
1	6.41E-06	1.97E-06
2	7.30E-06	n/a
3	7.91E-06	n/a
4	5.20E-06	n/a
5	6.41E-06	1.97E-06

If the ceiling is insulated to a level greater than R-30, the following factors shall be applied to scale up the achieved summer peak demand savings per square foot of treated ceiling area.

Table 148: Summer Peak Demand Scale-up Factors: Ceiling Insulation to greater than R-30 (kWh/sq. ft./ΔR)

Climate Zone	Refrigerated Air	Evaporative Cooling
1	4.22E-06	1.89E-06
2	4.92E-06	n/a
3	5.92E-06	n/a
4	3.47E-06	n/a
5	4.22E-06	1.89E-06

Deemed Winter Demand Savings Tables

Table 149 through Table 153 present the winter demand savings associated with ceiling insulation for the five Texas climate zones.

Climate Zone 1: Panhandle Region

**Table 149: Climate Zone 1: Panhandle Region—
Residential Ceiling Insulation to R-30 Deemed Winter Demand Savings (kW/sq. ft.)**

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	7.83E-05	2.25E-03	1.15E-03
R-1 to R-4	6.35E-05	1.90E-03	9.84E-04
R-5 to R-8	2.51E-05	8.74E-04	4.53E-04
R-9 to R-14	1.37E-05	4.56E-04	2.38E-04
R-15 to R-22	4.72E-06	1.95E-04	1.01E-04

Climate Zone 2: North Region

**Table 150: Climate Zone 2: North Region—
Residential Ceiling Insulation to R-30 Deemed Winter Demand Savings (kW/sq. ft.)**

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	6.02E-05	2.49E-03	1.62E-03
R-1 to R-4	5.35E-05	2.11E-03	1.41E-03
R-5 to R-8	2.79E-05	9.84E-04	6.60E-04
R-9 to R-14	1.45E-05	5.13E-04	3.51E-04
R-15 to R-22	6.42E-06	2.23E-04	1.52E-04

Climate Zone 3: South Region

**Table 151: Climate Zone 3: South Region -
Residential Ceiling Insulation to R-30 Deemed Winter Demand Savings (kW/sq. ft.)**

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	8.08E-05	1.96E-03	1.08E-03
R-1 to R-4	6.85E-05	1.65E-03	9.43E-04
R-5 to R-8	2.91E-05	7.71E-04	4.49E-04
R-9 to R-14	1.39E-05	4.01E-04	2.35E-04
R-15 to R-22	5.36E-06	1.74E-04	1.03E-04

Climate Zone 4: Valley Region

**Table 152: Climate Zone 4: Valley Region—
Residential Ceiling Insulation to R-30 Deemed Winter Demand Savings (kW/sq. ft.)**

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	5.28E-05	1.60E-03	7.50E-04
R-1 to R-4	4.48E-05	1.36E-03	6.47E-04
R-5 to R-8	2.18E-05	6.31E-04	3.03E-04
R-9 to R-14	1.13E-05	3.28E-04	1.57E-04
R-15 to R-22	5.71E-06	1.44E-04	6.95E-05

Climate Zone 5: West Region

**Table 153: Climate Zone 5: West Region—
Residential Ceiling Insulation to R-30 Deemed Winter Demand Savings (kW/sq. ft.)**

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	3.28E-05	9.12E-04	3.91E-04
R-1 to R-4	2.56E-05	8.13E-04	3.45E-04
R-5 to R-8	1.14E-05	3.72E-04	1.57E-04
R-9 to R-14	5.38E-06	1.79E-04	7.54E-05
R-15 to R-22	2.26E-06	7.41E-05	3.11E-05

Scale-down/up Factors for Demand Reduction: Insulation to Below or Above R-30

The factors presented in this section are to be used when the average post-retrofit insulation depth is providing more or less than R-30 insulation. Scale-down factors are provided for the case when average post-retrofit insulation depth is not sufficient to achieve R-30; scale-up factors are provided for the case when insulating to a level greater than R-30. In either case, the following equation should be applied to scale down or scale up the summer peak demand savings.

$$Demand\ Savings\ (kW) = \left\{R30\ Savings/ft^2 + \left[S_{D/U} \times (R_{Achieved} - 30)\right]\right\} \times A$$

Equation 76

Where:

R30 Savings/ft^2 = *Sum of project-appropriate deemed Cooling and Heating Energy Savings per square feet taken from Table 142 through Table 146 or Table 149 through Table 153*

$S_{D/U}$ = *Project-appropriate scale-down or scale-up factor from either Table 147 and Table 148 (Summer) or Table 154 and Table 155 (Winter)*

$R_{Achieved}$ = *Achieved R-value of installed insulation (e.g. for R-28, $R_{Achieved}$ = 28)*

A = *Treated area (ft^2)*

If the ceiling is insulated to a level less than R-30, the following factors shall be applied to scale down the achieved winter peak demand savings per square foot of treated ceiling area.

Table 154: Winter Peak Demand Scale-down Factors: Ceiling Insulation to less than R-30 (kWh/sq. ft./ΔR)

Climate Zone	Gas Heat	Electric Resistance	Heat Pump
1	4.29E-07	1.21E-05	6.30E-06
2	3.97E-07	1.40E-05	9.55E-06
3	3.05E-07	1.10E-05	6.53E-06
4	3.19E-07	9.18E-06	4.32E-06
5	4.29E-07	1.21E-05	6.30E-06

If the ceiling is insulated to a level greater than R-30, the following factors shall be applied to scale up the achieved winter peak demand savings per square foot of treated ceiling area.

Table 155: Winter Peak Demand Scale-up Factors: Ceiling Insulation to greater than R-30 (kWh/sq. ft./ ΔR)

Climate Zone	Gas Heat	Electric Resistance	Heat Pump
1	2.76E-07	7.85E-06	4.19E-06
2	2.57E-07	8.33E-06	4.80E-06
3	2.19E-07	7.33E-06	4.46E-06
4	1.72E-07	5.79E-06	2.72E-06
5	2.76E-07	7.85E-06	4.19E-06

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Example Deemed Savings Calculation

Example 1 (Scale-up). A home in Climate Zone 5 with evaporative cooling and an electric resistance furnace insulates 400 square feet from a baseline of R-1 to an efficient condition of R-38.

$$Cooling\ kWh\ savings\ per\ sq.ft. = 0.32 + 7.63x10^{-4} \times (38 - 30) = \mathit{0.33\ kWh/sq.ft.}$$

$$Heating\ kWh\ savings\ per\ sq.ft. = 2.95 + 2.18x10^{-2} \times (38 - 30) = \mathit{3.12\ kWh/sq.ft.}$$

$$kWh\ savings = (0.33 + 3.12) \times 400 = \mathit{1{,}381\ kWh}$$

$$Summer\ kW\ savings\ per\ sq.ft. = 3.25 \times 10^{-4} + 1.89 \times 10^{-6} \times (38 - 30) = \mathit{3.41} \times 10^{-4}\ kW/sq.ft.$$

$$Summer\ kW\ savings = 3.41 \times 10^{-4} \times 400 = 0.14\ kW$$

$$Winter\ kW savings\ per\ sq.ft\ = 8.13 \times 10^{-4} + 7.85 \times 10^{-5} \times (38 - 30) = \mathit{8.76} \times 10^{-4}\ kW/sq.ft.$$

$$Winter\ kW\ savings = 8.76 \times 10^{-4} \times 400 = 0.35\ kW$$

Example 2 (Scale-down). A home in Climate Zone 3 with an air-source heat pump insulates 550 square feet from a baseline of R-5 to an efficient condition of R-28.

$$Cooling\ kWh\ savings\ per\ sq.ft. = 0.46 + 5.47 \times 10^{-3} \times (28 - 30) = 0.45\ kWh/sq.ft.$$

$$Heating\ kWh\ savings\ per\ sq.ft. = 0.37 + 3.66 \times 10^{-3} \times (28 - 30) = 0.36\ kWh/sq.ft.$$

$$kWh\ savings = (0.45 + 0.36) \times 550 = 446.4\ kWh$$

$$Summer\ kW\ savings\ per\ sq.ft. = 5.51 \times 10^{-4} + 7.91 \times 10^{-6} \times (28 - 30) = 5.35 \times 10^{-4}\ kW/sq.ft.$$

$$Summer\ kW\ savings = 5.35 \times 10^{-4} \times 550 = 0.29\ kW$$

$$Winter\ kW\ savings\ per\ sq.ft. = 4.49 \times 10^{-4} + 6.53 \times 10^{-6} \times (28 - 30) = 4.36 \times 10^{-4}\ kW/sq.ft.$$

$$Winter\ kW\ savings = 4.36 \times 10^{-4} \times 550 = 0.24\ kW$$

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

According to the GDS Associates Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures (2007),[225] the estimated useful life is 25 years for ceiling insulation.

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone
- Base R-value of original insulation
- R-value of installed insulation
- Space cooling system type (evaporative cooling, refrigerated air conditioning)
- Space heating system type (gas, electric, heat pump)
- Square footage of ceiling insulation installed above a conditioned space
- For homes with a reported baseline R-value less than R-5
    - Two pictures: 1) a picture showing the entire attic floor, and 2) a close-up picture of a ruler that shows the measurement of the depth of the insulation

      Note: The second photo type is required for each area of insulation where there are varying R-values less than R-5. Additionally, both photo types are required for all separate attic/ceiling areas, even when the installed R-value is the same.

References and Efficiency Standards

Petitions and Rulings

- Docket No. 22241, Item 62. Petition by Frontier Associates for Approval of Second Set of Deemed Savings Estimates. Public Utility Commission of Texas.
- Docket No. 41070. Petition of El Paso Electric Company to Approve Revisions to Residential and Commercial Deemed Savings Based on Climate Data Specific to El Paso, Texas. Public Utility Commission of Texas.
- Docket No. 41722. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Sharyland Utilities, L.P., Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company to Approve Revisions to

[225] GDS Associates Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures (2007). http://library.cee1.org/sites/default/files/library/8842/CEE_Eval_MeasureLifeStudyLightsandHVACGDS_1Jun2007.pdf

Residential Deemed Savings to Incorporate Winter Peak Demand Impacts and Update Certain Existing Deemed Savings Values. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 156: Residential Ceiling Insulation Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Added detail on methodology and model characteristics.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. Provided savings tables for installation of insulation up to R-38. Multiplier provided to adjust cooling side savings for homes with evaporative cooling due to lower energy usage and demand associated with evaporative coolers relative to refrigerated air conditioning. Climate Zone 2 savings values awarded for Climate Zone 5 homes with heat pumps.
v3.1	11/05/2015	TRM v3.1 update. Provided example savings calculations. Clarified that no heating demand savings are to be claimed for homes with a gas furnace.
v4.0	10/10/2016	TRM v4.0 update. Updated energy and demand savings per new prototype simulation models and introduced new protocols for baseline and post-retrofit R-values, their associated savings estimations and documentation requirements.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Added clarifying language for U-factor methodology.

2.3.3 Attic Encapsulation Measure Overview

TRM Measure ID: R-BE-AE

Market Sector: Residential

Measure Category: Building envelope

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

Savings are estimated for bringing the attic into conditioned space by insulating and sealing the attic walls and roofs, eliminating leakage (to outside) and removing ceiling insulation, if present, to enhance airflow between the attic and the conditioned space directly below. Savings are presented according to Insulation Improvement and Infiltration Reduction components. Participants are expected to claim the sum of component savings.

Eligibility Criteria

Cooling savings in this measure apply to customers with central or mini-split electric refrigerated air conditioning in their homes or to customers in TRM climate zones 1 and 5 who have evaporative cooling systems. Homes must be centrally heated with either a furnace (gas or electric resistance) or a heat pump to claim heating savings. Customers who participate in hard-to-reach (HTR) or low-income (LI) programs are eligible to claim heating savings for homes heated with gas or electric resistance space heaters. Customers participating in HTR or LI programs are also eligible to claim reduced cooling savings for homes cooled by one or more room air conditioners by applying an adjustment to deemed savings that is specified for homes with refrigerated air.

Baseline Condition

The baseline condition is a vented, unfinished attic with some level of ceiling insulation. Ceiling insulation levels in existing construction can vary significantly, depending on the age of the home, type of insulation installed, and activity in the attic (such as using the attic for storage and HVAC equipment). Deemed savings have been developed based on different levels of encountered (existing) ceiling insulation in participating homes, ranging from no insulation material (R-0) to the equivalent of about 6 inches of fiberglass batt insulation (R-22). The average ceiling insulation level prior to the retrofit for at participating homes is to be determined and documented by the contractor. Degradation due to age and density of the existing insulation should be taken into account.

Because existing ceiling insulation must be removed during measure implementation, the existing R-value will be based upon the R-value of the existing insulation prior to removal.

For any reported pre-retrofit R-value that falls below R-5, the TRM requires all contractors to provide sufficient evidence including two pictures: 1) a picture showing the entire attic floor, and 2) a close-up picture of a ruler that shows the measurement of the depth of the insulation. In the absence of evidence demonstrating pre-retrofit ceiling insulation below R-5, the lowest level of pre-retrofit ceiling insulation that can be claimed is the R-5 to R-8 range.

High-efficiency Condition

A ceiling insulation level of R-30 is recommended throughout Texas as prescribed by the Department of Energy. Accordingly, deemed savings are provided for insulating to R-30. Adjustment factors are provided to allow contractors to estimate savings for installation of higher or lower levels of post-retrofit insulation. Contractors should estimate post-retrofit R-value according to the average insulation depth achieved across the area treated and the R per-inch of the insulation material installed.

Vents, obvious leaks, are to be sealed. Ceiling insulation between the attic and the conditioned space is removed.

Energy and Demand Savings Methodology

The energy and demand savings produced by the attic encapsulation measures have two components: 1) reduced heat transfer into the attic from the insulation improvement, and 2) reduced leakage of conditioned air to outside by closing off vents and sealing of leaks. Accordingly, deemed energy and demand savings are presented by their insulation and air infiltration components. Both insulation improvement component and infiltration reduction component savings should be claimed for all projects. Insulation improvement component savings shall be claimed using deemed savings derived for the ceiling insulation measure, as explained below. There are two paths for claiming infiltration reduction component savings depending on whether pre- and post-retrofit blower door testing is undertaken when implementing the attic encapsulation measure. If blower door testing is performed, savings for the infiltration reduction component can be estimated according to the Residential Air Infiltration measure (Measure 2.3.1). If blower door testing is not undertaken, savings for the Infiltration Reduction component shall be claimed as presented in the air infiltration reduction component savings presented in this measure (below).

In previous versions of the TRM, energy and demand savings for the attic encapsulation measure have been presented according to the results achieved by directly modeling the attic encapsulation measure according to the best interpretation of how the measure should be represented. The expectation is that this measure should, at a minimum, provide savings commensurate with those obtained from the installation of ceiling insulation. In general, the measure is expected to out-perform ceiling insulation. However, modeling results have not reflected this expectation due to complications accounting for reduced infiltration, resulting in lower deemed savings for the attic encapsulation measure than those estimated for ceiling insulation. To encourage implementation of the measure and begin to develop information about the outcomes, the savings presented in this measure for the insulation improvement component of the Attic Encapsulation Measure are equivalent to the ceiling insulation measure savings. After adding air infiltration reduction component savings to the insulation improvement component savings, attic encapsulation measure savings will exceed those of the ceiling insulation measure.

Insulation Component Savings

Savings Algorithms and Input Variables (Insulation Component)

Calibrated simulation modeling was used to develop these deemed savings values. Specifically, these deemed savings estimates were developed by modeling the ceiling insulation measure using BEopt 2.6, running EnergyPlus 8.4 as the underlying simulation engine. For details on the derivation of these savings, refer to the Residential Ceiling Insulation Measure (Measure 2.3.2).

Deemed Energy Savings Tables (Insulation Component)

Table 158 through Table 162 present the energy savings (kWh) associated with attic encapsulation for the five Texas climate zones. Annual energy savings are the sum of cooling and heating savings for the appropriate equipment types. Savings are specified per square foot of conditioned space directly below the treated attic.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling energy savings may be claimed for homes cooled by one or more room air conditioners by multiplying the appropriate cooling savings value from Table 158 through Table 162 by a factor of 0.6.

Table 157: Residential Attic Encapsulation—Prototypical Home Characteristics

Shell Characteristic	Value	Source
Base Attic Encapsulation	Vented Attic R-0 R1-R4 R5-R8 R9-R14 R15-R22	Typical construction practice throughout the state
Change Attic Encapsulation with blower door test	Sealed attic with no ceiling insulation and either R-19 or R-38 roof deck insulation	

Shell Characteristic	Value	Source
Change Attic Encapsulation without blower door test	Sealed attic with no ceiling insulation and either R-19 or R-38 roof deck insulation 18 percent leakage reduction	Leakage Reduction: mean reduction achieved via attic encapsulation according to ACCA Manual J, 8th Edition, Section 21-14[226]

Climate Zone 1: Panhandle Region

Table 158: Climate Zone 1: Panhandle Region—Deemed Annual Energy Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kWh/sq. ft)

Ceiling Insulation Base R-value	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
R-0	0.75	0.22	0.21	5.48	2.35
R-1 to R-4	0.62	0.18	0.18	4.60	1.97
R-5 to R-8	0.28	0.08	0.08	2.16	0.92
R-9 to R-14	0.15	0.04	0.05	1.17	0.50
R-15 to R-22	0.06	0.02	0.02	0.51	0.22

Climate Zone 2: North Region

Table 159: Climate Zone 2: North Region— Deemed Annual Energy Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kWh/sq. ft)

Ceiling Insulation Base R-value	Cooling Savings	Heating Savings		
		Gas Heat	Electric Resistance	Heat Pump
R-0	1.23	0.12	3.40	1.41
R-1 to R-4	1.01	0.10	2.87	1.18
R-5 to R-8	0.46	0.05	1.34	0.55
R-9 to R-14	0.25	0.03	0.72	0.30
R-15 to R-22	0.11	0.01	0.32	0.13

[226] Section 21-14 of ACCA Manual J states that, "…a foam encapsulated attic eliminates ceiling leakage to the outdoors (i.e. to a vented attic), which means that the reduction in infiltration Cfm may range from 3 to 30 percent, with an 18 percent mean, as noted above". See Air Conditioning Contractors of America. Manual J, 8th Edition Version 2.10. Nov. 2011, p. 188.

Climate Zone 3: South Region

Table 160: Climate Zone 3: South Region—Deemed Annual Energy Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kWh/sq. ft)

Ceiling Insulation Base R-value	Cooling Savings	Heating Savings		
		Gas Heat	Electric Resistance	Heat Pump
R-0	1.27	0.09	2.30	0.93
R-1 to R-4	1.04	0.07	1.96	0.79
R-5 to R-8	0.46	0.03	0.92	0.37
R-9 to R-14	0.24	0.02	0.50	0.20
R-15 to R-22	0.10	0.01	0.22	0.09

Climate Zone 4: Valley Region

Table 161: Climate Zone 4: Valley Region—Deemed Annual Energy Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kWh/sq. ft)

Ceiling Insulation Base R-value	Cooling Savings	Heating Savings		
		Gas Heat	Electric Resistance	Heat Pump
R-0	1.00	0.04	1.60	0.62
R-1 to R-4	0.78	0.04	1.35	0.52
R-5 to R-8	0.35	0.02	0.62	0.24
R-9 to R-14	0.18	0.01	0.33	0.13
R-15 to R-22	0.08	0.00	0.14	0.06

Climate Zone 5: West Region

Table 162: Climate Zone 5: West Region—Deemed Annual Energy Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kWh/sq. ft)

Ceiling Insulation Base R-value	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
R-0	1.17	0.38	0.12	3.44	1.43
R-1 to R-4	0.96	0.32	0.10	2.95	1.22
R-5 to R-8	0.43	0.15	0.05	1.40	0.57
R-9 to R-14	0.23	0.08	0.03	0.75	0.31
R-15 to R-22	0.10	0.03	0.01	0.33	0.13

Scale-down/up Factors for Energy Savings: Insulation to Below or Above R-30

The factors presented in this section are to be used when the average post-retrofit insulation depth is providing either more than or less than R-30 insulation. Scale-down factors are provided for the case when average post-retrofit insulation depth is not sufficient to achieve R-30; scale-up factors are provided for the case when insulating to a level greater than R-30. In either case, the following equation should be applied to scale down or scale up the energy savings.

$$Energy\ Savings\ (kWh) = \{R30\ Savings/ft^2 + [S_{D/U} \times (R_{Achieved} - 30)]\} \times A$$

Equation 77

Where:

$R30\ Savings/ft^2$ = *Sum of project-appropriate deemed Cooling and Heating Energy Savings per square feet taken from* Table 135 *through Table 139*

$S_{D/U}$ = *Project-appropriate scale-down or scale-up factor from either* Table 163 *or Table 164*

$R_{Achieved}$ = *Achieved R-value of installed insulation (e.g., for R-28,* $R_{Achieved}$ *= 28)*

A = *Treated area* (ft^2)

If the roof deck and attic walls are insulated to a level less than R-30, the factors in Table 163 shall be applied to scale down the achieved energy savings per square foot of treated ceiling area.

Table 163: Energy Scale-down Factors: Insulation Component of Residential Attic Encapsulation to less than R-30 (kWh/sq. ft./ΔR)

Climate Zone	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	4.00E-03	1.16E-03	1.27E-03	3.26E-02	1.38E-02
2	6.66E-03	n/a	7.11E-04	2.00E-02	8.20E-03
3	6.22E-03	n/a	4.67E-04	1.38E-02	5.47E-03
4	4.92E-03	n/a	2.44E-04	9.04E-03	3.47E-03
5	4.00E-03	1.16E-03	1.27E-03	3.26E-02	1.38E-02

If the roof deck and attic walls are insulated to a level greater than R-30, the following factors shall be applied to scale up the achieved energy savings per square foot of treated ceiling area.

Table 164: Energy Scale-up Factors: Insulation Component of Residential Attic Encapsulation to greater than R-30 (kWh/sq. ft./ΔR)

Climate Zone	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
1	2.66E-03	7.63E-04	8.45E-04	2.18E-02	9.18E-03
2	4.45E-03	n/a	4.82E-04	1.33E-02	5.47E-03
3	4.00E-03	n/a	2.97E-04	9.19E-03	3.66E-03
4	3.24E-03	n/a	1.62E-04	5.99E-03	2.30E-03
5	2.66E-03	7.63E-04	8.45E-04	2.18E-02	9.18E-03

Deemed Summer Demand Savings Tables

Table 165 through Table 169 present the summer demand savings (kW/sq. ft.) associated with the Insulation Improvement component of the Attic Encapsulation Measure for the five Texas climate zones.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying the appropriate cooling value in the refrigerated air column in Table 165 through Table 169 by a factor of 0.6.

Climate Zone 1: Panhandle Region

Table 165: Climate Zone 1: Panhandle Region—Deemed Summer Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Refrigerated Air	Evaporative Cooling
R-0	1.15E-03	3.44E-04
R-1 to R-4	9.78E-04	3.04E-04
R-5 to R-8	4.50E-04	1.47E-04
R-9 to R-14	2.33E-04	7.16E-05
R-15 to R-22	1.02E-04	2.87E-05

Climate Zone 2: North Region

Table 166: Climate Zone 2: North Region—Deemed Summer Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Demand Savings
R-0	1.27E-03
R-1 to R-4	1.10E-03
R-5 to R-8	5.17E-04
R-9 to R-14	2.67E-04
R-15 to R-22	1.15E-04

Climate Zone 3: South Region

Table 167: Climate Zone 3: South Region—Deemed Summer Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Demand Savings
R-0	1.44E-03
R-1 to R-4	1.21E-03
R-5 to R-8	5.51E-04
R-9 to R-14	2.87E-04
R-15 to R-22	1.22E-04

Climate Zone 4: Valley Region

Table 168: Climate Zone 4: Valley Region—Deemed Summer Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Demand Savings
R-0	8.70E-04
R-1 to R-4	7.16E-04
R-5 to R-8	3.40E-04
R-9 to R-14	1.79E-04
R-15 to R-22	7.95E-05

Climate Zone 5: West Region

Table 169: Climate Zone 5: West Region—Deemed Summer Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Refrigerated Air	Evaporative Cooling
R-0	1.18E-03	3.33E-04
R-1 to R-4	1.01E-03	3.25E-04
R-5 to R-8	4.72E-04	1.53E-04
R-9 to R-14	2.38E-04	6.25E-05
R-15 to R-22	1.03E-04	2.09E-05

Scale-down/up Factors: Insulation to Below or Above R-30

If the roof deck and attic walls are insulated to a level less than R-30, the following factors shall be applied to scale down the achieved summer peak demand savings per square foot of treated ceiling area.

Table 170: Summer Peak Demand Scale-down Factors: Ceiling Insulation to less than R-30 (kW/sq. ft./ΔR)

Climate Zone	Refrigerated Air	Evaporative Cooling
1	6.41E-06	1.97E-06
2	7.30E-06	n/a
3	7.91E-06	n/a
4	5.20E-06	n/a
5	6.41E-06	1.97E-06

If the roof deck and attic walls are insulated to a level greater than R-30, the following factors shall be applied to scale up the achieved summer peak demand savings per square foot of treated ceiling area.

Table 171: Summer Peak Demand Scale-up Factors: Ceiling Insulation to greater than R-30 (kW/sq. ft./ΔR)

Climate Zone	Refrigerated Air	Evaporative Cooling
1	4.22E-06	1.89E-06
2	4.92E-06	n/a
3	5.92E-06	n/a
4	3.47E-06	n/a
5	4.22E-06	1.89E-06

Deemed Winter Demand Savings Tables

Table 172 through Table 176 present the winter demand savings associated with the Insulation Improvement component of the Attic Encapsulation Measure for the five Texas climate zones.

Climate Zone 1: Panhandle Region

Table 172: Climate Zone 1: Panhandle Region—Deemed Winter Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	7.83E-05	2.25E-03	1.15E-03
R-1 to R-4	6.35E-05	1.90E-03	9.84E-04
R-5 to R-8	2.51E-05	8.74E-04	4.53E-04
R-9 to R-14	1.37E-05	4.56E-04	2.38E-04
R-15 to R-22	4.72E-06	1.95E-04	1.01E-04

Climate Zone 2: North Region

Table 173: Climate Zone 2: North Region—Deemed Winter Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	6.02E-05	2.49E-03	1.62E-03
R-1 to R-4	5.35E-05	2.11E-03	1.41E-03
R-5 to R-8	2.79E-05	9.84E-04	6.60E-04
R-9 to R-14	1.45E-05	5.13E-04	3.51E-04
R-15 to R-22	6.42E-06	2.23E-04	1.52E-04

Climate Zone 3: South Region

Table 174: Climate Zone 3: South Region-Deemed Winter Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	8.08E-05	1.96E-03	1.08E-03
R-1 to R-4	6.85E-05	1.65E-03	9.43E-04
R-5 to R-8	2.91E-05	7.71E-04	4.49E-04
R-9 to R-14	1.39E-05	4.01E-04	2.35E-04
R-15 to R-22	5.36E-06	1.74E-04	1.03E-04

Climate Zone 4: Valley Region

Table 175: Climate Zone 4: Valley Region—Deemed Winter Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	5.28E-05	1.60E-03	7.50E-04
R-1 to R-4	4.48E-05	1.36E-03	6.47E-04
R-5 to R-8	2.18E-05	6.31E-04	3.03E-04
R-9 to R-14	1.13E-05	3.28E-04	1.57E-04
R-15 to R-22	5.71E-06	1.44E-04	6.95E-05

Climate Zone 5: West Region

Table 176: Climate Zone 5: West Region—Deemed Winter Demand Savings for Insulation Component of Residential Attic Encapsulation: R-30 Insulation (kW/sq. ft.)

Ceiling Insulation Base R-value	Gas	Electric Resistance	Heat Pump
R-0	3.28E-05	9.12E-04	3.91E-04
R-1 to R-4	2.56E-05	8.13E-04	3.45E-04
R-5 to R-8	1.14E-05	3.72E-04	1.57E-04
R-9 to R-14	5.38E-06	1.79E-04	7.54E-05
R-15 to R-22	2.26E-06	7.41E-05	3.11E-05

Scale-down/up Factors for Demand Reduction: Insulation to Below or Above R-30

The factors presented in this section are to be used when the average post-retrofit insulation depth is providing more or less than R-30 insulation. Scale-down factors are provided for the case when average post-retrofit insulation depth is not sufficient to achieve R-30; scale-up factors are provided for the case when insulating to a level greater than R-30. In either case, the following equation should be applied to scale down or scale up the summer peak demand savings.

$$Demand\ Savings\ (kW) = \left\{R30\ Savings/ft^2 + \left[S_{D/U} \times (R_{Achieved} - 30)\right]\right\} \times A$$

Equation 78

Where:

R30 Savings/ft² = | *Sum of project-appropriate deemed Cooling and Heating Energy Savings per square feet taken from* Table 165 *through* Table 169 *or* Table 172 *through* Table 176.

$S_{D/U}$ = *Project-appropriate scale-down or scale-up factor from either* Table 170 *and* Table 171 *(summer) or* Table 177 *and* Table 178 *(winter)*

$R_{Achieved}$ = *Achieved R-value of installed insulation (e.g. for R-28,* $R_{Achieved}$ *= 28)*

A = *Treated area (ft²)*

If the roof deck and attic walls are insulated to a level less than R-30, the following factors shall be applied to scale down the achieved winter peak demand savings (per square foot of treated ceiling area).

Table 177: Winter Peak Demand Scale-down Factors: Ceiling Insulation to less than R-30 (kW/sq. ft./ΔR)

Climate Zone	Gas Heat	Electric Resistance	Heat Pump
1	4.29E-07	1.21E-05	6.30E-06
2	3.97E-07	1.40E-05	9.55E-06
3	3.05E-07	1.10E-05	6.53E-06
4	3.19E-07	9.18E-06	4.32E-06
5	4.29E-07	1.21E-05	6.30E-06

If the roof deck/attic walls are insulated to a level greater than R-30, the following factors shall be applied to scale up the achieved winter peak demand savings per square foot of treated ceiling area.

Table 178: Winter Peak Demand Scale-up Factors: Ceiling Insulation to greater than R-30 (kW/sq. ft./ ΔR)

Climate Zone	Gas Heat	Electric Resistance	Heat Pump
1	2.76E-07	7.85E-06	4.19E-06
2	2.57E-07	8.33E-06	4.80E-06
3	2.19E-07	7.33E-06	4.46E-06
4	1.72E-07	5.79E-06	2.72E-06
5	2.76E-07	7.85E-06	4.19E-06

Air Infiltration Reduction Component Savings

Energy and demand savings for the air infiltration reduction component of the attic encapsulation measure are calculated either using the results of pre- and post-retrofit blower door testing or an average percent infiltration reduction. Regardless of how air infiltration reduction component savings are calculated, they should be added to the insulation improvement component savings to arrive at the total energy and demand savings for implementing the Attic Encapsulation measure.

Homes without refrigerated cooling should not claim air infiltration reduction component savings for attic encapsulation.

With Blower Door Testing

Implementers choosing to perform pre- and post-measure blower door testing should claim the air infiltration reduction component deemed energy and demand savings for the Attic Encapsulation measure using the estimated CFM_{50} reduction from the blower door tests with the equations and coefficients in the Residential Infiltration measure (Measure 2.3.1).

Without Blower Door Testing

Implementers electing not to perform blower door testing when performing this measure shall claim air infiltration reduction component deemed energy and demand savings for the Attic Encapsulation measure using this section, which presents the annual energy (kWh) and summer and winter demand savings (kW) associated with attic encapsulation for the five Texas climate zones, taking into account a mean leakage reduction of 18 percent.[227] Savings are presented per home.

Savings Algorithms and Input Variables (Infiltration Reduction Component)

Calibrated simulation modeling was used to develop air infiltration reduction deemed savings, which are expressed in Measure 2.3.1 as linear functions of the leakage reduction achieved (in CFM_{50}).[228] For details on the derivation of the air infiltration measure savings, refer to the Residential Air Infiltration measure (Measure 2.3.1).

ACCA Manual J provides an average leakage reduction attributable to attic encapsulation projects of 18 percent.[229] Accordingly, deemed savings attributable to the air infiltration reduction component of an attic encapsulation project implemented without pre- and post-implementation blower door testing are estimated by applying an 18 percent leakage reduction to the infiltration rates embedded in the deemed savings prototype model homes used in the

[227] Section 21-14 of ACCA Manual J states that, "…a foam encapsulated attic eliminates ceiling leakage to the outdoors (i.e. to a vented attic), which means that the reduction in infiltration CFM may range from 3 to 30 percent, with an 18 percent mean, as noted above". See Air Conditioning Contractors of America. Manual J, 8th Edition Version 2.10. Nov. 2011, p. 188.

[228] Model testing indicates a straight line relationship between demand and energy savings achieved and CFM50 reductions is appropriate with beginning and ending leakage rates within the ranges permitted by the measure.

[229] Air Conditioning Contractors of America. Manual J, 8th Edition Version 2.10. Nov. 2011, p. 188.

derivation of residential envelope measure deemed savings for the Texas TRM. This 18 percent leakage reduction provides the CFM_{50} reduction input required to estimate air infiltration measure deemed savings with the equations in Measure 2.3.1.

Table 179: Residential Attic Encapsulation—Prototypical Home Characteristics

Shell Characteristic	CFM_{50} reduction	Source
Air Infiltration Reduction from Attic Encapsulation (without Blower Door Testing)	18% reduction	Mean reduction achieved via attic encapsulation according to ACCA Manual J, 8th Edition, Section 21-14[230]

Deemed Energy Savings Tables (Infiltration Reduction Component)

Annual energy savings are provided by the space heating equipment type combined with refrigerated cooling. Savings are specified per home based on a deemed 18 percent infiltration reduction. Homes without refrigerated cooling are not eligible to claim these savings.

Table 180: Deemed Annual Energy Savings for Infiltration Reduction Component of Residential Attic Encapsulation: 18% Air Infiltration Reduction (kWh/home)

Climate Zone	Heating Type		
	Gas Heat/ No Heat	Electric Resistance	Heat Pump
Zone 1: Panhandle	135.0	874.5	385.8
Zone 2: North	209.2	600.3	315.5
Zone 3: South	161.9	469.5	259.6
Zone 4: Valley	179.7	411.9	262.9
Zone 5: West*	64.3	524.7	226.5

Deemed Summer Demand Savings Tables (Infiltration Reduction Component)

Summer demand savings are specified per home based on a deemed 18 percent infiltration reduction. Homes without refrigerated cooling are not eligible to claim these savings.

230 Section 21-14 of ACCA Manual J states that, "…a foam encapsulated attic eliminates ceiling leakage to the outdoors (i.e. to a vented attic), which means that the reduction in infiltration Cfm may range from 3 to 30 percent, with an 18 percent mean, as noted above". See Air Conditioning Contractors of America. Manual J, 8th Edition Version 2.10. Nov. 2011, p. 188.

Table 181: Deemed Summer Demand Savings for Infiltration Reduction Component of Residential Attic Encapsulation: 18% Air Infiltration Reduction (kW/home)

Climate Zone	Refrigerated Air kW/home
Zone 1: Panhandle	0.088
Zone 2: North	0.117
Zone 3: South	0.117
Zone 4: Valley	0.098
Zone 5: West*	0.056

Deemed Winter Demand Savings Tables (Infiltration Reduction Component)

Winter demand savings are provided by space heating equipment types. Savings are specified per home based on a deemed 18 percent infiltration reduction.

Table 182: Deemed Winter Demand Savings for the Infiltration Reduction Component of Residential Attic Encapsulation: 18% Air Infiltration Reduction (kW/home)

Climate Zone	Heating Type		
	Gas Heat/ No Heat	Electric Resistance	Heat Pump
Zone 1: Panhandle	0	0.404	0.235
Zone 2: North	0	0.548	0.304
Zone 3: South	0	0.476	0.244
Zone 4: Valley	0	0.342	0.158
Zone 5: West*	0	0.161	0.066

Examples

Example 1. A contractor seals the attic and adds R-38 insulation to the underside of the roof to a home with 900 square feet of conditioned space below the treated attic in climate zone 3 with refrigerated air and a gas furnace, which has existing ceiling insulation estimated at R-7. No blower door testing is performed.

Insulation Component Savings:

$$Energy\ Savings/ft^2, Insulation\ to\ R-30 = 0.46 + \ 0.03 = \ 0.49\ kWh/ft^2$$

$$Energy\ Savings, Insulation\ to\ R-38 =$$

$$\{0.49 + [(4x10^{-3} + \ 2.97x10^{-4}) \times (38-30)]\} \times \ 900 = \ 471.9\ kWh$$

$$Summer\ Demand\ Savings, Insulation\ to\ R-38 =$$

$$\{5.51\ \times\ 10^{-4} + [5.92\ \times\ 10^{-6}\ x\ (38-30)]\} \times\ 900 = 0.54\ kW$$

$$Winter\ Demand\ Savings, Insulation\ to\ R-38 =$$

$$\{2.91\ \times\ 10^{-5} + [2.19x10^{-7} \times\ (38-30)]\} \times\ 900 = 0.03\ kW$$

Infiltration Reduction Component Savings:

$$Energy\ Savings, 18\%\ Infiltration\ Reduction = \ 161.9\ kWh$$

$$Summer\ Demand\ Savings, 18\%\ Infiltration\ Reduction = 0.12\ kW$$

$$Winter\ Demand\ Savings, 18\%\ Infiltration\ Reduction = 0$$

Measure Savings:

$$Energy\ Savings = \ 471.9\ + 161.9 = 633.8\ kWh$$

$$Summer\ Demand\ Savings = 0.54 + 0.12 = 0.66\ kW$$

$$Winter\ Demand\ Savings = 0.03 + \ 0 = 0.03\ kW$$

Example 2. A contractor seals the attic and adds R-30 insulation to the underside of the roof to a home with 1,200 square feet of conditioned space below the treated attic in climate zone 4 with an air-source heat pump in which existing ceiling insulation is demonstrated to be only R-4. Blower door testing performed before and after measure implementation demonstrated a 750 CFM_{50} reduction in leakage rate.

Insulation Component Savings:

$$Energy\ Savings = (0.78 + 0.52) \times 1{,}200 = 1{,}560\ kWh$$

$$Summer\ Demand\ Savings = 7.16 \times 10^{-4} \times 1{,}200 = 0.86\ kW$$

$$Winter\ Demand\ Savings = 6.47 \times 10^{-4} \times 1{,}200 = 0.78\ kW$$

Infiltration Reduction Component Savings:

$$Energy\ Savings, 750\ CFM_{50}\ Infiltration\ Reduction =$$

$$750 \times (0.39 \times 1 + 0.21) = 450\ kWh$$

$$Summer\ Demand\ Savings, 750\ CFM_{50}\ Infiltration\ Reduction =$$

$$750 \times (2.24x10^{-4} \times 1) = 0.17\ kW$$

$$Winter\ Demand\ Savings, 750\ CFM_{50}\ Infiltration\ Reduction =$$

$$750 \times (3.60x10^{-4}) = 0.27\ kW$$

Measure Savings:

$$Energy\ Savings = 1{,}560 + 450 = 2{,}010\ kWh$$

$$Summer\ Demand\ Savings = 0.86 + 0.17 = 1.03\ kW$$

$$Winter\ Demand\ Savings = 0.78 + 0.27 = 1.05\ kW$$

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

According to the GDS Associates Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures (2007),[231] the Estimated Useful Life is 25 years for ceiling insulation. The measure life specified for ceiling insulation is also appropriate for attic encapsulation.

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone
- Base R-value of original insulation
- R-value of installed insulation
- Space cooling system type (evaporative cooling, refrigerated air conditioning)
- Space heating system type (gas, electric, heat pump)
- Square footage of conditioned space directly below the treated attic
- Only for homes with a reported baseline R-value that is less than R-5:
    - Two pictures: 1) a picture showing the entire attic floor, and 2) a close-up picture of a ruler that shows the measurement of the depth of the insulation
- Indicate whether blower door testing was performed and whether air infiltration reduction component savings are claimed in this measure or separately using the Air Infiltration measure

References and Efficiency Standards

Petitions and Rulings

- 10/2017

Relevant Standards and Reference Sources

This section is not applicable.

[231] GDS Associates Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures (2007). http://library.cee1.org/sites/default/files/library/8842/CEE_Eval_MeasureLifeStudyLightsandHVACGDS_1Jun2007.pdf

Document Revision History

Table 183: Residential Attic Encapsulation Revision History

TRM Version	Date	Description of Change
v4.0	10/10/2016	TRM v4.0 origin.
v5.0	10/2017	TRM v5.0 update. Incorporated alternative savings path that includes savings for infiltration reduction.
v6.0	11/2018	TRM v6.0 update. Removed closed cell recommendation.
v7.0	11/2019	TRM v7.0 update. Incorporated EM&V guidance memo.

2.3.4 Wall Insulation Measure Overview

TRM Measure ID: R-BE-WI

Market Sector: Residential

Measure Category: Building Envelope

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

Wall insulation is added to the walls surrounding conditioned space in existing homes, either by removing wall enclosures and applying batt or spray insulation or by otherwise filling (e.g., blowing in loose insulation) the cavity space between studs in the walls of existing homes. Walls may be either 2x4 or 2x6 construction. Savings are estimated for filling the wall cavities of 2x4 or 2x6 walls with fiberglass batts, cellulose, or closed-cell spray foam and are presented per square foot of treated wall area (gross wall area less window and door area).

Eligibility Criteria

Cooling savings in this measure apply to customers with central or mini-split electric refrigerated air conditioning in their homes, or to customers in TRM climate zones 1 and 5 who have evaporative cooling systems. Homes must be centrally heated with either a furnace (gas or electric resistance) or a heat pump to claim heating savings. Customers who participate in hard-to-reach (HTR) or low-income (LI) programs are eligible to claim heating savings for homes heated with gas or electric resistance space heaters. Customers participating in HTR or LI programs are also eligible to claim reduced cooling savings for homes cooled by one or more room air conditioners by applying an adjustment to deemed savings that is specified for homes with refrigerated air.

Refer to the Baseline Condition section below for eligibility criteria regarding the pre-retrofit level of wall insulation.

Baseline Condition

The baseline is considered to be a house with little or no wall insulation in the wall cavity. For those homes for which a minimal level of insulation is encountered, the baseline is established at R-4. This baseline should be used to represent homes for which installed insulation covers a very limited amount of the wall area to be treated, is significantly degraded, and/or is less than an inch thick. Homes with more than this base level of insulation are not eligible for the measure.

Baseline homes may have either 2x4 or 2x6 construction.

High-efficiency Condition

The standard throughout Texas for adding wall insulation to an existing wall cavity is R-13, as prescribed by the United States Department of Energy (DOE) and Texas Department of Housing and Community Affairs (TDHCA) programs. The standard is achieved by filling a 2x4 wall cavity with fiberglass batt or cellulose insulation, which typically provides an R-value per inch (thickness) of between 3 and 4 $hr \cdot ft^2 \cdot °F/Btu$. Other wall insulation materials may be used, such as closed-cell spray foam, which approximately provides R-6 per inch.

As such, deemed savings are provided for insulating 2x4 and 2x6 walls to the levels presented in Table 184:

Table 184: High-efficiency Condition R-Values for 2x4 and 2x6 Walls

Insulation Material	2x4 Wall	2x6 Wall
Fiberglass batt or cellulose	R-13	R-17
Closed-cell spray foam	R-21	R-33

Wall insulation reduces the ventilation rate in the home, and therefore, a post-installation blower door test must be conducted. Results must comply with the minimum final ventilation rate discussed in the High-efficiency Condition section found in the Air Infiltration section of this document. This requirement applies to retrofits implemented under the HTR and RSOP programs.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Calibrated simulation modeling was used to develop these deemed savings values. Specifically, these deemed savings estimates were developed using BEopt 2.6, running EnergyPlus 8.4 as the underlying simulation engine. To model this measure, the prototype home models for each climate zone were modified as follows: the default R-11 insulation was reduced to either R-0 or R-4.

The model runs calculated energy use for the prototypical home prior to the installation of the wall insulation measure. Next, change-case models were run to calculate energy use with the wall insulation measure in place.

Table 185: Residential Wall Insulation—Prototypical Home Characteristics, Climate Zones 1-4

Shell Characteristic	Value	Source
Base wall insulation	R-0 R-4	BEopt estimates wall assembly R-value for uninsulated walls to be 3.6 for 2x4 construction and 3.7 for 2x6 construction. Assembly R-values for R-4 walls are 6.7 and 7.1 for 2x4 and 2x6 construction, respectively. Listed base levels are for the insulation material only.
Change wall insulation 2x4 wall	R-13 R-21	For retrofit with fiberglass batt/cellulose and closed-cell spray foam, respectively.
Change wall insulation 2x6 wall	R-17 R-33	EF or retrofit with fiberglass batt/cellulose and closed-cell spray foam, respectively.

Deemed Energy Savings Tables

Savings are presented separately for insulating 2x4 wall construction and homes with 2x6 walls. Annual energy savings are the sum of cooling and heating savings for the appropriate equipment types.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying the appropriate cooling value in Table 186 through Table 189 by a factor of 0.6.

2x4 Walls

Table 186 presents the deemed energy savings values for insulating 2x4 walls to R-13 for all five Texas climate zones.

Table 186: Deemed Annual Energy Savings, Insulation of 2x4 Walls to R- 13 (kWh/sq. ft.)

Climate Zone	Base Case Wall Insulation	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	Uninsulated	0.50	0.17	0.18	3.96	1.67
Climate Zone 2: North		0.85	N/A	0.09	2.44	0.99
Climate Zone 3: South		0.90	N/A	0.07	1.67	0.66
Climate Zone 4: Valley		0.53	N/A	0.04	1.19	0.45
Climate Zone 5: West		0.76	0.29	0.09	2.40	0.98
Climate Zone 1: Panhandle	R-4	0.18	0.06	0.07	1.52	0.64
Climate Zone 2: North		0.32	N/A	0.04	0.93	0.38
Climate Zone 3: South		0.33	N/A	0.03	0.64	0.25
Climate Zone 4: Valley		0.19	N/A	0.01	0.45	0.17
Climate Zone 5: West		0.28	0.11	0.03	0.92	0.37

Table 187 presents the deemed energy savings values for insulating 2x4 walls to R-21 for all five Texas climate zones.

Table 187: Deemed Annual Energy Savings, Insulation of 2x4 Walls to R-21 (kWh/sq. ft.)

Climate Zone	Base Case Wall Insulation	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	Uninsulated	0.56	0.18	0.20	4.44	1.87
Climate Zone 2: North		0.95	N/A	0.10	2.73	1.11
Climate Zone 3: South		1.01	N/A	0.08	1.88	0.74
Climate Zone 4: Valley		0.59	N/A	0.04	1.33	0.50
Climate Zone 5: West		0.85	0.33	0.10	2.69	1.09
Climate Zone 1: Panhandle	R-4	0.24	0.08	0.09	2.00	0.84
Climate Zone 2: North		0.42	N/A	0.05	1.23	0.50
Climate Zone 3: South		0.43	N/A	0.03	0.84	0.33
Climate Zone 4: Valley		0.26	N/A	0.02	0.59	0.22
Climate Zone 5: West		0.37	0.14	0.05	1.20	0.49

2x6 Walls

Table 188 presents the deemed energy savings values for insulating 2x6 walls to R-17 for all five Texas climate zones.

Table 188: Deemed Annual Energy Savings, Insulation of 2x6 Walls to R-17 (kWh/sq. ft.)

Climate Zone	Base Case Wall Insulation	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	Uninsulated	0.53	0.18	0.19	4.27	1.80
Climate Zone 2: North		0.91	N/A	0.10	2.63	1.07
Climate Zone 3: South		0.97	N/A	0.08	1.81	0.71
Climate Zone 4: Valley		0.56	N/A	0.04	1.27	0.48
Climate Zone 5: West		0.81	0.31	0.10	2.58	1.05
Climate Zone 1: Panhandle	R-4	0.22	0.07	0.08	1.81	0.76
Climate Zone 2: North		0.38	N/A	0.04	1.11	0.45
Climate Zone 3: South		0.39	N/A	0.03	0.76	0.30
Climate Zone 4: Valley		0.23	N/A	0.02	0.53	0.20
Climate Zone 5: West		0.33	0.13	0.04	1.08	0.44

Table 189 presents the deemed energy savings values for insulating 2x6 walls to R-33 for all five Texas climate zones.

Table 189: Deemed Annual Energy Savings, Insulation of 2x6 Walls to R-33 (kWh/sq. ft.)

Climate Zone	Base Case Wall Insulation	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	Uninsulated	0.59	0.20	0.22	4.79	2.01
Climate Zone 2: North		1.01	N/A	0.11	2.94	1.20
Climate Zone 3: South		1.07	N/A	0.09	2.02	0.80
Climate Zone 4: Valley		0.62	N/A	0.04	1.42	0.54
Climate Zone 5: West		0.90	0.35	0.11	2.88	1.17
Climate Zone 1: Panhandle	R-4	0.28	0.09	0.11	2.33	0.98
Climate Zone 2: North		0.48	N/A	0.05	1.42	0.58
Climate Zone 3: South		0.49	N/A	0.04	0.98	0.38
Climate Zone 4: Valley		0.29	N/A	0.02	0.67	0.25
Climate Zone 5: West		0.42	0.16	0.05	1.38	0.56

Deemed Summer Demand Savings Tables

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying the appropriate cooling value in Table 190 through Table 193 by a factor of 0.6.

2x4 Walls

Table 190 presents the deemed summer demand savings values for insulating 2x4 walls to R-13 for all five Texas climate zones.

Table 190: Deemed Summer Demand Savings, Insulation of 2x4 Walls to R-13 (kW/sq. ft.)

Climate Zone	Base Case Wall Insulation	Cooling Type	
		Refrigerated Air	Evaporative Cooling
Climate Zone 1: Panhandle	Uninsulated	6.41E-04	2.40E-04
Climate Zone 2: North		7.32E-04	N/A
Climate Zone 3: South		8.50E-04	N/A
Climate Zone 4: Valley		4.17E-04	N/A
Climate Zone 5: West		6.52E-04	2.00E-04
Climate Zone 1: Panhandle	R-4	2.35E-04	9.16E-05
Climate Zone 2: North		2.70E-04	N/A
Climate Zone 3: South		3.02E-04	N/A
Climate Zone 4: Valley		1.55E-04	N/A
Climate Zone 5: West		2.43E-04	7.40E-05

Table 191 presents the deemed summer demand savings values for insulating 2x4 walls to R-13 for all five Texas climate zones.

Table 191: Deemed Summer Demand Savings, Insulation of 2x4 Walls to R-21 (kW/sq. ft.)

Climate Zone	Base Case Wall Insulation	Cooling Type	
		Refrigerated Air	Evaporative Cooling
Climate Zone 1: Panhandle	Uninsulated	7.34E-04	2.66E-04
Climate Zone 2: North		8.16E-04	N/A
Climate Zone 3: South		9.55E-04	N/A
Climate Zone 4: Valley		4.69E-04	N/A
Climate Zone 5: West		7.32E-04	2.23E-04
Climate Zone 1: Panhandle	R-4	3.29E-04	1.18E-04
Climate Zone 2: North		3.55E-04	N/A
Climate Zone 3: South		4.08E-04	N/A
Climate Zone 4: Valley		2.07E-04	N/A
Climate Zone 5: West		3.24E-04	9.68E-05

2x6 Walls

Table 192 presents the deemed summer demand savings values for insulating 2x6 walls to R-17 for all five Texas climate zones.

Table 192: Deemed Summer Demand Savings, Insulation of 2x6 Walls to R-17 (kW/sq. ft.)

Climate Zone	Base Case Wall Insulation	Cooling Type	
		Refrigerated Air	Evaporative Cooling
Climate Zone 1: Panhandle	Uninsulated	7.00E-04	2.59E-04
Climate Zone 2: North		7.87E-04	N/A
Climate Zone 3: South		9.20E-04	N/A
Climate Zone 4: Valley		4.56E-04	N/A
Climate Zone 5: West		7.06E-04	2.14E-04
Climate Zone 1: Panhandle	R-4	2.88E-04	1.06E-04
Climate Zone 2: North		3.19E-04	N/A
Climate Zone 3: South		3.67E-04	N/A
Climate Zone 4: Valley		1.88E-04	N/A
Climate Zone 5: West		2.91E-04	8.44E-05

Table 193 presents the deemed summer demand savings values for insulating 2x6 walls to R-33 for all five Texas climate zones.

Table 193: Deemed Summer Demand Savings, Insulation of 2x6 Walls to R-33 (kW/sq. ft.)

Climate Zone	Base Case Wall Insulation	Cooling Type	
		Refrigerated Air	Evaporative Cooling
Climate Zone 1: Panhandle	Uninsulated	7.76E-04	2.83E-04
Climate Zone 2: North		8.77E-04	N/A
Climate Zone 3: South		1.02E-03	N/A
Climate Zone 4: Valley		5.08E-04	N/A
Climate Zone 5: West		7.80E-04	2.38E-04
Climate Zone 1: Panhandle	R-4	3.64E-04	1.30E-04
Climate Zone 2: North		4.09E-04	N/A
Climate Zone 3: South		4.64E-04	N/A
Climate Zone 4: Valley		2.40E-04	N/A
Climate Zone 5: West		3.65E-04	1.08E-04

Deemed Winter Demand Savings

2x4 Walls

Table 194 presents the deemed winter demand savings values for insulating 2x4 walls to R-13 for all five Texas climate zones.

Table 194: Deemed Winter Demand Savings, Insulation of 2x4 Walls to R-13 (kW/sq. ft.)

Climate Zone	Base Case Wall Insulation	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	Uninsulated	6.93E-05	1.71E-03	8.78E-04
Climate Zone 2: North		6.66E-05	1.96E-03	1.30E-03
Climate Zone 3: South		7.49E-05	1.48E-03	8.39E-04
Climate Zone 4: Valley		4.28E-05	1.22E-03	5.78E-04
Climate Zone 5: West		2.06E-05	6.78E-04	2.84E-04
Climate Zone 1: Panhandle	R-4	2.58E-05	6.20E-04	3.19E-04
Climate Zone 2: North		2.46E-05	7.32E-04	4.94E-04
Climate Zone 3: South		2.61E-05	5.50E-04	3.20E-04
Climate Zone 4: Valley		1.61E-05	4.51E-04	2.13E-04
Climate Zone 5: West		6.23E-06	2.23E-04	9.39E-05

Table 195 presents the deemed winter demand savings values for insulating 2x4 walls to R-21 for all five Texas climate zones.

Table 195: Deemed Winter Demand Savings, Insulation of 2x4 Walls to R-17 (kW/sq. ft.)

Climate Zone	Base Case Wall Insulation	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	Uninsulated	7.69E-05	1.89E-03	9.75E-04
Climate Zone 2: North		7.41E-05	2.18E-03	1.46E-03
Climate Zone 3: South		8.19E-05	1.65E-03	9.40E-04
Climate Zone 4: Valley		4.78E-05	1.36E-03	6.41E-04
Climate Zone 5: West		2.24E-05	7.37E-04	3.10E-04
Climate Zone 1: Panhandle	R-4	3.34E-05	8.06E-04	4.16E-04
Climate Zone 2: North		3.20E-05	9.57E-04	6.50E-04
Climate Zone 3: South		3.31E-05	7.19E-04	4.21E-04
Climate Zone 4: Valley		2.11E-05	5.88E-04	2.77E-04
Climate Zone 5: West		8.01E-06	2.83E-04	1.20E-04

2x6 Walls

Table 196 presents the deemed winter demand savings values for insulating 2x6 walls to R-17 for all five Texas climate zones.

Table 196: Deemed Winter Demand Savings, Insulation of 2x6 Walls to R-17 (kW/sq. ft.)

Climate Zone	Base Case Wall Insulation	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	Uninsulated	6.99E-05	1.76E-03	9.09E-04
Climate Zone 2: North		7.01E-05	2.07E-03	1.40E-03
Climate Zone 3: South		7.86E-05	1.57E-03	9.10E-04
Climate Zone 4: Valley		4.58E-05	1.29E-03	6.08E-04
Climate Zone 5: West		1.84E-05	6.24E-04	2.64E-04
Climate Zone 1: Panhandle	R-4	2.68E-05	6.93E-04	3.58E-04
Climate Zone 2: North		2.84E-05	8.49E-04	5.84E-04
Climate Zone 3: South		2.96E-05	6.40E-04	3.82E-04
Climate Zone 4: Valley		1.90E-05	5.19E-04	2.41E-04
Climate Zone 5: West		5.59E-06	2.06E-04	8.81E-05

Table 197 presents the deemed winter demand savings values for insulating 2x6 walls to R-33 for all five Texas climate zones.

Table 197: Deemed Winter Demand Savings, Insulation of 2x6 Walls to R-33 (kW/sq. ft.)

Climate Zone	Base Case Wall Insulation	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	Uninsulated	7.66E-05	1.95E-03	1.00E-03
Climate Zone 2: North		7.77E-05	2.31E-03	1.56E-03
Climate Zone 3: South		8.62E-05	1.75E-03	1.02E-03
Climate Zone 4: Valley		5.11E-05	1.43E-03	6.73E-04
Climate Zone 5: West		1.96E-05	6.66E-04	2.82E-04
Climate Zone 1: Panhandle	R-4	3.35E-05	8.76E-04	4.53E-04
Climate Zone 2: North		3.60E-05	1.08E-03	7.44E-04
Climate Zone 3: South		3.72E-05	8.17E-04	4.92E-04
Climate Zone 4: Valley		2.43E-05	6.59E-04	3.06E-04
Climate Zone 5: West		6.87E-06	2.48E-04	1.06E-04

Examples

Example 1. A home with uninsulated 2x4 walls in climate zone 1 with evaporative cooling and an electric resistance furnace insulates 750 square feet to R-13 with fiberglass batt insulation.

$$kWh\ savings = (0.17 + 3.96) \times 750 = \mathit{3{,}091.5}\ kWh$$

$$Summer\ kW\ savings = 2.40 \times 10^{-4} \times 750 = 0.18\ kW$$

$$Winter\ kW\ savings = 1.71 \times 10^{-3} \times 750 = 1.28\ kW$$

Example 2. A home in climate zone 4 with uninsulated 2x6 walls with a central air conditioning unit and a gas furnace insulates 500 square feet to R-17 with closed-cell spray foam.

$$kWh\ savings = (0.56 + 0.04) \times 500 = \mathit{300.0}\ kWh$$

$$Summer\ kW\ savings = 4.56 \times 10^{-4} \times 500 = 0.23\ kW$$

$$Winter\ kW\ savings = 4.58 \times 10^{-5} \times 500 = 0.02\ kW$$

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

According to the GDS Associates Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures (2007), the Estimated Useful Life is 25 years for wall insulation.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Space heating system type (gas, electric, heat pump)
- Space cooling system type (evaporative cooling, refrigerated air conditioning)
- Square footage of retrofitted wall area (gross wall area excluding window and door area)

References and Efficiency Standards

Petitions and Rulings

- Docket No. 22241, Item 58. Petition by Frontier Associates for Approval of Second Set of Deemed Savings Estimates. Public Utility Commission of Texas.
- Docket No. 22241, Item 62. Petition by Frontier Associates for Approval of Second Set of Deemed Savings Estimates. Public Utility Commission of Texas.
- Docket No. 41070. Petition of El Paso Electric Company to Approve Revisions to Residential and Commercial Deemed Savings Based on Climate Data Specific to El Paso, Texas. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 198: Residential Wall Insulation Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Added detail on methodology and model characteristics.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. Multiplier provided to adjust cooling side savings for homes with evaporative cooling due to lower energy usage and demand associated with evaporative coolers relative to refrigerated air. Climate Zone 2 savings values awarded for Climate Zone 5 homes with heat pumps.
v3.1	11/05/2015	TRM v3.1 update. Provided example savings calculations.
v4.0	8/31/2016	TRM v4.0 update. Updated energy and demand savings per new prototype energy simulation models. Added separate savings for 2x4 and 2x6 wall framing and for homes with central AC versus evaporative cooling. Added a two-tier baseline definition of R-0 and R-4.
v5.0	10/2017	TRM v5.0 update. Make an explicit allowance for cellulose insulation.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.

2.3.5 Floor Insulation Measure Overview

TRM Measure ID: R-BE-FI

Market Sector: Residential

Measure Category: Building envelope

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

Floor insulation is installed on the underside of floor areas sitting below conditioned space. Typically, it is installed in ventilated crawlspaces. Savings are presented per square foot of treated floor area.

Eligibility Criteria

Cooling savings in this measure apply to customers with central or mini-split electric refrigerated air conditioning in their homes, or to customers in TRM climate zones 1 and 5 who have evaporative cooling systems. Homes must be centrally heated with either an electric resistance furnace or a heat pump to claim heating savings. Customers who participate in hard-to-reach (HTR) or low-income (LI) programs are eligible to claim heating savings for homes heated with electric resistance space heaters. Customers participating in HTR or LI programs are also eligible to claim reduced cooling savings for homes cooled by one or more room air conditioners by applying an adjustment to deemed savings that is specified for homes with refrigerated air.

Homes with gas heating are disqualified for adding floor insulation since this may result in an energy penalty due to floors not getting cooled from the ground during summer.

Baseline Condition

The baseline is considered to be a house with pier and beam construction and no floor insulation against the floor of the conditioned area.

High-efficiency Condition

A floor insulation level of R-19 is recommended for site-built homes throughout Texas as prescribed by DOE and Texas Department of Housing and Community Affairs (TDHCA) programs. Batt insulation is recommended in most cases and must have the vapor barrier installed facing up and against the floor or conditioned area. Insulation should be attached or secured so that it can reasonably be expected to remain in place for at least 10 years.

Typical floor construction depth of manufactured homes usually does not allow R-19 batt to be installed within the floor joists, so R-15 loose-fill insulation is recommended by TDHCA.

A minimum of 24-inch clearance from the bottom of the insulation to the ground is required by the Occupational Safety and Health Association (OSHA).

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Calibrated simulation modeling was used to develop these deemed savings values.

Savings values for the deemed savings estimates for this measure were developed using demand and energy savings calculated using BEopt 2.6, running Energy Plus 8.1 as the underlying simulation engine. To model this measure, the prototype home models for each climate zone were modified as follows: slab foundation was replaced with a crawlspace. A 5/8" thick wood floor is also specified.

The model runs calculated energy use for the prototypical home prior to the installation of the floor insulation measure. Next, change-case models were run to calculate energy use with the floor insulation measure in place.

Table 199: Residential Floor Insulation—Modifications to the Prototype Home Characteristics

Shell Characteristic	Value	Source
Foundation	Crawlspace	Skirting around the perimeter is assumed uninsulated and vented. The ground under the home is assumed to be bare, without any type of moisture barrier.
Base Floor Insulation	R-3.1	BEopt default for floor assembly, assuming 5/8" thick hardwood floor without carpet or another type of covering.
Change Floor Insulation	R-19 (except for manufactured housing, R-15)	Efficiency measure - retrofit insulation level as required by DOE and Texas Department of Housing and Community Affairs programs in Texas. Due to the typical floor joists depths found in manufactured housing, TDHCA recommends R-15 loose-fill insulation for manufactured housing and other non-site-built homes.

Deemed Energy Savings Tables

Table 200 through Table 204 present energy savings on a kWh per square foot of insulation installed basis for all five Texas climate zones. Annual energy savings are the sum of cooling and heating savings for the appropriate equipment types.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying the appropriate cooling value in Table 200 through Table 203 by a factor of 0.6.

Table 200: Climate Zone 1: Panhandle Region—Residential Floor Insulation Deemed Annual Energy Savings (kWh/sq. ft.)

Home Type	Cooling Savings		Heating Savings	
	Refrigerated Air	Evaporative Cooling	Electric Resistance	Heat Pump
Site-built Home	-0.13	-0.07	1.72	0.68
Manufactured Home	-0.11	-0.06	1.52	0.60

Table 201: Climate Zone 2: North Region—Residential Floor Insulation Deemed Annual Energy Savings (kWh/sq. ft.)

Home Type	Cooling Savings		Heating Savings	
	Refrigerated Air	Evaporative Cooling	Electric Resistance	Heat Pump
Site-built Home	-0.12	-	0.96	0.38
Manufactured Home	-0.10	-	0.85	0.33

Table 202: Climate Zone 3: South Region—Residential Floor Insulation Deemed Annual Energy Savings (kWh/sq. ft.)

Home Type	Cooling Savings		Heating Savings	
	Refrigerated Air	Evaporative Cooling	Electric Resistance	Heat Pump
Site-built Home	-0.12	-	0.63	0.24
Manufactured Home	-0.10	-	0.56	0.21

Table 203: Climate Zone 4: Valley Region—Residential Floor Insulation Deemed Annual Energy Savings (kWh/sq. ft.)

Home Type	Cooling Savings		Heating Savings	
	Refrigerated Air	Evaporative Cooling	Electric Resistance	Heat Pump
Site-built Home	-0.07	-	0.40	0.15
Manufactured Home	-0.06	-	0.35	0.13

Table 204: Climate Zone 5: West Region—Residential Floor Insulation Deemed Annual Energy Savings (kWh/sq. ft.)

Home Type	Cooling Savings		Heating Savings	
	Refrigerated Air	Evaporative Cooling	Electric Resistance	Heat Pump
Site-built Home	-0.16	-0.07	1.10	0.43
Manufactured Home	-0.13	-0.06	0.97	0.38

Deemed Summer Demand Savings Tables

Table 205 through Table 209 present the deemed summer demand savings (kW) for all five Texas climate zones.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying the appropriate cooling value in Table 205 through Table 209 by a factor of 0.6.

Table 205: Climate Zone 1: Panhandle Region—Residential Floor Insulation Deemed Summer Demand Savings (kW/sq. ft.)

Home Type	Refrigerated Air	Evaporative Cooling
Site-built Home	6.17E-06	-1.52E-05
Manufactured Home	5.48E-06	-1.30E-05

Table 206: Climate Zone 2: North Region—Residential Floor Insulation Deemed Summer Demand Savings (kW/sq. ft.)

Home Type	Refrigerated Air	Evaporative Cooling
Site-built Home	3.10E-05	-
Manufactured Home	2.75E-05	-

Table 207: Climate Zone 3: South Region—Residential Floor Insulation Deemed Summer Demand Savings (kW/sq. ft.)

Home Type	Refrigerated Air	Evaporative Cooling
Site-built Home	3.36E-05	-
Manufactured Home	2.77E-05	-

Table 208: Climate Zone 4: Valley Region—Residential Floor Insulation Deemed Summer Demand Savings (kW/sq. ft.)

Home Type	Refrigerated Air	Evaporative Cooling
Site-built Home	3.58E-05	-
Manufactured Home	3.07E-05	-

Table 209: Climate Zone 5: West Region—Residential Floor Insulation Deemed Summer Demand Savings (kW/sq. ft.)

Home Type	Refrigerated Air	Evaporative Cooling
Site-built Home	6.29E-06	-1.34E-06
Manufactured Home	8.30E-07	1.85E-07

Deemed Winter Demand Savings Tables

Table 210 through Table 214 present the deemed winter demand savings for all five Texas climate zones. Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Table 210: Climate Zone 1: Panhandle Region—Residential Floor Insulation Deemed Winter Demand Savings (kW/sq. ft.)

Home Type	Electric Resistance	Heat Pump
Site-built Home	5.23E-04	2.55E-04
Manufactured Home	4.62E-04	2.25E-04

Table 211: Climate Zone 2: North Region—Residential Floor Insulation Deemed Winter Demand Savings (kW/sq. ft.)

Home Type	Electric Resistance	Heat Pump
Site-built Home	5.19E-04	2.88E-04
Manufactured Home	4.56E-04	2.50E-04

Table 212: Climate Zone 3: South Region—Residential Floor Insulation Deemed Winter Demand Savings (kW/sq. ft.)

Home Type	Electric Resistance	Heat Pump
Site-built Home	4.22E-04	2.03E-04
Manufactured Home	3.64E-04	1.74E-04

Table 213: Climate Zone 4: Valley Region—Residential Floor Insulation Deemed Winter Demand Savings (kW/sq. ft.)

Home Type	Electric Resistance	Heat Pump
Site-built Home	3.51E-04	1.53E-04
Manufactured Home	3.02E-04	1.31E-04

Table 214: Climate Zone 5: West Region—Residential Floor Insulation Deemed Winter Demand Savings (kW/sq. ft.)

Home Type	Electric Resistance	Heat Pump
Site-built Home	3.54E-04	1.44E-04
Manufactured Home	3.19E-04	1.30E-04

Examples

Example 1. A manufactured home in Climate Zone 5 with evaporative cooling and an electric resistance furnace insulates 500 square feet.

$$kWh\ savings = (-0.06 + 0.97) \times 500 = \mathit{457.0}\ kWh$$

$$Summer\ kW\ savings = 1.85 \times 10^{-7} \times 500 = 0.00\ kW$$

$$Winter\ kW\ savings = 3.19 \times 10^{-4} \times 500 = 0.16\ kW$$

Example 2. A site-built home in Climate Zone 2 with an air-source heat pump insulates 825 square feet.

$$kWh\ savings = (-0.12 + 0.38) \times 825 = \mathit{212.0}\ kWh$$

$$Summer\ kW\ savings = 3.10 \times 10^{-5} \times 825 = 0.03\ kW$$

$$Winter\ kW\ savings = 2.88 \times 10^{-4} \times 825 = 0.24\ kW$$

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

According to the GDS Associates Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures (2007), the Estimated Useful Life is 25 years for floor insulation.

<u>Program Tracking Data and Evaluation Requirements</u>

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are: The climate zone

- Climate zone
- Space heating system type (gas, electric, heat pump)

- Space cooling system type (evaporative cooling or electric air conditioning)
- Home type (site built or manufactured)
- Square footage of installed insulation

References and Efficiency Standards

Petitions and Rulings

- Docket No. 22241, Item 62. Petition by Frontier Associates for Approval of Second Set of Deemed Savings Estimates. Public Utility Commission of Texas.
- Docket No. 41070. Petition of El Paso Electric Company to Approve Revisions to Residential and Commercial Deemed Savings Based on Climate Data Specific to El Paso, Texas. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 215: Residential Floor Insulation Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Added detail on methodology and model characteristics.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. Multiplier provided to adjust cooling side savings for homes with evaporative cooling due to lower energy usage and demand associated with evaporative coolers relative to refrigerated air. Climate Zone 2 savings values awarded for Climate Zone 5 homes with heat pumps.
v3.1	11/05/2015	TRM v3.1 update. Provided example savings calculations.
v4.0	10/10/2016	TRM v4.0 update. Updated energy and demand savings per new prototype energy simulation models. Added separate savings for homes with evaporative cooling. Disqualified homes with gas heating for adding floor insulation.
v5.0	10/2017	TRM v5.0 update. Added an explicit reference to mini-split technology.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.

2.3.6 ENERGY STAR® Windows Measure Overview

TRM Measure ID: R-BE-EW

Market Sector: Residential

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Measure Category: Building envelope

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

ENERGY STAR® windows savings are calculated on a per square foot of window basis, inclusive of frame and sash.

Eligibility Criteria

Cooling savings in this measure apply to customers with central or mini-split electric refrigerated air conditioning in their homes, or to customers in TRM climate zones 1 and 5 who have evaporative cooling systems. Homes must be centrally heated with either a furnace (gas or electric resistance) or a heat pump to claim heating savings. Customers who participate in hard-to-reach (HTR) or low-income (LI) programs are eligible to claim heating savings for homes heated with gas or electric resistance space heaters. Customers participating in HTR or LI programs are also eligible to claim reduced cooling savings for homes cooled by one or more room air conditioners by applying an adjustment to deemed savings that is specified for homes with refrigerated air.

Baseline

There are two base cases: single-pane and double-pane windows. In both cases, a metal frame is specified. Estimated U-Values and SHGCs for baseline windows are presented in Table 216.

Table 216: Baseline Windows

Number of Panes	U-Factor Btu/(h·ft^2·°F)	Solar Heat Gain Coefficient (SHGC)
1	1.16	0.76
2	0.76	0.67

High-efficiency Condition

For a window to qualify for these deemed savings, it must meet the relevant ENERGY STAR® criteria for the location in the state where the window is to be installed. Table 217 lists the ENERGY STAR® specifications for windows as of January 1, 2015. These values are subject to updates in ENERGY STAR® specifications; energy efficiency service providers are expected to comply with the latest ENERGY STAR® code.

Table 217: ENERGY STAR® Windows Specifications effective January 2015

U.S. Region, ENERGY STAR®	U-Factor Btu/(h·ft^2·°F)	Solar Heat Gain Coefficient (SHGC)
North-Central	≤ 0.30	≤ 0.40
South-Central	≤ 0.30	≤ 0.25
Southern	≤ 0.40	≤ 0.25

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Deemed savings values have been estimated using calibrated simulation models. Base case homes were fitted with single-pane and double-pane windows: change case homes were equipped with windows meeting the appropriate ENERGY STAR window specification for the location in which the window was to be installed. The climate zones in the ENERGY STAR® windows specification were mapped to the Texas TRM climate zones as shown in Table 218:

Table 218. TRM Climate Zones and ENERGY STAR® Windows Climate Zones

Texas TRM Climate Zones	U.S. Region, ENERGY STAR® Windows
Climate Zone 1: Panhandle	North-Central
Climate Zone 2: North	South-Central
Climate Zone 3: South	Southern
Climate Zone 4: Valley	Southern
Climate Zone 5: West	South-Central

Deemed Energy Savings Tables

Table 219 and Table 220 present the energy savings (kWh) for the five Texas climate zones. Annual energy savings are the sum of cooling and heating savings for the appropriate equipment types.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying appropriate cooling values in Table 219 and Table 220 by a factor of 0.6.

Table 219: ENERGY STAR® Windows Replacing Single-Pane Windows, Deemed Annual Energy Savings (kWh/sq. ft.)

Climate Zone	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	2.83	0.98	0.29	6.70	3.16
Climate Zone 2: North	5.42	-	0.10	3.09	1.45
Climate Zone 3: South	5.32	-	0.02	0.77	0.41
Climate Zone 4: Valley	5.97	-	0.02	0.82	0.34
Climate Zone 5: West	5.67	1.90	0.00	0.99	0.69

Table 220: ENERGY STAR® Windows Replacing Double-Pane Windows Deemed Annual Energy Savings (kWh/sq. ft.)

Climate Zone	Cooling Savings		Heating Savings		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	2.03	0.72	0.18	4.15	2.00
Climate Zone 2: North	4.11	-	0.04	1.47	0.76
Climate Zone 3: South	3.96	-	-0.01	-0.21	0.01
Climate Zone 4: Valley	4.45	-	0.00	-0.01	0.02
Climate Zone 5: West	4.24	1.46	-0.03	-0.18	0.16

Deemed Summer Demand Savings Tables

Table 221 and Table 222 presents the summer demand savings (kW) for the five Texas climate zones.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying appropriate cooling values in Table 221 and Table 222 by a factor of 0.6.

Table 221: ENERGY STAR® Windows Replacing Single-Pane Windows, Deemed Summer Demand Savings (kW/sq. ft.)

Climate Zone	Refrigerated Air	Evaporative Cooling
Climate Zone 1: Panhandle	3.09E-03	1.16E-03
Climate Zone 2: North	3.89E-03	-
Climate Zone 3: South	3.51E-03	-
Climate Zone 4: Valley	2.99E-03	-
Climate Zone 5: West	3.86E-03	1.05E-03

Table 222: ENERGY STAR® Windows Replacing Double-Pane Windows, Deemed Summer Demand Savings (kW/sq. ft.)

Climate Zone	Refrigerated Air	Evaporative Cooling
Climate Zone 1: Panhandle	2.08E-03	8.36E-04
Climate Zone 2: North	2.80E-03	-
Climate Zone 3: South	2.40E-03	-
Climate Zone 4: Valley	2.15E-03	-
Climate Zone 5: West	2.76E-03	8.09E-04

Deemed Winter Demand Savings Tables

Table 223 and Table 224 presents the winter demand savings (kW) for the five Texas climate zones.

Table 223: ENERGY STAR® Windows Replacing Single-Pane Windows, Deemed Winter Demand Savings by Heat Type (kW/sq. ft.)

Climate Zone	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	2.01E-04	4.98E-03	2.43E-03
Climate Zone 2: North	1.77E-04	4.73E-03	2.74E-03
Climate Zone 3: South	6.89E-05	1.78E-03	3.11E-04
Climate Zone 4: Valley	4.78E-05	1.65E-03	6.68E-04
Climate Zone 5: West	2.83E-05	1.10E-03	5.00E-04

Table 224: ENERGY STAR® Windows Replacing Double-Pane Windows, Deemed Winter Demand Savings by Heat Type (kW/sq. ft.)

Climate Zone	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	1.32E-04	3.30E-03	1.64E-03
Climate Zone 2: North	1.12E-04	3.16E-03	1.89E-03
Climate Zone 3: South	2.33E-05	6.68E-04	3.58E-06
Climate Zone 4: Valley	1.53E-05	5.62E-04	2.34E-04
Climate Zone 5: West	1.31E-05	5.84E-04	2.76E-04

Examples

Example 1. A home in Climate Zone 1 with evaporative cooling and an electric resistance furnace replaces 125 square feet of single-pane windows with ENERGY STAR® windows.

$$kWh\ savings = (0.98 + 6.70) \times 125 = 960\ kWh$$

$$Summer\ kW\ savings = 1.16x10^{-3} \times 125 = 0.15\ kW$$

$$Winter\ kW\ savings = 4.98x10^{-3} \times 125 = 0.62\ kW$$

Example 2. A home in climate zone 5 with a central air conditioning unit and a gas furnace replaces 250 square feet of double-pane windows with ENERGY STAR® windows.

$$kWh\ savings = \left(4.24 + (-0.03)\right) \times 250 = 1{,}052.5\ kWh$$

$$Summer\ kW\ savings = 2.76 \times 10^{-3} \times 250 = 0.69\ kW$$

$$Winter\ kW\ savings = 1.31 \times 10^{-5} \times 250 = 0.00\ kW$$

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

According to the GDS Associates Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures (2007), the Estimated Useful Life is 25 years for ENERGY STAR® windows.

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone
- Space heating system type (non-electric, electric resistance, heat pump)
- Space cooling system type (evaporative cooling or electric air conditioning)
- Area of ENERGY STAR® windows installed
- Proof of purchase – with date of purchase and quantity
  - Alternative: photo of unit installed or another pre-approved method of installation verification.

References and Efficiency Standards

Petitions and Rulings

- Docket No. 22241, Item 48. Petition by Frontier Associates for Approval of Second Set of Deemed Savings Estimates. Public Utility Commission of Texas.
- Docket No. 27903. Order Adopting New §25.184 as Approved at the August 21, 2003, Open Meeting and Submitted to the Secretary of State. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 225: Residential ENERGY STAR® Windows Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor edits to language.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. Multiplier provided to adjust cooling side savings for homes with evaporative cooling due to lower energy usage and demand associated with evaporative coolers relative to refrigerated air. Climate Zone 2 savings values awarded for Climate Zone 5 homes.
v3.1	11/05/2015	TRM v3.1 update. Provided example savings calculations. Consolidated table formats.
v4.0	10/10/2016	TRM v4.0 update. Updated energy and demand savings per new prototype energy simulation models. Added separate savings for homes with evaporative cooling.
v5.0	10/2017	TRM v5.0 update. Added explicit reference to mini-split technology
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Updated documentation requirements.

2.3.7 Solar Screens Measure Overview

TRM Measure ID: R-BE-SS

Market Sector: Residential

Measure Category: Building Envelope

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

Savings are presented for the installation of solar screens on west- and/or south-facing windows or glass doors. Deemed savings are calculated per square foot of treated window or door opening.

Eligibility Criteria

Cooling savings in this measure apply to customers with central or mini-split electric refrigerated air conditioning in their homes, or to customers in TRM climate Zznes 1 and 5 who have evaporative cooling systems. The heating savings penalty applies to homes that are centrally heated with either a furnace (gas or electric resistance) or a heat pump.

Solar screens must be installed on windows or glass doors that face west or south and receive significant direct sun exposure. Solar screens must block at least 65 percent of the solar heat gain to qualify for deemed savings.

Baseline Condition

The baseline is a single pane, clear glass, unshaded, west-, or south-facing window with a solar heat gain coefficient of 0.68. The baseline window area is assumed to be 7.5 percent of the total wall area.

High-efficiency Condition

Solar screen material installed on south- or west-facing windows must reduce solar heat gain by at least 65 percent. Solar screens are not recommended for homes with electric resistance heat.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Deemed savings values have been estimated using calibrated simulation models. Specifically, these deemed savings estimates were developed using BEopt 2.6, running EnergyPlus 8.4 as the underlying simulation engine. A single modification was made to the prototype models for the various climate zone-HVAC type combinations to create the base case models for estimating savings for the solar screens measure. Windows facing all directions are assumed to be single-pane windows with U-values of 1.16 BTU/h-ft^2-R and solar heat gain coefficients (SHGC) of 0.76.

For the change case models, an 80 percent reduction was applied to the solar heat gain coefficient for the south- and west-facing windows.

Summer and winter peak demand savings are estimated by taking the difference in demand for the 20 hours identified from the TMY3 datasets in which the summer and winter peaks are most likely to occur, as described in TRM Volume 1 Section 4 - Peak Demand Definitions.

The model assumes the average solar screen installed blocks 80 percent of the solar heat gain attributed to the south and west-facing windows based on performance data from solar screens analyzed at sun angles of 30, 45, and 75 degrees to the window. [232]

While it is recommended that solar screens be removed during winter to allow the advantage of free heat from the sun, they are often not removed seasonally. This may be due to solar screens serving as an insect screen in addition to blocking the sun or simply that they're installed in difficult-to-reach areas such as second-floor windows. The savings estimates presented herein assume that the installed solar screens remain in place year-round.

Thermal Performance Improvement

Manual J and other studies researched indicate a thermal improvement to a window with a solar screen due to reduced air infiltration. The National Certified Testing Laboratories provided a report stating a 15 percent reduction in the thermal transmittance of a single pane, ¼" clear glass window with a solar screen added to the exterior.

Another study that was conducted for NFRC indicated between a 22 percent and 4 percent improvement to the U-value of a window with a solar screen. A single pane, clear window has a 22 percent improvement with the addition of a solar screen, whereas a double pane, spectrally selective low-E window may only have a 4 percent improvement. The deemed savings models assume an average 10 percent improvement in thermal performance with the addition of a solar screen.

[232] Performance data from Matrix, Inc., Mesa, Arizona testing facility for Phifer Wire Products' SunTex screen, blocks 80 percent of solar heat gain.

Window Frame

The window frame accounts for 10-30 percent[233] of the window area, and since it is opaque and blocks sunlight from entering the home, it is factored into the model. An average of 15 percent frame area was incorporated into the performance of the window.

Example Calculation

Example 1. A home in climate zone 4 with a central air conditioning unit and an electric resistance furnace installs 75 square feet of solar screens.

$$kWh\ savings = \left(6.09 + (-3.21)\right) \times 75 = 216\ kWh$$

$$Summer\ kW\ savings = 3.17 \times 10^{-3} \times 75 = 0.24\ kW$$

$$Winter\ kW\ savings = -2.32 \times 10^{-3} \times 75 = -0.17\ kW$$

Deemed Energy Savings Tables

Table 226 presents the deemed energy savings value per square foot of solar screen installed. Annual energy savings are the sum of cooling and heating savings for the appropriate equipment types.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying appropriate cooling value in Table 226 by a factor of 0.6.

Table 226: Deemed Energy (kWh) Savings per Square Foot of Solar Screen

Climate Zone	Cooling Savings (kWh/sq. ft.)		Heating Savings (kWh/sq. ft.)		
	Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	3.67	1.34	-0.62	-12.81	-4.54
Climate Zone 2: North	5.38	-	-0.29	-7.14	-2.56
Climate Zone 3: South	5.33	-	-0.16	-4.69	-1.69
Climate Zone 4: Valley	6.09	-	-0.09	-3.21	-1.16
Climate Zone 5: West	5.62	1.99	-0.44	-10.48	-3.81

[233] Residential Windows – A Guide to New Technologies and Energy Performance, 2000.

Deemed Summer Demand Savings Tables

Table 227 presents the deemed summer peak demand savings value per square foot of solar screen installed.

For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying appropriate cooling value in Table 227 by a factor of 0.6.

Table 227: Deemed Summer Peak Demand (kW) Savings per Square Foot of Solar Screen

Climate Zone	Refrigerated Air	Evaporative Cooling
Climate Zone 1: Panhandle	2.89E-03	1.35E-03
Climate Zone 2: North	3.42E-03	-
Climate Zone 3: South	3.29E-03	-
Climate Zone 4: Valley	3.17E-03	-
Climate Zone 5: West	3.12E-03	1.07E-03

Deemed Winter Demand Savings Tables

Table 228 presents the deemed winter peak demand savings value per square foot of solar screen installed. Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Table 228: Deemed Winter Peak Demand (kW) Savings per Square Foot of Solar Screen

Climate Zone	Gas Heat	Electric Resistance	Heat Pump
Climate Zone 1: Panhandle	-1.16E-04	-1.73E-03	-9.45E-04
Climate Zone 2: North	-5.20E-05	-1.32E-03	-7.96E-04
Climate Zone 3: South	-1.07E-04	-2.65E-03	-1.71E-03
Climate Zone 4: Valley	-7.68E-05	-2.32E-03	-1.08E-03
Climate Zone 5: West	-1.45E-04	-3.34E-03	-1.30E-03

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of solar screens is established at 10 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[234]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Space cooling system type (evaporative cooling, refrigerated air conditioning)
- Space heating system type (gas, electric, heat pump)
- Square footage of windows or door openings treated
- Proof of purchase – with date of purchase and quantity
  - Alternative: photo of unit installed or other pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

- Docket No. 22241, Item 62. Petition by Frontier Associates for Approval of Second Set of Deemed Savings Estimates. Public Utility Commission of Texas.
- Docket No. 41070. Petition of El Paso Electric Company to Approve Revisions to Residential and Commercial Deemed Savings Based on Climate Data Specific to El Paso, Texas. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

[234] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer2013-update-for-2014-codes.

Document Revision History

Table 229: Residential Solar Screens Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Added detail on methodology and model characteristics. Savings awarded for south-facing windows, in addition to east- and west-facing windows.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. Multiplier provided to adjust cooling side savings for homes with evaporative cooling due to lower energy usage and demand associated with evaporative coolers relative to refrigerated air. Climate Zone 2 savings values awarded for Climate Zone 5 homes with heat pumps.
v3.1	11/05/2015	TRM v3.1 update. Provided example savings calculations.
v4.0	10/10/2016	TRM v4.0 update. Updated energy and demand savings per new prototype energy simulation models. Added separate savings for homes with evaporative cooling.
v5.0	10/2017	TRM v5.0 update. Added explicit reference to mini-split technology. Added provision for low-income and hard-to-reach customers cooled by room air conditioners to claim savings.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Updated documentation requirements.

2.3.8 Cool Roofs Measure Overview

TRM Measure ID: R-BE-CR

Market Sector: Residential

Measure Category: Building Envelope

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Building simulation modeling

Measure Description

Reflective roofing materials reduce the overall heat load on a home by reducing the total heat energy absorbed into the building system from incident solar radiation. This reduction in total load provides space cooling energy savings during the cooling season, but the same energy is free heat during the heating season, so the measure saves energy in the summer but costs energy in winter. As such, cool roofs are most beneficial in warmer climates and may not be recommended for homes where the primary heat source is electric resistance. The measure is for retrofit of existing homes.

Eligibility Criteria

Cooling savings in this measure apply to customers with central or mini-split electric refrigerated air conditioning in their homes, or to customers in TRM climate zones 1 and 5 who have evaporative cooling systems. Homes must be centrally heated with either a furnace (gas or electric resistance) or a heat pump to claim heating savings. Customers who participate in hard-to-reach (HTR) or low-income (LI) programs are eligible to claim heating savings for homes heated with gas or electric resistance space heaters and are also eligible to claim reduced cooling savings for homes cooled by one or more room air conditioners by applying an adjustment to deemed savings that is specified for homes with refrigerated air.

Baseline Condition

The baseline condition is an existing home with a standard medium- or dark-colored roof.

High-efficiency Condition

The measure requires installation of roof products that have been rated by the Cool Roof Rating Council and compliance with ENERGY STAR® certified roof product performance specifications for the relevant roof application. The ENERGY STAR® program classifies roofs with a slope greater than 2/12 as having a steep slope and roofs with a slope less than or equal to 2/12 as low slope roofs. ENERGY STAR® performance specifications for cool roof products for use on roofs with steep slopes and low slopes are provided in Table 230.

Table 230. Energy Star Solar Reflectance Specification for Cool Roof Products

Roof Slope	Characteristic	Performance Specification
Low Slope <= 2/12	Initial Solar Reflectance	>= 0.65
	3-Year Solar Reflectance	>= 0.50
High Slope > 2/12	Initial Solar Reflectance	>= 0.25
	3-Year Solar Reflectance	>= 0.15

In the event that a cool roof is installed concurrently with changes to attic insulation levels, savings should be claimed for the reflective roof according to the post-retrofit (ceiling or roof deck) insulation levels. Savings for changes in insulation levels should be claimed separately according to the ceiling insulation or attic encapsulation measures, assuming the retrofit performed meets the requirements of those measures.

Energy and Demand Savings Methodology

Energy and demand savings are presented for cool roofs according to the rated 3-year reflectance of the installed cool roof product and the type of roof (low-slope, high-slope) on which it is installed.

Savings Algorithms and Input Variables

Calibrated simulation modeling was used to develop these deemed savings values. Specifically, these deemed savings estimates were developed using BEopt 2.6, running EnergyPlus 8.4 as the underlying simulation engine. To model this measure, the prototype home models for each climate zone were modified as follows. Roof slopes were modified to reflect representative levels for the low slope and steep slope roofs. A 1/12 slope was selected for modeling low slope roofs (defined as having slope <= 2/12), and a 4/12 slope was selected for modeling steep slope roofs (slope > 2/12). Based on the performance criteria and review of the rated 3-year reflectance of rated products listed in the CRRC database, four reflectance levels were selected for modeling: 0.2, 0.4, 0.6, and 0.8, representing 20 to 80 percent reflectance.

Because of the interplay between the performance of insulation and attic/roof deck temperatures, which are directly affected by the installation of a cool roof, savings were estimated for a range of different attic insulation scenarios: a range of ceiling insulation levels from no insulation (R-0) to R-30, and two roof deck insulation levels, R-19 and R-38, were modeled. Savings for a roof deck insulation level of R-30 are provided by interpolating between the R-19 and R-38 scenarios.

These modifications are shown in Table 231.

The model runs calculated energy use for the prototypical home prior to encapsulating the attic. Change-case models were run to calculate energy use with the floor insulation measure in place with either R-30 or R-38 insulation.

Table 231: **Residential Reflective Roof – Prototypical Home Characteristics**

Shell Characteristic	Value	Source
Base Case Roof Material	Medium Asphalt Shingle, Reflectance = 0.15	Prototype home default
Change Case Roof Material	Medium Asphalt Shingle, Reflectance = 0.2 Reflectance = 0.4 Reflectance = 0.6 Reflectance = 0.8	Lower reflectance levels only relevant for steep slope roofs. Modeled reflectance levels reflect midpoints of ranges: 0.15 <=R < 0.3 Reflectance 0.3 <=R < 0.5 Reflectance 0.5 <=R < 0.7 Reflectance > 0.7
Roof Slope: Low-Slope Roof	1/12	Not modified between base and change cases
Roof Slope: Steep Slope Roof	4/12	Not modified between base and change cases
Ceiling (attic floor) Insulation Levels	R-0 R1-R4 R5-R8 R9-R14 R15-R22 R-30	Not modified between base and change cases
Roof Deck (underside) Insulation Levels	R-19 R-38	Not modified between base and change cases

Deemed Energy Savings Tables

Savings are presented first for homes with ceiling insulation and subsequently for those with roof deck insulation. For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying appropriate cooling values in Table 232 through Table 236 by a factor of 0.6.

Homes with Ceiling Insulation

Table 232 through Table 236 present the energy savings (kWh) for installation of a reflective roof on homes with varying levels of ceiling (attic floor) insulation for the five Texas climate zones. Annual energy savings are the sum of cooling and heating savings for the appropriate equipment types. Savings are per square foot of treated roof area.

Climate Zone 1: Panhandle Region

Table 232: Climate Zone 1: Panhandle Region – Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
Steep Slope						
R-0	0.15 - 0.29	0.05	0.02	-0.01	-0.08	-0.03
R-0	0.3 – 0.49	0.25	0.09	-0.02	-0.43	-0.16
R-0	0.5 – 0.69	0.45	0.17	-0.05	-0.80	-0.30
R-0	>= 0.7	0.65	0.24	-0.08	-1.21	-0.45
R-1 to R-4	0.15 - 0.29	0.04	0.02	0.00	-0.07	-0.03
R-1 to R-4	0.3 – 0.49	0.21	0.08	-0.02	-0.35	-0.13
R-1 to R-4	0.5 – 0.69	0.38	0.14	-0.04	-0.66	-0.25
R-1 to R-4	>= 0.7	0.55	0.20	-0.07	-1.00	-0.37
R-5 to R-8	0.15 - 0.29	0.02	0.01	0.00	-0.04	-0.01
R-5 to R-8	0.3 – 0.49	0.12	0.04	-0.02	-0.20	-0.07
R-5 to R-8	0.5 – 0.69	0.21	0.08	-0.03	-0.36	-0.14
R-5 to R-8	>= 0.7	0.31	0.12	-0.05	-0.54	-0.20
R-9 to R-14	0.15 - 0.29	0.02	0.01	0.00	-0.03	-0.01
R-9 to R-14	0.3 – 0.49	0.08	0.03	-0.01	-0.13	-0.05
R-9 to R-14	0.5 – 0.69	0.15	0.06	-0.03	-0.25	-0.09
R-9 to R-14	>= 0.7	0.22	0.08	-0.04	-0.37	-0.14
R-15 to R-22	0.15 - 0.29	0.01	0.00	0.00	-0.02	-0.01
R-15 to R-22	0.3 – 0.49	0.06	0.02	-0.01	-0.09	-0.04
R-15 to R-22	0.5 – 0.69	0.10	0.04	-0.02	-0.17	-0.06
R-15 to R-22	>= 0.7	0.15	0.06	-0.03	-0.25	-0.10
R-30	0.15 - 0.29	0.01	0.00	0.00	-0.01	0.00
R-30	0.3 – 0.49	0.04	0.01	-0.01	-0.06	-0.02
R-30	0.5 – 0.69	0.07	0.02	-0.02	-0.11	-0.04
R-30	>= 0.7	0.10	0.04	-0.03	-0.16	-0.06
Low Slope						
R-0	0.5 – 0.69	0.48	0.18	-0.05	-0.86	-0.33
R-0	> = 0.7	0.69	0.25	-0.08	-1.30	-0.49
R-1 to R-4	0.5 – 0.69	0.41	0.15	-0.05	-0.71	-0.27
R-1 to R-4	> = 0.7	0.59	0.22	-0.07	-1.08	-0.40

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
R-5 to R-8	0.5 – 0.69	0.23	0.09	-0.03	-0.40	-0.15
R-5 to R-8	> = 0.7	0.34	0.13	-0.05	-0.59	-0.22
R-9 to R-14	0.5 – 0.69	0.16	0.06	-0.03	-0.27	-0.10
R-9 to R-14	> = 0.7	0.23	0.09	-0.04	-0.41	-0.15
R-15 to R-22	0.5 – 0.69	0.11	0.04	-0.02	-0.19	-0.07
R-15 to R-22	> = 0.7	0.17	0.07	-0.03	-0.28	-0.11
R-30	0.5 – 0.69	0.08	0.03	-0.02	-0.13	-0.05
R-30	> = 0.7	0.12	0.05	-0.03	-0.19	-0.07

Climate Zone 2: North Region

**Table 233: Climate Zone 2: North Region –
Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)**

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
Steep Slope					
R-0	0.15 - 0.29	0.08	0.00	-0.05	-0.02
R-0	0.3 – 0.49	0.38	-0.01	-0.29	-0.11
R-0	0.5 – 0.69	0.69	-0.02	-0.54	-0.20
R-0	>= 0.7	1.02	-0.04	-0.83	-0.31
R-1 to R-4	0.15 - 0.29	0.06	0.00	-0.05	-0.02
R-1 to R-4	0.3 – 0.49	0.32	-0.01	-0.24	-0.09
R-1 to R-4	0.5 – 0.69	0.59	-0.02	-0.44	-0.17
R-1 to R-4	>= 0.7	0.86	-0.03	-0.68	-0.25
R-5 to R-8	0.15 - 0.29	0.04	0.00	-0.03	-0.01
R-5 to R-8	0.3 – 0.49	0.18	-0.01	-0.13	-0.05
R-5 to R-8	0.5 – 0.69	0.34	-0.01	-0.24	-0.09
R-5 to R-8	>= 0.7	0.50	-0.02	-0.36	-0.14
R-9 to R-14	0.15 - 0.29	0.03	0.00	-0.02	-0.01
R-9 to R-14	0.3 – 0.49	0.13	-0.01	-0.09	-0.03
R-9 to R-14	0.5 – 0.69	0.24	-0.01	-0.16	-0.06
R-9 to R-14	>= 0.7	0.35	-0.02	-0.25	-0.09
R-15 to R-22	0.15 - 0.29	0.02	0.00	-0.01	0.00

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
R-15 to R-22	0.3 – 0.49	0.09	0.00	-0.06	-0.02
R-15 to R-22	0.5 – 0.69	0.17	-0.01	-0.11	-0.04
R-15 to R-22	>= 0.7	0.25	-0.01	-0.17	-0.06
R-30	0.15 - 0.29	0.01	0.00	-0.01	0.00
R-30	0.3 – 0.49	0.06	0.00	-0.04	-0.02
R-30	0.5 – 0.69	0.12	-0.01	-0.07	-0.03
R-30	>= 0.7	0.18	-0.01	-0.11	-0.04
Low Slope					
R-0	0.5 – 0.69	0.75	-0.03	-0.60	-0.22
R-0	> = 0.7	1.10	-0.04	-0.91	-0.34
R-1 to R-4	0.5 – 0.69	0.64	-0.02	-0.49	-0.18
R-1 to R-4	> = 0.7	0.94	-0.03	-0.75	-0.28
R-5 to R-8	0.5 – 0.69	0.37	-0.01	-0.27	-0.10
R-5 to R-8	> = 0.7	0.55	-0.02	-0.40	-0.15
R-9 to R-14	0.5 – 0.69	0.26	-0.01	-0.19	-0.07
R-9 to R-14	> = 0.7	0.39	-0.02	-0.28	-0.10
R-15 to R-22	0.5 – 0.69	0.19	-0.01	-0.13	-0.05
R-15 to R-22	> = 0.7	0.28	-0.01	-0.19	-0.07
R-30	0.5 – 0.69	0.14	-0.01	-0.08	-0.03
R-30	> = 0.7	0.20	-0.01	-0.13	-0.05

Climate Zone 3: South Region

Table 234: Climate Zone 3: South Region – Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
Steep Slope					
R-0	0.15 - 0.29	0.09	0.00	-0.04	-0.02
R-0	0.3 – 0.49	0.43	-0.01	-0.22	-0.08
R-0	0.5 – 0.69	0.78	-0.02	-0.42	-0.16
R-0	>= 0.7	1.15	-0.03	-0.63	-0.24
R-1 to R-4	0.15 - 0.29	0.07	0.00	-0.03	-0.01

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
R-1 to R-4	0.3 – 0.49	0.36	-0.01	-0.18	-0.07
R-1 to R-4	0.5 – 0.69	0.66	-0.01	-0.34	-0.13
R-1 to R-4	>= 0.7	0.97	-0.02	-0.52	-0.19
R-5 to R-8	0.15 - 0.29	0.04	0.00	-0.02	-0.01
R-5 to R-8	0.3 – 0.49	0.20	0.00	-0.10	-0.04
R-5 to R-8	0.5 – 0.69	0.37	-0.01	-0.18	-0.07
R-5 to R-8	>= 0.7	0.55	-0.01	-0.28	-0.10
R-9 to R-14	0.15 - 0.29	0.03	0.00	-0.01	-0.01
R-9 to R-14	0.3 – 0.49	0.14	0.00	-0.07	-0.03
R-9 to R-14	0.5 – 0.69	0.26	-0.01	-0.13	-0.05
R-9 to R-14	>= 0.7	0.39	-0.01	-0.19	-0.07
R-15 to R-22	0.15 - 0.29	0.02	0.00	-0.01	0.00
R-15 to R-22	0.3 – 0.49	0.10	0.00	-0.05	-0.02
R-15 to R-22	0.5 – 0.69	0.18	-0.01	-0.09	-0.03
R-15 to R-22	>= 0.7	0.27	-0.01	-0.13	-0.05
R-30	0.15 - 0.29	0.01	0.00	-0.01	0.00
R-30	0.3 – 0.49	0.06	0.00	-0.03	-0.01
R-30	0.5 – 0.69	0.12	-0.01	-0.06	-0.02
R-30	>= 0.7	0.18	-0.01	-0.08	-0.03
Low Slope					
R-0	0.5 – 0.69	0.86	-0.02	-0.46	-0.17
R-0	> = 0.7	1.26	-0.03	-0.70	-0.26
R-1 to R-4	0.5 – 0.69	0.73	-0.01	-0.37	-0.14
R-1 to R-4	> = 0.7	1.07	-0.02	-0.57	-0.21
R-5 to R-8	0.5 – 0.69	0.42	-0.01	-0.21	-0.08
R-5 to R-8	> = 0.7	0.62	-0.01	-0.31	-0.12
R-9 to R-14	0.5 – 0.69	0.30	-0.01	-0.14	-0.05
R-9 to R-14	> = 0.7	0.44	-0.01	-0.21	-0.08
R-15 to R-22	0.5 – 0.69	0.21	-0.01	-0.10	-0.04
R-15 to R-22	> = 0.7	0.31	-0.01	-0.15	-0.06
R-30	0.5 – 0.69	0.14	-0.01	-0.07	-0.03
R-30	> = 0.7	0.22	-0.01	-0.10	-0.04

Climate Zone 4: Valley Region

**Table 235: Climate Zone 4: Valley Region –
Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)**

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
Steep Slope					
R-0	0.15 - 0.29	0.06	0.00	-0.03	-0.01
R-0	0.3 – 0.49	0.31	0.00	-0.14	-0.05
R-0	0.5 – 0.69	0.57	-0.01	-0.27	-0.10
R-0	>= 0.7	0.84	-0.01	-0.41	-0.15
R-1 to R-4	0.15 - 0.29	0.05	0.00	-0.02	-0.01
R-1 to R-4	0.3 – 0.49	0.26	0.00	-0.12	-0.04
R-1 to R-4	0.5 – 0.69	0.47	-0.01	-0.22	-0.08
R-1 to R-4	>= 0.7	0.70	-0.01	-0.33	-0.12
R-5 to R-8	0.15 - 0.29	0.03	0.00	-0.01	0.00
R-5 to R-8	0.3 – 0.49	0.14	0.00	-0.06	-0.02
R-5 to R-8	0.5 – 0.69	0.26	0.00	-0.11	-0.04
R-5 to R-8	>= 0.7	0.38	-0.01	-0.17	-0.06
R-9 to R-14	0.15 - 0.29	0.02	0.00	-0.01	0.00
R-9 to R-14	0.3 – 0.49	0.10	0.00	-0.04	-0.02
R-9 to R-14	0.5 – 0.69	0.17	0.00	-0.08	-0.03
R-9 to R-14	>= 0.7	0.26	0.00	-0.11	-0.04
R-15 to R-22	0.15 - 0.29	0.01	0.00	-0.01	0.00
R-15 to R-22	0.3 – 0.49	0.06	0.00	-0.03	-0.01
R-15 to R-22	0.5 – 0.69	0.12	0.00	-0.05	-0.02
R-15 to R-22	>= 0.7	0.17	0.00	-0.08	-0.03
R-30	0.15 - 0.29	0.01	0.00	0.00	0.00
R-30	0.3 – 0.49	0.04	0.00	-0.02	-0.01
R-30	0.5 – 0.69	0.07	0.00	-0.03	-0.01
R-30	>= 0.7	0.11	0.00	-0.05	-0.02
Low Slope					
R-0	0.5 – 0.69	0.61	-0.01	-0.29	-0.11
R-0	> = 0.7	0.90	-0.01	-0.44	-0.16
R-1 to R-4	0.5 – 0.69	0.51	-0.01	-0.24	-0.09

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
R-1 to R-4	> = 0.7	0.75	-0.01	-0.36	-0.13
R-5 to R-8	0.5 – 0.69	0.28	0.00	-0.13	-0.05
R-5 to R-8	> = 0.7	0.41	-0.01	-0.19	-0.07
R-9 to R-14	0.5 – 0.69	0.19	0.00	-0.09	-0.03
R-9 to R-14	> = 0.7	0.28	0.00	-0.13	-0.05
R-15 to R-22	0.5 – 0.69	0.13	0.00	-0.06	-0.02
R-15 to R-22	> = 0.7	0.19	0.00	-0.08	-0.03
R-30	0.5 – 0.69	0.09	0.00	-0.04	-0.01
R-30	> = 0.7	0.13	0.00	-0.06	-0.02

Climate Zone 5: West Region

Table 236: Climate Zone 5: West Region – Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
Steep Slope						
R-0	0.15 - 0.29	0.09	0.03	0.00	-0.08	-0.03
R-0	0.3 – 0.49	0.44	0.17	-0.02	-0.43	-0.16
R-0	0.5 – 0.69	0.80	0.30	-0.03	-0.84	-0.32
R-0	>= 0.7	1.18	0.44	-0.05	-1.31	-0.49
R-1 to R-4	0.15 - 0.29	0.07	0.03	0.00	-0.07	-0.03
R-1 to R-4	0.3 – 0.49	0.37	0.14	-0.01	-0.35	-0.13
R-1 to R-4	0.5 – 0.69	0.68	0.26	-0.03	-0.68	-0.26
R-1 to R-4	>= 0.7	1.01	0.38	-0.05	-1.07	-0.40
R-5 to R-8	0.15 - 0.29	0.04	0.02	0.00	-0.04	-0.01
R-5 to R-8	0.3 – 0.49	0.21	0.08	-0.01	-0.20	-0.07
R-5 to R-8	0.5 – 0.69	0.39	0.15	-0.02	-0.38	-0.14
R-5 to R-8	>= 0.7	0.58	0.23	-0.03	-0.59	-0.22
R-9 to R-14	0.15 - 0.29	0.03	0.01	0.00	-0.03	-0.01
R-9 to R-14	0.3 – 0.49	0.15	0.06	-0.01	-0.14	-0.05
R-9 to R-14	0.5 – 0.69	0.27	0.11	-0.01	-0.27	-0.10
R-9 to R-14	>= 0.7	0.41	0.16	-0.02	-0.41	-0.15

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
R-15 to R-22	0.15 - 0.29	0.02	0.01	0.00	-0.02	-0.01
R-15 to R-22	0.3 – 0.49	0.10	0.04	-0.01	-0.10	-0.04
R-15 to R-22	0.5 – 0.69	0.19	0.08	-0.01	-0.18	-0.07
R-15 to R-22	>= 0.7	0.29	0.12	-0.02	-0.28	-0.10
R-30	0.15 - 0.29	0.01	0.01	0.00	-0.01	-0.01
R-30	0.3 – 0.49	0.07	0.03	0.00	-0.06	-0.02
R-30	0.5 – 0.69	0.13	0.05	-0.01	-0.12	-0.04
R-30	>= 0.7	0.20	0.08	-0.01	-0.18	-0.07
Low Slope						
R-0	0.5 – 0.69	0.90	0.34	-0.04	-0.94	-0.36
R-0	> = 0.7	1.31	0.49	-0.06	-1.48	-0.56
R-1 to R-4	0.5 – 0.69	0.77	0.29	-0.03	-0.77	-0.29
R-1 to R-4	> = 0.7	1.13	0.43	-0.05	-1.22	-0.45
R-5 to R-8	0.5 – 0.69	0.45	0.18	-0.02	-0.44	-0.16
R-5 to R-8	> = 0.7	0.66	0.26	-0.03	-0.68	-0.25
R-9 to R-14	0.5 – 0.69	0.32	0.13	-0.02	-0.31	-0.12
R-9 to R-14	> = 0.7	0.47	0.19	-0.03	-0.47	-0.18
R-15 to R-22	0.5 – 0.69	0.23	0.09	-0.01	-0.21	-0.08
R-15 to R-22	> = 0.7	0.34	0.14	-0.02	-0.32	-0.12
R-30	0.5 – 0.69	0.17	0.07	-0.01	-0.14	-0.06
R-30	> = 0.7	0.25	0.10	-0.02	-0.22	-0.08

Homes with Roof Deck Insulation

Table 237 through Table 241 present the energy savings (kWh) for the installation of a reflective roof on homes with varying levels of roof deck insulation for the five Texas climate zones. Annual energy savings are the sum of cooling and heating savings for the appropriate equipment types. Savings are per square foot of treated roof area.

Climate Zone 1: Panhandle Region

Table 237: Climate Zone 1: Panhandle Region – Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
Steep Slope						
R-19	0.15 - 0.29	0.00	0.00	0.00	0.00	0.00
R-19	0.3 – 0.49	0.06	0.02	-0.01	-0.13	-0.05
R-19	0.5 – 0.69	0.13	0.04	-0.01	-0.28	-0.11
R-19	>= 0.7	0.20	0.07	-0.02	-0.42	-0.16
R-30	0.15 - 0.29	0.01	0.00	0.00	-0.01	-0.01
R-30	0.3 – 0.49	0.05	0.02	-0.01	-0.12	-0.04
R-30	0.5 – 0.69	0.11	0.03	-0.01	-0.23	-0.09
R-30	>= 0.7	0.16	0.05	-0.02	-0.35	-0.14
R-38	0.15 - 0.29	0.01	0.00	0.00	-0.02	-0.01
R-38	0.3 – 0.49	0.05	0.02	-0.01	-0.11	-0.04
R-38	0.5 – 0.69	0.09	0.03	-0.01	-0.20	-0.08
R-38	>= 0.7	0.13	0.04	-0.02	-0.30	-0.12
Low Slope						
R-19	0.5 – 0.69	0.13	0.04	-0.01	-0.27	-0.11
R-19	>= 0.7	0.20	0.07	-0.02	-0.42	-0.16
R-30	0.5 – 0.69	0.11	0.03	-0.01	-0.23	-0.09
R-30	>= 0.7	0.16	0.05	-0.02	-0.34	-0.13
R-38	0.5 – 0.69	0.09	0.03	-0.01	-0.20	-0.08
R-38	>= 0.7	0.13	0.04	-0.02	-0.29	-0.11

Climate Zone 2: North Region

**Table 238: Climate Zone 2: North Region –
Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)**

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
Steep Slope					
R-19	0.15 - 0.29	0.00	0.00	0.00	0.00
R-19	0.3 – 0.49	0.10	0.00	-0.09	-0.03
R-19	0.5 – 0.69	0.21	-0.01	-0.18	-0.07
R-19	>= 0.7	0.32	-0.01	-0.28	-0.11
R-30	0.15 - 0.29	0.01	0.00	-0.01	-0.01
R-30	0.3 – 0.49	0.09	0.00	-0.08	-0.03
R-30	0.5 – 0.69	0.17	-0.01	-0.15	-0.06
R-30	>= 0.7	0.26	-0.01	-0.23	-0.09
R-38	0.15 - 0.29	0.02	0.00	-0.01	-0.01
R-38	0.3 – 0.49	0.08	0.00	-0.07	-0.03
R-38	0.5 – 0.69	0.14	-0.01	-0.13	-0.05
R-38	>= 0.7	0.21	-0.01	-0.19	-0.07
Low Slope					
R-19	0.5 – 0.69	0.21	-0.01	-0.18	-0.07
R-19	>= 0.7	0.32	-0.01	-0.28	-0.11
R-30	0.5 – 0.69	0.17	-0.01	-0.15	-0.06
R-30	>= 0.7	0.26	-0.01	-0.23	-0.09
R-38	0.5 – 0.69	0.14	-0.01	-0.13	-0.05
R-38	>= 0.7	0.21	-0.01	-0.19	-0.07

Climate Zone 3: South Region

**Table 239: Climate Zone 3: South Region –
Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)**

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
Steep Slope					
R-19	0.15 - 0.29	0.00	0.00	0.00	0.00
R-19	0.3 – 0.49	0.11	0.00	-0.07	-0.03
R-19	0.5 – 0.69	0.22	-0.01	-0.14	-0.05
R-19	>= 0.7	0.34	-0.01	-0.22	-0.08
R-30	0.15 - 0.29	0.01	0.00	-0.01	0.00
R-30	0.3 – 0.49	0.09	0.00	-0.06	-0.02
R-30	0.5 – 0.69	0.19	0.00	-0.12	-0.04

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
R-30	>= 0.7	0.28	-0.01	-0.18	-0.07
R-38	0.15 - 0.29	0.02	0.00	-0.01	0.00
R-38	0.3 – 0.49	0.08	0.00	-0.06	-0.02
R-38	0.5 – 0.69	0.16	0.00	-0.10	-0.04
R-38	>= 0.7	0.23	-0.01	-0.15	-0.06
Low Slope					
R-19	0.5 – 0.69	0.22	-0.01	-0.14	-0.06
R-19	>= 0.7	0.35	-0.01	-0.22	-0.08
R-30	0.5 – 0.69	0.19	0.00	-0.12	-0.05
R-30	>= 0.7	0.28	-0.01	-0.18	-0.07
R-38	0.5 – 0.69	0.16	0.00	-0.10	-0.04
R-38	>= 0.7	0.23	-0.01	-0.15	-0.06

Climate Zone 4: Valley Region

Table 240: Climate Zone 4: Valley Region –
Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings (Refrigerated Air)	Heating Savings		
			Gas Heat	Electric Resistance	Heat Pump
Steep Slope					
R-19	0.15 - 0.29	0.00	0.00	0.00	0.00
R-19	0.3 – 0.49	0.09	0.00	-0.04	-0.02
R-19	0.5 – 0.69	0.17	0.00	-0.09	-0.03
R-19	>= 0.7	0.26	0.00	-0.13	-0.05
R-30	0.15 - 0.29	0.01	0.00	-0.01	0.00
R-30	0.3 – 0.49	0.08	0.00	-0.03	-0.01
R-30	0.5 – 0.69	0.14	0.00	-0.07	-0.02
R-30	>= 0.7	0.21	0.00	-0.11	-0.04
R-38	0.15 - 0.29	0.01	0.00	-0.01	0.00
R-38	0.3 – 0.49	0.07	0.00	-0.03	-0.01
R-38	0.5 – 0.69	0.12	0.00	-0.06	-0.02
R-38	>= 0.7	0.18	0.00	-0.09	-0.03
Low Slope					
R-19	0.5 – 0.69	0.23	-0.01	-0.29	-0.11
R-19	>= 0.7	0.36	-0.02	-0.46	-0.18
R-30	0.5 – 0.69	0.17	0.00	-0.16	-0.06
R-30	>= 0.7	0.26	-0.01	-0.25	-0.09
R-38	0.5 – 0.69	0.12	0.00	-0.06	-0.02
R-38	>= 0.7	0.18	0.00	-0.09	-0.03

Climate Zone 5: West Region

Table 241: Climate Zone 5: West Region – Deemed Annual Energy Savings for Residential Reflective Roof Installation (kWh/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Cooling Savings		Heating Savings		
		Refrigerated Air	Evaporative Cooling	Gas Heat	Electric Resistance	Heat Pump
Steep Slope						
R-19	0.15 - 0.29	0.00	0.00	0.00	0.00	0.00
R-19	0.3 – 0.49	0.11	0.04	-0.01	-0.14	-0.05
R-19	0.5 – 0.69	0.22	0.08	-0.01	-0.28	-0.11
R-19	>= 0.7	0.35	0.12	-0.02	-0.45	-0.17
R-30	0.15 - 0.29	0.01	0.01	0.00	-0.01	-0.01
R-30	0.3 – 0.49	0.10	0.03	0.00	-0.12	-0.04
R-30	0.5 – 0.69	0.19	0.06	-0.01	-0.23	-0.09
R-30	>= 0.7	0.28	0.10	-0.01	-0.37	-0.14
R-38	0.15 - 0.29	0.02	0.01	0.00	-0.02	-0.01
R-38	0.3 – 0.49	0.09	0.03	0.00	-0.11	-0.04
R-38	0.5 – 0.69	0.16	0.05	-0.01	-0.20	-0.08
R-38	>= 0.7	0.23	0.08	-0.01	-0.31	-0.12
Low Slope						
R-19	0.5 – 0.69	0.23	0.08	-0.01	-0.29	-0.11
R-19	>= 0.7	0.36	0.12	-0.02	-0.46	-0.18
R-30	0.5 – 0.69	0.19	0.06	-0.01	-0.24	-0.09
R-30	>= 0.7	0.29	0.10	-0.01	-0.38	-0.15
R-38	0.5 – 0.69	0.16	0.05	-0.01	-0.21	-0.08
R-38	>= 0.7	0.24	0.08	-0.01	-0.32	-0.12

Deemed Summer Demand Savings Tables

Savings are presented first for homes with ceiling insulation, and subsequently for those with roof deck insulation. For customers who participate in hard-to-reach (HTR) or low-income (LI) programs, cooling savings may be claimed for homes cooled by one or more room air conditioners by multiplying appropriate cooling values in Table 242 through Table 246 by a factor of 0.6.

Homes with Ceiling Insulation

Table 242 through Table 246 present the summer demand savings (kW) associated with the installation of a reflective roof in homes with varying levels of ceiling insulation (attic floor) for the five Texas climate zones. Savings are per square foot of treated roof area.

Climate Zone 1: Panhandle Region

Table 242: Climate Zone 1: Panhandle Region – Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope		Steep Slope	
		Refrigerated Air	Evaporative Cooling	Refrigerated Air	Evaporative Cooling
R-0	0.15 - 0.29	n/a	n/a	4.43E-5	1.84E-5
R-0	0.3 – 0.49	n/a	n/a	2.29E-4	9.23E-5
R-0	0.5 – 0.69	4.56E-4	2.01E-4	4.35E-4	1.80E-4
R-0	>= 0.7	6.90E-4	2.92E-4	6.65E-4	2.79E-4
R-1 to R-4	0.15 - 0.29	n/a	n/a	3.76E-5	1.70E-5
R-1 to R-4	0.3 – 0.49	n/a	n/a	1.88E-4	8.67E-5
R-1 to R-4	0.5 – 0.69	3.71E-4	1.61E-4	3.54E-4	1.57E-4
R-1 to R-4	>= 0.7	5.84E-4	2.59E-4	5.74E-4	2.61E-4
R-5 to R-8	0.15 - 0.29	n/a	n/a	1.48E-5	6.69E-6
R-5 to R-8	0.3 – 0.49	n/a	n/a	8.09E-5	4.47E-5
R-5 to R-8	0.5 – 0.69	1.78E-4	9.21E-5	1.63E-4	7.51E-5
R-5 to R-8	>= 0.7	2.85E-4	1.55E-4	2.86E-4	1.40E-4
R-9 to R-14	0.15 - 0.29	n/a	n/a	6.05E-6	7.93E-6
R-9 to R-14	0.3 – 0.49	n/a	n/a	5.64E-5	2.18E-5
R-9 to R-14	0.5 – 0.69	1.17E-4	5.99E-5	1.08E-4	4.52E-5
R-9 to R-14	>= 0.7	1.92E-4	9.10E-5	1.90E-4	9.38E-5
R-15 to R-22	0.15 - 0.29	n/a	n/a	2.30E-6	-8.73E-7
R-15 to R-22	0.3 – 0.49	n/a	n/a	3.55E-5	1.53E-5
R-15 to R-22	0.5 – 0.69	7.90E-5	3.73E-5	7.34E-5	2.74E-5
R-15 to R-22	>= 0.7	1.31E-4	6.28E-5	1.37E-4	7.50E-5
R-30	0.15 - 0.29	n/a	n/a	-7.06E-7	3.42E-6
R-30	0.3 – 0.49	n/a	n/a	2.36E-5	1.83E-5
R-30	0.5 – 0.69	5.39E-5	1.76E-5	4.99E-5	2.70E-5
R-30	>= 0.7	9.25E-5	4.31E-5	9.56E-5	5.99E-5

Climate Zone 2: North Region

**Table 243: Climate Zone 2: North Region –
Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)**

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope	Steep Slope
R-0	0.15 - 0.29	n/a	5.60E-5
R-0	0.3 – 0.49	n/a	3.06E-4
R-0	0.5 – 0.69	5.62E-4	5.35E-4
R-0	>= 0.7	8.70E-4	8.05E-4
R-1 to R-4	0.15 - 0.29	n/a	4.83E-5
R-1 to R-4	0.3 – 0.49	n/a	2.51E-4
R-1 to R-4	0.5 – 0.69	4.97E-4	4.69E-4
R-1 to R-4	>= 0.7	7.45E-4	6.96E-4
R-5 to R-8	0.15 - 0.29	n/a	2.63E-5
R-5 to R-8	0.3 – 0.49	n/a	1.36E-4
R-5 to R-8	0.5 – 0.69	2.83E-4	2.64E-4
R-5 to R-8	>= 0.7	4.10E-4	4.06E-4
R-9 to R-14	0.15 - 0.29	n/a	1.78E-5
R-9 to R-14	0.3 – 0.49	n/a	1.02E-4
R-9 to R-14	0.5 – 0.69	1.99E-4	1.73E-4
R-9 to R-14	>= 0.7	2.85E-4	2.85E-4
R-15 to R-22	0.15 - 0.29	n/a	9.26E-6
R-15 to R-22	0.3 – 0.49	n/a	7.69E-5
R-15 to R-22	0.5 – 0.69	1.47E-4	1.23E-4
R-15 to R-22	>= 0.7	2.04E-4	2.15E-4
R-30	0.15 - 0.29	n/a	1.34E-5
R-30	0.3 – 0.49	n/a	5.58E-5
R-30	0.5 – 0.69	1.01E-4	8.64E-5
R-30	>= 0.7	1.52E-4	1.58E-4

Climate Zone 3: South Region

Table 244: Climate Zone 3: South Region –
Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope	Steep Slope
R-0	0.15 - 0.29	n/a	5.86E-5
R-0	0.3 – 0.49	n/a	3.16E-4
R-0	0.5 – 0.69	6.01E-4	5.84E-4
R-0	>= 0.7	9.53E-4	9.10E-4
R-1 to R-4	0.15 - 0.29	n/a	4.74E-5
R-1 to R-4	0.3 – 0.49	n/a	2.43E-4
R-1 to R-4	0.5 – 0.69	5.05E-4	4.95E-4
R-1 to R-4	>= 0.7	7.90E-4	7.49E-4
R-5 to R-8	0.15 - 0.29	n/a	2.38E-5
R-5 to R-8	0.3 – 0.49	n/a	1.33E-4
R-5 to R-8	0.5 – 0.69	2.76E-4	2.72E-4
R-5 to R-8	>= 0.7	4.64E-4	4.28E-4
R-9 to R-14	0.15 - 0.29	n/a	1.55E-5
R-9 to R-14	0.3 – 0.49	n/a	1.07E-4
R-9 to R-14	0.5 – 0.69	2.12E-4	2.03E-4
R-9 to R-14	>= 0.7	3.30E-4	3.11E-4
R-15 to R-22	0.15 - 0.29	n/a	1.75E-5
R-15 to R-22	0.3 – 0.49	n/a	7.56E-5
R-15 to R-22	0.5 – 0.69	1.53E-4	1.44E-4
R-15 to R-22	>= 0.7	2.37E-4	2.26E-4
R-30	0.15 - 0.29	n/a	9.44E-6
R-30	0.3 – 0.49	n/a	5.11E-5
R-30	0.5 – 0.69	1.09E-4	9.65E-5
R-30	>= 0.7	1.75E-4	1.64E-4

Climate Zone 4: Valley Region

**Table 245: Climate Zone 4: Valley Region –
Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)**

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope	Steep Slope
R-0	0.15 - 0.29	n/a	3.34E-5
R-0	0.3 – 0.49	n/a	1.64E-4
R-0	0.5 – 0.69	3.14E-4	3.02E-4
R-0	>= 0.7	5.12E-4	4.89E-4
R-1 to R-4	0.15 - 0.29	n/a	2.42E-5
R-1 to R-4	0.3 – 0.49	n/a	1.29E-4
R-1 to R-4	0.5 – 0.69	2.42E-4	2.38E-4
R-1 to R-4	>= 0.7	3.97E-4	3.82E-4
R-5 to R-8	0.15 - 0.29	n/a	1.46E-5
R-5 to R-8	0.3 – 0.49	n/a	6.97E-5
R-5 to R-8	0.5 – 0.69	1.22E-4	1.23E-4
R-5 to R-8	>= 0.7	2.02E-4	2.01E-4
R-9 to R-14	0.15 - 0.29	n/a	6.80E-6
R-9 to R-14	0.3 – 0.49	n/a	4.15E-5
R-9 to R-14	0.5 – 0.69	7.62E-5	7.37E-5
R-9 to R-14	>= 0.7	1.26E-4	1.28E-4
R-15 to R-22	0.15 - 0.29	n/a	4.71E-6
R-15 to R-22	0.3 – 0.49	n/a	2.55E-5
R-15 to R-22	0.5 – 0.69	4.24E-5	4.39E-5
R-15 to R-22	>= 0.7	7.33E-5	7.94E-5
R-30	0.15 - 0.29	n/a	2.50E-6
R-30	0.3 – 0.49	n/a	1.01E-5
R-30	0.5 – 0.69	2.41E-5	2.04E-5
R-30	>= 0.7	4.01E-5	4.77E-5

Climate Zone 5: West Region

Table 246: Climate Zone 5: West Region – Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope		Steep Slope	
		Refrigerated Air	Evaporative Cooling	Refrigerated Air	Evaporative Cooling
R-0	0.15 - 0.29	n/a	n/a	5.64E-5	2.11E-5
R-0	0.3 – 0.49	n/a	n/a	2.87E-4	1.24E-4
R-0	0.5 – 0.69	6.38E-4	2.29E-4	5.68E-4	2.55E-4
R-0	>= 0.7	9.44E-4	3.37E-4	8.31E-4	3.12E-4
R-1 to R-4	0.15 - 0.29	n/a	n/a	5.01E-5	1.91E-5
R-1 to R-4	0.3 – 0.49	n/a	n/a	2.48E-4	9.96E-5
R-1 to R-4	0.5 – 0.69	5.42E-4	1.86E-4	4.86E-4	2.11E-4
R-1 to R-4	>= 0.7	8.46E-4	3.04E-4	7.23E-4	2.90E-4
R-5 to R-8	0.15 - 0.29	n/a	n/a	2.72E-5	8.96E-6
R-5 to R-8	0.3 – 0.49	n/a	n/a	1.27E-4	6.00E-5
R-5 to R-8	0.5 – 0.69	3.06E-4	1.34E-4	2.59E-4	1.38E-4
R-5 to R-8	>= 0.7	4.77E-4	2.05E-4	3.97E-4	1.78E-4
R-9 to R-14	0.15 - 0.29	n/a	n/a	1.25E-5	9.26E-6
R-9 to R-14	0.3 – 0.49	n/a	n/a	8.24E-5	5.30E-5
R-9 to R-14	0.5 – 0.69	2.07E-4	1.00E-4	1.73E-4	8.86E-5
R-9 to R-14	>= 0.7	3.27E-4	1.44E-4	2.60E-4	1.22E-4
R-15 to R-22	0.15 - 0.29	n/a	n/a	6.16E-6	3.73E-6
R-15 to R-22	0.3 – 0.49	n/a	n/a	6.18E-5	4.40E-5
R-15 to R-22	0.5 – 0.69	1.50E-4	7.63E-5	1.24E-4	6.49E-5
R-15 to R-22	>= 0.7	2.42E-4	1.11E-4	1.88E-4	8.86E-5
R-30	0.15 - 0.29	n/a	n/a	6.64E-6	5.65E-7
R-30	0.3 – 0.49	n/a	n/a	4.77E-5	2.87E-5
R-30	0.5 – 0.69	1.01E-4	5.91E-5	8.81E-5	5.07E-5
R-30	>= 0.7	1.80E-4	8.50E-5	1.32E-4	6.75E-5

Homes with Roof Deck Insulation

Table 247 through Table 251 present the summer demand savings (kW) associated with the installation of a reflective roof in homes with varying levels of roof deck for the five Texas climate zones. Savings are per square foot of treated roof area.

Climate Zone 1: Panhandle Region

Table 247: Climate Zone 1: Panhandle Region – Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope		Steep Slope	
		Refrigerated Air	Evaporative Cooling	Refrigerated Air	Evaporative Cooling
R-19	0.15 - 0.29	n/a	n/a	-	-
R-19	0.3 – 0.49	n/a	n/a	2.67E-5	7.62E-6
R-19	0.5 – 0.69	5.56E-5	1.84E-5	5.35E-5	1.55E-5
R-19	>= 0.7	9.88E-5	7.61E-6	8.81E-5	1.52E-5
R-30	0.15 - 0.29	n/a	n/a	3.37E-6	3.42E-6
R-30	0.3 – 0.49	n/a	n/a	1.97E-5	7.38E-6
R-30	0.5 – 0.69	3.21E-5	9.13E-6	3.06E-5	1.25E-5
R-30	>= 0.7	6.91E-5	8.48E-6	5.94E-5	1.60E-5
R-38	0.15 - 0.29	n/a	n/a	5.82E-6	5.90E-6
R-38	0.3 – 0.49	n/a	n/a	1.46E-5	7.20E-6
R-38	0.5 – 0.69	1.50E-5	2.38E-6	1.40E-5	1.04E-5
R-38	>= 0.7	4.75E-5	9.12E-6	3.85E-5	1.66E-5

Climate Zone 2: North Region

Table 248: Climate Zone 2: North Region – Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope	Steep Slope
		Refrigerated Air	Refrigerated Air
R-19	0.15 - 0.29	n/a	5.45E-5
R-19	0.3 – 0.49	n/a	9.02E-5
R-19	0.5 – 0.69	7.41E-5	1.21E-4
R-19	>= 0.7	1.16E-4	5.18E-6
R-30	0.15 - 0.29	n/a	2.22E-5
R-30	0.3 – 0.49	n/a	5.01E-5
R-30	0.5 – 0.69	4.37E-5	7.67E-5
R-30	>= 0.7	7.41E-5	3.37E-5
R-38	0.15 - 0.29	n/a	-1.31E-6
R-38	0.3 – 0.49	n/a	2.10E-5
R-38	0.5 – 0.69	2.16E-5	4.44E-5

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope	Steep Slope
		Refrigerated Air	Refrigerated Air
R-38	>= 0.7	4.36E-5	5.45E-5

Climate Zone 3: South Region

Table 249: Climate Zone 3: South Region – Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope	Steep Slope
		Refrigerated Air	Refrigerated Air
R-19	0.15 - 0.29	n/a	-
R-19	0.3 – 0.49	n/a	4.30E-5
R-19	0.5 – 0.69	9.43E-5	9.42E-5
R-19	>= 0.7	1.32E-4	1.21E-4
R-30	0.15 - 0.29	n/a	-1.46E-6
R-30	0.3 – 0.49	n/a	2.60E-5
R-30	0.5 – 0.69	7.13E-5	6.50E-5
R-30	>= 0.7	8.56E-5	8.46E-5
R-38	0.15 - 0.29	n/a	-2.53E-6
R-38	0.3 – 0.49	n/a	1.37E-5
R-38	0.5 – 0.69	5.46E-5	4.37E-5
R-38	>= 0.7	5.19E-5	5.82E-5

Climate Zone 4: Valley Region

Table 250: Climate Zone 4: Valley Region – Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope	Steep Slope
		Refrigerated Air	Refrigerated Air
R-19	0.15 - 0.29	n/a	-
R-19	0.3 – 0.49	n/a	3.38E-5
R-19	0.5 – 0.69	4.44E-5	5.01E-5
R-19	>= 0.7	7.43E-5	7.37E-5
R-30	0.15 - 0.29	n/a	3.36E-6
R-30	0.3 – 0.49	n/a	2.68E-5

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope	Steep Slope
		Refrigerated Air	Refrigerated Air
R-30	0.5 – 0.69	2.09E-5	3.56E-5
R-30	>= 0.7	5.33E-5	5.29E-5
R-38	0.15 - 0.29	n/a	5.81E-6
R-38	0.3 – 0.49	n/a	2.17E-5
R-38	0.5 – 0.69	3.83E-6	2.51E-5
R-38	>= 0.7	3.80E-5	3.78E-5

Climate Zone 5: West Region

Table 251: Climate Zone 5: West Region – Deemed Summer Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope		Steep Slope	
		Refrigerated Air	Evaporative Cooling	Refrigerated Air	Evaporative Cooling
R-19	0.15 - 0.29	n/a	n/a	-	-
R-19	0.3 – 0.49	n/a	n/a	3.64E-5	2.24E-5
R-19	0.5 – 0.69	8.11E-5	2.76E-5	8.95E-5	4.42E-5
R-19	>= 0.7	1.33E-4	2.30E-5	1.35E-4	4.44E-5
R-30	0.15 - 0.29	n/a	n/a	6.66E-6	1.11E-6
R-30	0.3 – 0.49	n/a	n/a	3.01E-5	5.29E-6
R-30	0.5 – 0.69	5.61E-5	1.09E-5	6.63E-5	1.83E-5
R-30	>= 0.7	1.13E-4	1.29E-5	1.05E-4	2.23E-5
R-38	0.15 - 0.29	n/a	n/a	1.15E-5	1.91E-6
R-38	0.3 – 0.49	n/a	n/a	2.55E-5	-7.15E-6
R-38	0.5 – 0.69	3.79E-5	-1.22E-6	4.95E-5	-5.19E-7
R-38	>= 0.7	9.92E-5	5.60E-6	8.40E-5	6.29E-6

Deemed Winter Demand Savings Tables

Homes with Ceiling Insulation

Table 252 through Table 256 present the winter demand savings (kW) associated with the installation of a reflective roof in homes with varying levels of ceiling insulation (attic floor) for the five Texas climate zones. Savings are per square foot of treated roof area.

Climate Zone 1: Panhandle Region

Table 252: Climate Zone 1: Panhandle Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-0	0.15 - 0.29	n/a	n/a	n/a	7.03E-7	-2.04E-5	-9.92E-6
R-0	0.3 – 0.49	n/a	n/a	n/a	-6.69E-6	-9.53E-5	-3.96E-5
R-0	0.5 – 0.69	-1.24E-5	-1.93E-4	-9.51E-5	-1.75E-5	-1.77E-4	-8.14E-5
R-0	>= 0.7	-2.90E-5	-2.76E-4	-1.36E-4	-2.81E-5	-2.64E-4	-1.27E-4
R-1 to R-4	0.15 - 0.29	n/a	n/a	n/a	1.91E-7	-1.56E-5	-7.24E-6
R-1 to R-4	0.3 – 0.49	n/a	n/a	n/a	-1.12E-6	-7.78E-5	-3.58E-5
R-1 to R-4	0.5 – 0.69	-1.06E-5	-1.49E-4	-7.04E-5	-8.61E-6	-1.39E-4	-6.18E-5
R-1 to R-4	>= 0.7	-2.40E-5	-2.18E-4	-1.07E-4	-2.33E-5	-2.05E-4	-9.72E-5
R-5 to R-8	0.15 - 0.29	n/a	n/a	n/a	-1.01E-6	-9.53E-6	-4.74E-6
R-5 to R-8	0.3 – 0.49	n/a	n/a	n/a	-4.25E-6	-4.66E-5	-2.12E-5
R-5 to R-8	0.5 – 0.69	1.52E-6	-9.25E-5	-4.52E-5	-5.04E-6	-8.62E-5	-4.15E-5
R-5 to R-8	>= 0.7	-9.01E-6	-1.34E-4	-6.68E-5	-2.13E-5	-1.24E-4	-5.82E-5
R-9 to R-14	0.15 - 0.29	n/a	n/a	n/a	-8.59E-7	-7.63E-6	-3.69E-6
R-9 to R-14	0.3 – 0.49	n/a	n/a	n/a	-3.68E-6	-3.63E-5	-1.55E-5
R-9 to R-14	0.5 – 0.69	-1.04E-7	-7.28E-5	-3.43E-5	-1.49E-5	-6.73E-5	-3.07E-5
R-9 to R-14	>= 0.7	-6.86E-6	-1.05E-4	-4.98E-5	-2.11E-5	-9.83E-5	-4.57E-5
R-15 to R-22	0.15 - 0.29	n/a	n/a	n/a	-8.96E-7	-5.40E-6	-2.51E-6
R-15 to R-22	0.3 – 0.49	n/a	n/a	n/a	-3.85E-6	-2.60E-5	-1.08E-5
R-15 to R-22	0.5 – 0.69	-1.72E-6	-5.26E-5	-2.47E-5	-1.19E-5	-4.80E-5	-2.15E-5
R-15 to R-22	>= 0.7	-9.72E-7	-7.65E-5	-3.64E-5	-1.44E-5	-7.05E-5	-3.23E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	-8.09E-7	-3.58E-6	-1.64E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	-1.08E-5	-1.73E-5	-7.31E-6
R-30	0.5 – 0.69	-5.10E-6	-3.52E-5	-1.58E-5	-1.54E-5	-3.12E-5	-1.36E-5
R-30	>= 0.7	-3.71E-6	-5.35E-5	-2.58E-5	-2.10E-5	-4.64E-5	-2.11E-5

Climate Zone 2: North Region

Table 253: Climate Zone 2: North Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-0	0.15 - 0.29	n/a	n/a	n/a	1.24E-6	-2.12E-5	-1.08E-5
R-0	0.3 – 0.49	n/a	n/a	n/a	-3.32E-6	-1.09E-4	-5.47E-5
R-0	0.5 – 0.69	-2.31E-6	-2.40E-4	-1.18E-4	-6.57E-6	-2.02E-4	-1.01E-4
R-0	>= 0.7	-2.47E-5	-3.57E-4	-1.77E-4	-6.70E-6	-3.02E-4	-1.49E-4
R-1 to R-4	0.15 - 0.29	n/a	n/a	n/a	-1.22E-6	-1.72E-5	-8.84E-6
R-1 to R-4	0.3 – 0.49	n/a	n/a	n/a	-2.72E-6	-8.68E-5	-4.17E-5
R-1 to R-4	0.5 – 0.69	-1.94E-6	-1.95E-4	-9.82E-5	-5.81E-6	-1.63E-4	-8.03E-5
R-1 to R-4	>= 0.7	-9.73E-6	-2.88E-4	-1.42E-4	-5.23E-6	-2.45E-4	-1.22E-4
R-5 to R-8	0.15 - 0.29	n/a	n/a	n/a	4.57E-6	-1.03E-5	-5.30E-6
R-5 to R-8	0.3 – 0.49	n/a	n/a	n/a	1.59E-6	-4.70E-5	-2.68E-5
R-5 to R-8	0.5 – 0.69	-3.36E-6	-1.19E-4	-5.69E-5	1.19E-6	-9.33E-5	-4.88E-5
R-5 to R-8	>= 0.7	-3.79E-6	-1.74E-4	-8.66E-5	-4.46E-6	-1.43E-4	-7.18E-5
R-9 to R-14	0.15 - 0.29	n/a	n/a	n/a	-7.26E-7	-8.09E-6	-3.86E-6
R-9 to R-14	0.3 – 0.49	n/a	n/a	n/a	-2.92E-6	-4.23E-5	-2.03E-5
R-9 to R-14	0.5 – 0.69	-1.29E-5	-9.30E-5	-4.31E-5	-3.26E-6	-7.90E-5	-3.76E-5
R-9 to R-14	>= 0.7	-1.27E-5	-1.41E-4	-6.53E-5	-7.53E-6	-1.19E-4	-5.52E-5
R-15 to R-22	0.15 - 0.29	n/a	n/a	n/a	3.23E-7	-5.84E-6	-2.76E-6
R-15 to R-22	0.3 – 0.49	n/a	n/a	n/a	-1.95E-6	-3.04E-5	-1.43E-5
R-15 to R-22	0.5 – 0.69	-1.48E-5	-6.81E-5	-3.23E-5	-2.74E-6	-5.69E-5	-2.66E-5
R-15 to R-22	>= 0.7	-1.61E-5	-1.02E-4	-4.67E-5	-3.88E-7	-8.65E-5	-4.05E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	-3.74E-7	2.81E-6	8.71E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	-1.78E-6	-1.39E-5	9.39E-7
R-30	0.5 – 0.69	-3.37E-6	-4.77E-5	-2.23E-5	-2.20E-6	-3.16E-5	-7.00E-6
R-30	>= 0.7	-1.67E-5	-7.04E-5	-3.03E-5	-4.41E-6	-5.14E-5	-1.57E-5

Climate Zone 3: South Region

Table 254: Climate Zone 3: South Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-0	0.15 - 0.29	n/a	n/a	n/a	-1.09E-6	-2.42E-5	-1.29E-5
R-0	0.3 – 0.49	n/a	n/a	n/a	-4.20E-6	-1.22E-4	-6.46E-5
R-0	0.5 – 0.69	-2.61E-6	-2.43E-4	-1.26E-4	5.36E-6	-2.19E-4	-1.13E-4
R-0	>= 0.7	-6.37E-6	-3.47E-4	-1.72E-4	6.52E-6	-3.20E-4	-1.65E-4
R-1 to R-4	0.15 - 0.29	n/a	n/a	n/a	-8.77E-7	-2.02E-5	-9.95E-6
R-1 to R-4	0.3 – 0.49	n/a	n/a	n/a	-3.88E-6	-1.01E-4	-5.32E-5
R-1 to R-4	0.5 – 0.69	-1.64E-6	-2.02E-4	-1.03E-4	-6.56E-6	-1.84E-4	-9.58E-5
R-1 to R-4	>= 0.7	-4.95E-6	-2.89E-4	-1.44E-4	-5.61E-6	-2.65E-4	-1.37E-4
R-5 to R-8	0.15 - 0.29	n/a	n/a	n/a	-7.39E-7	-1.25E-5	-6.46E-6
R-5 to R-8	0.3 – 0.49	n/a	n/a	n/a	-2.67E-6	-6.28E-5	-3.05E-5
R-5 to R-8	0.5 – 0.69	-4.26E-6	-1.28E-4	-6.54E-5	-5.79E-6	-1.14E-4	-5.59E-5
R-5 to R-8	>= 0.7	-4.68E-6	-1.84E-4	-9.11E-5	-9.38E-6	-1.68E-4	-8.50E-5
R-9 to R-14	0.15 - 0.29	n/a	n/a	n/a	-6.93E-7	-9.35E-6	-4.68E-6
R-9 to R-14	0.3 – 0.49	n/a	n/a	n/a	-3.38E-6	-4.69E-5	-2.31E-5
R-9 to R-14	0.5 – 0.69	-5.14E-6	-9.71E-5	-4.78E-5	-6.46E-6	-8.68E-5	-4.28E-5
R-9 to R-14	>= 0.7	-4.83E-6	-1.41E-4	-6.90E-5	-1.00E-5	-1.27E-4	-6.19E-5
R-15 to R-22	0.15 - 0.29	n/a	n/a	n/a	-7.06E-7	-6.48E-6	-3.22E-6
R-15 to R-22	0.3 – 0.49	n/a	n/a	n/a	-3.70E-6	-3.32E-5	-1.62E-5
R-15 to R-22	0.5 – 0.69	-5.52E-6	-6.85E-5	-3.34E-5	-6.80E-6	-6.15E-5	-3.00E-5
R-15 to R-22	>= 0.7	-8.06E-6	-1.00E-4	-4.89E-5	-9.55E-6	-9.10E-5	-4.44E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	-6.32E-7	-4.54E-6	-2.25E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	-3.32E-6	-2.23E-5	-1.07E-5
R-30	0.5 – 0.69	-5.55E-6	-4.83E-5	-2.35E-5	-6.05E-6	-4.13E-5	-2.00E-5
R-30	>= 0.7	-6.77E-6	-7.30E-5	-3.95E-5	-8.39E-6	-6.06E-5	-2.93E-5

Climate Zone 4: Valley Region

Table 255: Climate Zone 4: Valley Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-0	0.15 - 0.29	n/a	n/a	n/a	-9.43E-7	-2.51E-5	-1.37E-5
R-0	0.3 – 0.49	n/a	n/a	n/a	-3.97E-6	-1.30E-4	-7.29E-5
R-0	0.5 – 0.69	-1.25E-5	-2.47E-4	-1.23E-4	-9.15E-6	-2.31E-4	-1.22E-4
R-0	>= 0.7	-1.10E-5	-3.51E-4	-1.61E-4	-1.29E-5	-3.33E-4	-1.70E-4
R-1 to R-4	0.15 - 0.29	n/a	n/a	n/a	-5.89E-7	-1.93E-5	-8.99E-6
R-1 to R-4	0.3 – 0.49	n/a	n/a	n/a	-2.99E-6	-9.64E-5	-4.50E-5
R-1 to R-4	0.5 – 0.69	-8.23E-6	-2.03E-4	-1.02E-4	-7.44E-6	-1.76E-4	-8.06E-5
R-1 to R-4	>= 0.7	-8.24E-6	-2.85E-4	-1.29E-4	-1.09E-5	-2.62E-4	-1.22E-4
R-5 to R-8	0.15 - 0.29	n/a	n/a	n/a	-4.02E-7	-1.19E-5	-5.71E-6
R-5 to R-8	0.3 – 0.49	n/a	n/a	n/a	-2.13E-6	-5.99E-5	-2.89E-5
R-5 to R-8	0.5 – 0.69	-3.72E-6	-1.20E-4	-5.60E-5	-3.17E-6	-1.08E-4	-5.08E-5
R-5 to R-8	>= 0.7	-7.11E-6	-1.79E-4	-8.65E-5	-4.84E-6	-1.61E-4	-7.59E-5
R-9 to R-14	0.15 - 0.29	n/a	n/a	n/a	-6.35E-7	-8.94E-6	-4.36E-6
R-9 to R-14	0.3 – 0.49	n/a	n/a	n/a	-1.95E-6	-4.53E-5	-2.21E-5
R-9 to R-14	0.5 – 0.69	-3.55E-6	-9.21E-5	-4.40E-5	-2.94E-6	-8.27E-5	-3.89E-5
R-9 to R-14	>= 0.7	-4.77E-6	-1.35E-4	-6.41E-5	-3.95E-6	-1.23E-4	-5.95E-5
R-15 to R-22	0.15 - 0.29	n/a	n/a	n/a	-1.73E-6	-6.16E-6	-2.94E-6
R-15 to R-22	0.3 – 0.49	n/a	n/a	n/a	-2.67E-6	-3.25E-5	-1.62E-5
R-15 to R-22	0.5 – 0.69	-3.83E-6	-6.74E-5	-3.45E-5	-3.08E-6	-5.91E-5	-2.83E-5
R-15 to R-22	>= 0.7	-4.47E-6	-9.81E-5	-4.84E-5	-4.19E-6	-8.82E-5	-4.34E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	-1.34E-7	-4.03E-6	-1.87E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	-9.58E-7	-2.14E-5	-1.03E-5
R-30	0.5 – 0.69	-3.13E-6	-4.69E-5	-2.41E-5	-2.42E-6	-4.01E-5	-2.00E-5
R-30	>= 0.7	-3.46E-6	-6.78E-5	-3.32E-5	-2.98E-6	-5.89E-5	-2.88E-5

Climate Zone 5: West Region

Table 256: Climate Zone 5: West Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Ceiling Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-0	0.15 - 0.29	n/a	n/a	n/a	-1.72E-6	-4.29E-5	-1.75E-5
R-0	0.3 – 0.49	n/a	n/a	n/a	-9.07E-6	-2.19E-4	-8.87E-5
R-0	0.5 – 0.69	-1.39E-5	-4.75E-4	-1.91E-4	-1.45E-5	-4.08E-4	-1.64E-4
R-0	>= 0.7	-2.19E-5	-7.00E-4	-2.75E-4	-2.26E-5	-6.10E-4	-2.44E-4
R-1 to R-4	0.15 - 0.29	n/a	n/a	n/a	-1.38E-6	-3.39E-5	-1.37E-5
R-1 to R-4	0.3 – 0.49	n/a	n/a	n/a	-1.14E-5	-1.82E-4	-7.76E-5
R-1 to R-4	0.5 – 0.69	-1.86E-5	-3.87E-4	-1.55E-4	-1.54E-5	-3.35E-4	-1.39E-4
R-1 to R-4	>= 0.7	-2.15E-5	-5.77E-4	-2.30E-4	-2.25E-5	-5.00E-4	-2.04E-4
R-5 to R-8	0.15 - 0.29	n/a	n/a	n/a	-2.41E-7	-1.98E-5	-7.98E-6
R-5 to R-8	0.3 – 0.49	n/a	n/a	n/a	-4.83E-6	-1.03E-4	-4.14E-5
R-5 to R-8	0.5 – 0.69	-1.33E-5	-2.36E-4	-9.44E-5	-1.22E-5	-1.99E-4	-7.97E-5
R-5 to R-8	>= 0.7	-1.47E-5	-3.64E-4	-1.48E-4	-1.73E-5	-3.11E-4	-1.28E-4
R-9 to R-14	0.15 - 0.29	n/a	n/a	n/a	-5.77E-7	-1.35E-5	-5.48E-6
R-9 to R-14	0.3 – 0.49	n/a	n/a	n/a	-4.07E-6	-7.56E-5	-3.15E-5
R-9 to R-14	0.5 – 0.69	-9.52E-6	-1.70E-4	-6.83E-5	-9.66E-6	-1.44E-4	-5.76E-5
R-9 to R-14	>= 0.7	-1.06E-5	-2.73E-4	-1.12E-4	-1.38E-5	-2.33E-4	-9.66E-5
R-15 to R-22	0.15 - 0.29	n/a	n/a	n/a	-4.29E-7	-9.41E-6	-4.20E-6
R-15 to R-22	0.3 – 0.49	n/a	n/a	n/a	-3.14E-6	-4.91E-5	-2.00E-5
R-15 to R-22	0.5 – 0.69	-7.55E-6	-1.14E-4	-4.66E-5	-7.70E-6	-9.71E-5	-4.02E-5
R-15 to R-22	>= 0.7	-8.94E-6	-1.85E-4	-7.43E-5	-1.05E-5	-1.55E-4	-6.29E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	-2.85E-7	-6.26E-6	-2.54E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	-2.32E-6	-3.11E-5	-1.25E-5
R-30	0.5 – 0.69	-5.52E-6	-7.44E-5	-2.95E-5	-6.01E-6	-5.97E-5	-2.46E-5
R-30	>= 0.7	-7.73E-6	-1.20E-4	-4.89E-5	-7.78E-6	-9.69E-5	-3.98E-5

Homes with Roof Deck Insulation

Table 257 through Table 261 present the winter demand savings (kW) associated with the installation of a reflective roof in homes with varying levels of roof deck for the five Texas climate zones. Savings are per square foot of treated roof area.

Climate Zone 1: Panhandle Region

Table 257: Climate Zone 1: Panhandle Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-19	0.15 - 0.29	n/a	n/a	n/a	-	-	-
R-19	0.3 – 0.49	n/a	n/a	n/a	6.62E-7	-3.75E-5	-1.86E-5
R-19	0.5 – 0.69	1.68E-6	-6.28E-5	-2.35E-5	5.59E-6	-7.49E-5	-3.71E-5
R-19	>= 0.7	-1.78E-6	-9.77E-5	-4.08E-5	7.13E-6	-1.12E-4	-5.19E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	-1.08E-7	-3.00E-6	-1.52E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	2.49E-6	-3.23E-5	-1.75E-5
R-30	0.5 – 0.69	-5.08E-7	-5.14E-5	-2.26E-5	3.99E-6	-6.01E-5	-3.15E-5
R-30	>= 0.7	-1.76E-6	-7.76E-5	-3.59E-5	4.24E-6	-8.76E-5	-4.38E-5
R-38	0.15 - 0.29	n/a	n/a	n/a	-1.87E-7	-5.19E-6	-2.62E-6
R-38	0.3 – 0.49	n/a	n/a	n/a	3.82E-6	-2.85E-5	-1.67E-5
R-38	0.5 – 0.69	-2.10E-6	-4.31E-5	-2.20E-5	2.82E-6	-4.93E-5	-2.74E-5
R-38	>= 0.7	-1.74E-6	-6.29E-5	-3.23E-5	2.13E-6	-6.99E-5	-3.79E-5

Climate Zone 2: North Region

Table 258: Climate Zone 2: North Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-19	0.15 - 0.29	n/a	n/a	n/a	-	-	-
R-19	0.3 – 0.49	n/a	n/a	n/a	-1.68E-6	-4.21E-5	-2.13E-5
R-19	0.5 – 0.69	3.73E-6	-8.26E-5	-3.29E-5	3.93E-6	-8.72E-5	-4.49E-5
R-19	>= 0.7	2.09E-6	-1.33E-4	-5.96E-5	2.27E-6	-1.30E-4	-5.31E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	-7.35E-8	-3.36E-6	-1.70E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	-1.19E-6	-3.52E-5	-1.73E-5
R-30	0.5 – 0.69	6.09E-7	-6.66E-5	-3.33E-5	8.00E-8	-6.99E-5	-3.56E-5
R-30	>= 0.7	-1.22E-6	-1.03E-4	-5.11E-5	-1.19E-6	-1.03E-4	-4.63E-5
R-38	0.15 - 0.29	n/a	n/a	n/a	-1.27E-7	-5.81E-6	-2.93E-6
R-38	0.3 – 0.49	n/a	n/a	n/a	-8.41E-7	-3.02E-5	-1.44E-5

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-38	0.5 – 0.69	-1.66E-6	-5.49E-5	-3.36E-5	-2.72E-6	-5.73E-5	-2.88E-5
R-38	>= 0.7	-3.63E-6	-8.17E-5	-4.49E-5	-3.70E-6	-8.42E-5	-4.14E-5

Climate Zone 3: South Region

Table 259: Climate Zone 3: South Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-19	0.15 - 0.29	n/a	n/a	n/a	-	-	-
R-19	0.3 – 0.49	n/a	n/a	n/a	5.21E-8	-4.60E-5	-2.10E-5
R-19	0.5 – 0.69	-4.82E-7	-9.84E-5	-5.19E-5	-1.73E-7	-9.69E-5	-4.88E-5
R-19	>= 0.7	1.47E-6	-1.47E-4	-7.52E-5	2.13E-6	-1.52E-4	-8.03E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	2.41E-8	-3.94E-6	-2.10E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	1.86E-7	-4.00E-5	-1.93E-5
R-30	0.5 – 0.69	-1.49E-6	-8.32E-5	-4.30E-5	-4.20E-7	-7.79E-5	-4.01E-5
R-30	>= 0.7	-1.30E-6	-1.17E-4	-6.28E-5	-7.36E-7	-1.19E-4	-6.33E-5
R-38	0.15 - 0.29	n/a	n/a	n/a	4.96E-8	-6.80E-6	-3.63E-6
R-38	0.3 – 0.49	n/a	n/a	n/a	4.75E-7	-3.56E-5	-1.81E-5
R-38	0.5 – 0.69	-2.23E-6	-7.22E-5	-3.66E-5	-5.99E-7	-6.41E-5	-3.37E-5
R-38	>= 0.7	-3.32E-6	-9.52E-5	-5.37E-5	-2.82E-6	-9.58E-5	-5.09E-5

Climate Zone 4: Valley Region

Table 260: Climate Zone 4: Valley Region – Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-19	0.15 - 0.29	n/a	n/a	n/a	-	-	-
R-19	0.3 – 0.49	n/a	n/a	n/a	-1.53E-6	-4.45E-5	-2.26E-5
R-19	0.5 – 0.69	-2.27E-6	-9.14E-5	-3.90E-5	-2.29E-6	-9.18E-5	-4.65E-5
R-19	>= 0.7	-2.65E-6	-1.39E-4	-6.06E-5	-4.16E-6	-1.37E-4	-6.18E-5

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-30	0.15 - 0.29	n/a	n/a	n/a	-1.08E-7	-3.76E-6	-1.77E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	-1.19E-6	-3.68E-5	-1.74E-5
R-30	0.5 – 0.69	-2.72E-6	-7.35E-5	-3.29E-5	-2.34E-6	-7.31E-5	-3.62E-5
R-30	>= 0.7	-3.34E-6	-1.09E-4	-4.88E-5	-3.60E-6	-1.09E-4	-5.07E-5
R-38	0.15 - 0.29	n/a	n/a	n/a	-1.87E-7	-6.50E-6	-3.06E-6
R-38	0.3 – 0.49	n/a	n/a	n/a	-9.37E-7	-3.12E-5	-1.36E-5
R-38	0.5 – 0.69	-3.05E-6	-6.05E-5	-2.85E-5	-2.37E-6	-5.95E-5	-2.87E-5
R-38	>= 0.7	-3.85E-6	-8.74E-5	-4.03E-5	-3.19E-6	-8.78E-5	-4.27E-5

Climate Zone 5: West Region

**Table 261: Climate Zone 5: West Region –
Deemed Winter Demand Savings for Residential Reflective Roof Installation (kW/sq. ft.)**

Roof Deck Insulation R-value	Installed Roof Material 3-Year Reflectance	Low Slope			Steep Slope		
		Gas Heat	Electric Resistance	Heat Pump	Gas Heat	Electric Resistance	Heat Pump
R-19	0.15 - 0.29	n/a	n/a	n/a	-	-	-
R-19	0.3 – 0.49	n/a	n/a	n/a	2.07E-6	-5.87E-5	-2.38E-5
R-19	0.5 – 0.69	7.97E-7	-1.30E-4	-5.39E-5	1.10E-6	-1.31E-4	-5.30E-5
R-19	>= 0.7	-1.19E-6	-2.13E-4	-8.83E-5	-8.95E-7	-2.10E-4	-8.53E-5
R-30	0.15 - 0.29	n/a	n/a	n/a	-1.04E-7	-4.45E-6	-1.81E-6
R-30	0.3 – 0.49	n/a	n/a	n/a	4.81E-7	-4.81E-5	-1.95E-5
R-30	0.5 – 0.69	3.74E-8	-1.01E-4	-4.16E-5	-7.12E-7	-1.01E-4	-4.15E-5
R-30	>= 0.7	-1.64E-6	-1.61E-4	-6.73E-5	-2.51E-6	-1.60E-4	-6.58E-5
R-38	0.15 - 0.29	n/a	n/a	n/a	-1.79E-7	-7.68E-6	-3.13E-6
R-38	0.3 – 0.49	n/a	n/a	n/a	-6.75E-7	-4.04E-5	-1.63E-5
R-38	0.5 – 0.69	-5.15E-7	-7.93E-5	-3.26E-5	-2.03E-6	-7.94E-5	-3.31E-5
R-38	>= 0.7	-1.97E-6	-1.24E-4	-5.20E-5	-3.68E-6	-1.24E-4	-5.16E-5

Examples

Example 1. A contractor installs 1500 square feet of white asphalt shingle roofing with a 3-year rated reflectance of 0.55 on a home in climate zone 3 with a roof slope of 4/12, refrigerated air, and a gas furnace, which has existing ceiling insulation estimated at R-12.

$$kWh\ savings = (0.26 - \ 0.01) \times 1500 = 375\ kWh$$

$$Summer\ kW\ savings = 2.03x10^{-4} \times 1500 = 0.30\ kW$$

$$Winter\ kW\ savings = -6.46x10^{-6} \times 1500 = -0.01\ kW$$

Example 2. A contractor applies a reflective coating to a 1200 square foot home with a heat pump and a low-slope roof in Climate Zone 2, with R-19 roof deck insulation. The coating has a 3-year rated reflectance of 0.75.

$$kWh\ savings = (0.32 - \ 0.11) \times 1200 = 252\ kWh$$

$$Summer\ kW\ savings = N/A$$

$$Winter\ kW\ savings = -5.96x10^{-5} \times 1200 = -0.07\ kW$$

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for a cool roof measure is 15 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[235]

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- TRM climate zone
- R-value of insulation (as is, post measure installation of ceiling/roof insulation)
- Space cooling system type (evaporative cooling, refrigerated air conditioning)
- Space heating system type (gas, electric, heat pump)
- Square footage of reflective roofing material installed

[235] 2014 California Database for Energy Efficiency Resources. Accessed via the READI database v2.4.7 which can be downloaded from the California Public Utilities Commission Website at http://www.deeresources.com/.

- Slope of the roof (low or high slope)
- Three-year solar reflectance as rated by Cool Roof Rating Certification of the reflective material installed
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification.

References and Efficiency Standards

Petitions and Rulings

- Docket No. 47755-1. Petition of AEP Texas Inc., CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company. Petition To Approve Revisions To Residential And Nonresidential Deemed Savings Incorporated In Texas Technical Reference Manual Version 5.0 Program Year 2018 And Deemed Savings Derived For A New Measure. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 262: Residential Cool Roofs Revision History

TRM Version	Date	Description of Change
v6.0	11/2018	TRM v6.0 origin.
v7.0	11/2019	TRM v7.0 update. Added savings for R-30 insulation.

2.4 RESIDENTIAL: WATER HEATING

2.4.1 Faucet Aerators Measure Overview

TRM Measure ID: R-WH-FA

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure involves installing aerators on kitchen and bathroom water faucets as a retrofit measure.

Eligibility Criteria

The savings values are per faucet aerator installed. It is not a requirement that all faucets in a home be treated for the deemed savings to be applicable.

These deemed savings are for residential, retrofit-only installation of kitchen and bathroom faucet aerators. In order to be awarded these deemed savings, the fuel type of the water heater must be electricity.

Baseline Condition

The 2.2 gallon per minute (GPM) baseline faucet flow rate is based on the Energy Policy Act of 1992 (EPAct 92). The deemed savings assume that the existing faucet aerators have a minimum flow rate of 2.2 GPM. The US EPA WaterSense specification for faucet aerators is 1.5 GPM.[236]

Table 263: Faucet Aerators—Baseline and Efficiency Standard

Baseline	Efficiency Standard
2.2 GPM minimum	1.5 GPM maximum

[236] https://www.epa.gov/watersense/bathroom-faucets.

High-efficiency Condition

Aerators that have been defaced so as to make the flow rating illegible are not eligible for replacement. For direct install programs, all aerators removed shall be collected by the contractor and held for possible inspection by the utility until all inspections for invoiced installations have been completed.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

The deemed savings, for any faucet aerator change case using aerators with flow rates of 1.5 GPM or lower, are calculated as follows:

$$Energy\ Savings\ (per\ aerator) = \frac{\rho \times C_P \times (GPM_{Base} - GPM_{Low}) \times N \times t \times 365 \times \left(T_{FaucetAvg} - T_{SupplyAvg}\right)}{FPH \times RE \times Conversion\ Factor}$$

Equation 79

Where:

ρ	=	*Water density, 8.33 lbs/gallon*
C_P	=	*Specific heat of water, 1 Btu/lb°F*
GPM_{Base}	=	*Average baseline flow rate of aerator = 2.2 gallons per minute*
GPM_{Low}	=	*Post-installation flow rate of aerator, typically 1.5, 1.0, or 0.5 gallons per minute; if unknown, assume 1.5 gallons per minute*
N	=	*Average number of persons per household = 2.82 persons*[237]
t	=	*Average time in minutes of hot water usage per person per day; default = 2.34 min/person/day*[238]
$T_{SetPoint}$	=	*Average faucet temperature = 88°F*[239]

[237] Occupants per home for Texas from US Census Bureau, "Persons per household, 2009-2013". Accessed December 2015. http://quickfacts.census.gov/qfd/states/48000.html.

[238] Cadmus and Opinion Dynamics Evaluation Team, "Memorandum: Showerhead and Faucet Aerator Meter Study". Prepared for Michigan Evaluation Working Group. Derived by taking weighted average of average minutes per person per day specified for kitchens (4.5) and bathrooms (1.6) assuming 1 kitchen aerator and 2.93 bathrooms.

[239] Cadmus and Opinion Dynamics Evaluation Team, "Memorandum: Showerhead and Faucet Aerator Meter Study". Prepared for Michigan Evaluation Working Group. Derived by taking weighted average of average temperature for kitchens (93 °F) and bathrooms (86 °F) assuming 1 kitchen aerator and 2.93 bathrooms.
Data collection discussed in Appendix D of the EM&V team's Annual Statewide Portfolio Report for Program Year 2014-Volume 1, Project Number 40891 (August 2015), also supports a default value of 120°F.

$T_{SupplyAverage}$ = *Average supply water temperature (see Table 264)*

FPH = *Average number of faucets per household = 3.93 faucets*[240]

RE = *Recovery Efficiency (or in the case of heat pump water heaters, COP). If unknown, use 0.98 as a default for electric resistance water heaters or 2.2 for heat pump water heaters.*[241]

ConversionFactor = *3,412 Btu/kWh*

Demand Savings Algorithms

Demand savings will be calculated using the following formula:

$$Demand\ Savings\ (per\ aerator) = \frac{\rho \times C_P \times (GPM_{Base} - GPM_{Low}) \times N \times t \times 365 \times (T_{FaucetAvg} - T_{SupplySeasonal})}{FPH \times RE \times Conversion\ Factor} \times Ratio_{annual\ kWh}^{Peak_{seasonal}kW}$$

Equation 80

Where:

$T_{SupplySeasonal}$ = *Seasonal supply water temperature (Table 264)*

$Ratio_{annual\ kWh}^{Peak_{seasonal}kW}$ = *Ratio of peak seasonal kW to annual kWh savings (Table 265)*

Table 264: Water Mains Temperature

Climate Zone	Water Mains Temperature °F*		
	$T_{SupplyAverage}$	$T_{SupplySeasonal}$	
		Summer	Winter
Climate Zone 1: Panhandle	62.9	73.8	53.7
Climate Zone 2: North	71.8	84.0	60.6
Climate Zone 3: South	74.7	84.5	65.5
Climate Zone 4: Valley	77.2	86.1	68.5
Climate Zone 5: West	70.4	81.5	60.4

* Based on typical meteorological year (TMY) dataset for TMY3: http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/.

240 Faucets per home assumed to be equal to one (kitchen) plus number of half bathrooms and full bathrooms per home as specified in the 2009 Residential Energy Consumption Survey (RECS), Table HC2.10.

241 Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at http://www.ahrinet.org.

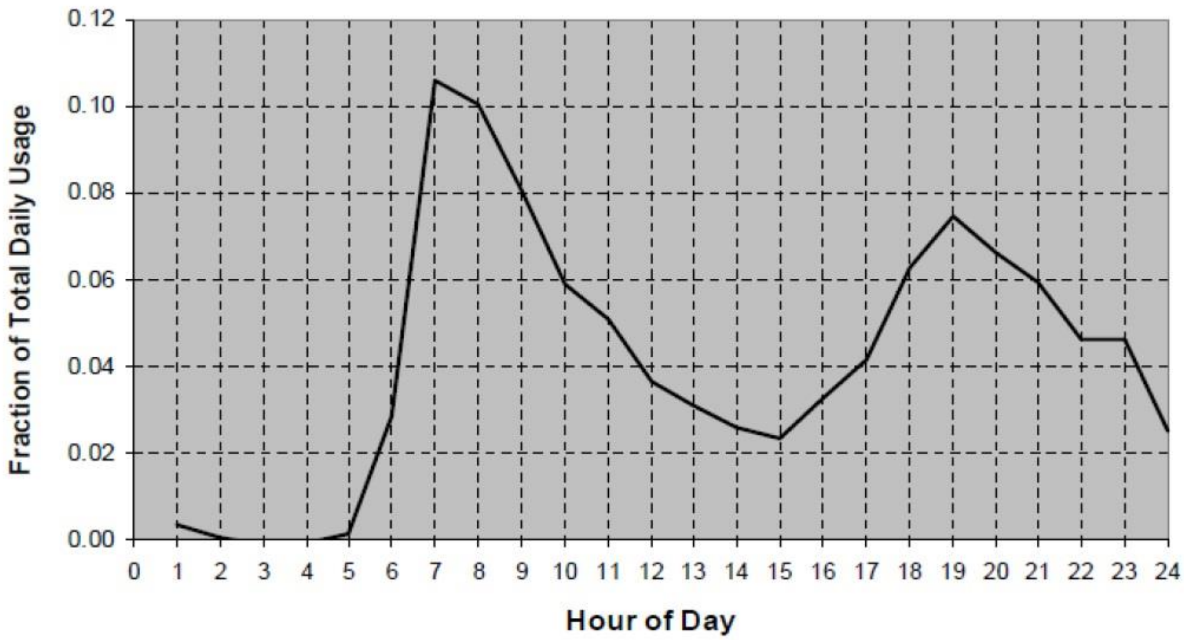
Table 265: Water Fixture Peak Demand Ratios

Peak Demand Ratios*	
Summer	**Winter**
0.000110	0.000274

* US Department of Energy's "Building America Performance Analysis Procedures for Existing Homes" combined domestic hot water use profile (http://www.nrel.gov/docs/fy06osti/38238.pdf).

The fixture peak demand ratios were derived by taking the fraction hot water use during the peak hour (summer: 4-5PM, winter: 7-8AM) to the total daily usage from the Building America Performance Analysis Procedures for Existing Homes and dividing it by the number of days per year (365). The fraction of hot water use during the winter peak hour to total daily water usage is 0.1: $0.1/365 = 0.000274$. The summer peak hour to total daily water usage is 0.04: $0.04/365 = 0.000110$.

Figure 8: Shower, Bath, and Sink Hot Water Use Profile



Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of a faucet aerator is established at ten years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[242]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Recovery Efficiency (RE) or COP, if available
- Flow rate in gallons per minute (GPM) of faucet installed
- Water heater type (e.g., heat pump, electric resistance)

References and Efficiency Standards

Petitions and Rulings

- Docket No. 41722. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Sharyland Utilities, L.P., Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company to Approve Revisions to Residential Deemed Savings to Incorporate Winter Peak Demand Impacts and Update Certain Existing Deemed Savings Values. Public Utility Commission of Texas.

[242] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer2013-update-for-2014-codes.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 266: Residential Faucet Aerators Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor edits to language.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. No revision.
v3.1	10/30/2015	TRM v3.1 update. Supplemented reference for water heater setpoint temperature.
v4.0	10/10/2016	TRM v4.0 update. Updated methodology to calculate energy and demand savings.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	11/2019	TRM v7.0 update. No revision.

2.4.2 Low-flow Showerheads Measure Overview

TRM Measure ID: R-WH-SH

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure consists of removing existing showerheads and installing low-flow showerheads in residences.

Eligibility Criteria

The incentive is for replacement of an existing showerhead with a new showerhead rated at 2.0, 1.7, or 1.5 gallons per minute (GPM). The only showerheads eligible for installation are those that are not easily modified to increase the flow rate.

These deemed savings are for showerheads installed as a retrofit measure in existing homes. In order to be awarded these deemed savings, the fuel type of the water heater must be electricity.

Baseline Condition

Federal standards set a maximum flow rate of 2.5 GPM,[243] while the US Environmental Protection Agency (EPA) WaterSense Program has implemented efficiency standards for showerheads requiring a maximum flow rate of 2.0 GPM.[244]

[243] http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/37.
[244] http://www.epa.gov/watersense/products/showerheads.html.

Table 267: Low-flow Showerhead—Baseline and Efficiency Standards

Existing Showerhead Baseline Flow Rate	New Showerhead Flow Rate*
2.5 GPM maximum	1.5 GPM, 1.75 GPM or 2.0 GPM maximum

* All flow rate requirements listed here are the rated flow of the showerhead measured at 80 pounds per square inch of pressure (psi).

High-efficiency Condition

In addition to meeting the baseline requirements above, existing showerheads that have been defaced so as to make the flow rating illegible are not eligible for replacement. All showerheads removed shall be collected by the contractor and held for possible inspection by the utility until all inspections for invoiced installations have been completed.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings for this measure are calculated as follows:

$$Energy\ Savings\ (per\ showerhead) = \frac{\rho \times C_P \times (GPM_{Base} - GPM_{Low}) \times N \times t \times 365 \times (T_{ShowerAvg} - T_{SupplyAvg})}{SPH \times RE \times Conversion\ Factor}$$

Equation 81

Where:

ρ = *Water density, 8.33 lbs/gallon*

C_P = *Specific heat of water, 1 Btu/lb°F*

GPM_{Base} = *Average baseline flow rate of aerator = 2.5 gallons per minute*

GPM_{Low} = *Post-installation flow rate of aerator, typically 2.0, 1.75, or 1.5 gallons per minute; if unknown, assume 2.0 gallons per minute*

N = *Average number of persons per household = 2.82 persons*[245]

t = *Average time in minutes of hot water usage per person per day; default = 7.8 min/person/day*[246]

245 Occupants per home for Texas from US Census Bureau, "Persons per household, 2009-2013". Accessed December 2015. http://quickfacts.census.gov/qfd/states/48000.html.

246 Cadmus and Opinion Dynamics Evaluation Team, "Memorandum: Showerhead and Faucet Aerator Meter Study". Prepared for Michigan Evaluation Working Group.

$T_{SetPoint}$ = *Average shower temperature = 101°F* [247]

T_{Supply} = *Average supply water temperature (see Table 268)*

SPH = *Average number of showerheads per household = 1.68 showerheads*[248]

RE = *Recovery Efficiency (or in the case of heat pump water heaters, COP). If unknown, use 0.98 as a default for electric resistance water heaters or 2.2 for heat pump water* heaters.[249]

ConversionFactor = *3,412 Btu/kWh*

Demand Savings Algorithms

Demand savings will be calculated using the following formula:

$$Demand\ Savings\ (per\ showerhead) = \frac{\rho \times C_P \times (GPM_{Base} - GPM_{Low}) \times N \times t \times 365 \times (T_{ShowerAvg} - T_{SupplySeasonal})}{SPH \times RE \times Conversion\ Factor} \times Ratio_{annual\ kWh}^{Peak_{seasonal} kW}$$

Equation 82

Where:

$T_{SupplySeasonal}$ = *Seasonal supply water temperature (see Table 268)*

$Ratio_{annual\ kWh}^{Peak_{seasonal} kW}$ = *Ratio of peak seasonal kW to annual kWh savings (see Table 269)*

[247] Data collection discussed in Appendix D of the EM&V team's Annual Statewide Portfolio Report for Program Year 2014-Volume 1, Project Number 40891 (August 2015), also supports a default value of 120°F.

[248] Showerheads per home assumed to be equal to the number of full bathrooms per home as specified in the 2009 Residential Energy Consumption Survey (RECS), Table HC2.10.

[249] Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at http://cafs.ahrinet.org/gama_cafs/sdpsearch/search.jsp?table=CWH.

Table 268: Water Mains Temperature

Climate Zone	Water Mains Temperature (°F) *		
	$T_{SupplyAverage}$	$T_{SupplySeasonal}$	
		Summer	Winter
Climate Zone 1: Panhandle	62.9	73.8	53.7
Climate Zone 2: North	71.8	84.0	60.6
Climate Zone 3: South	74.7	84.5	65.5
Climate Zone 4: Valley	77.2	86.1	68.5
Climate Zone 5: West	70.4	81.5	60.4

* Based on typical meteorological year (TMY) dataset for TMY3: http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/.

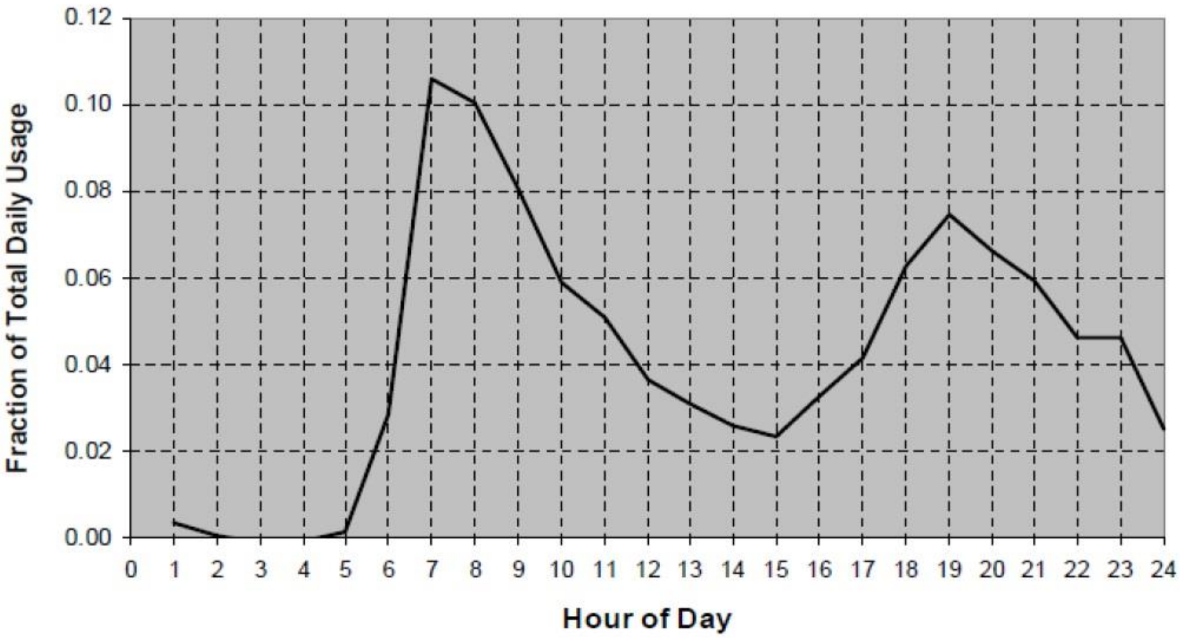
Table 269: Water Fixture Peak Demand Ratios

Peak Demand Ratios*	
Summer	Winter
0.000110	0.000274

* US Department of Energy's "Building America Performance Analysis Procedures for Existing Homes" combined domestic hot water use profile (http://www.nrel.gov/docs/fy06osti/38238.pdf).

The fixture peak demand ratios were derived by taking the fraction hot water use during the peak hour (summer: 4-5pm, winter: 7-8am) to the total daily usage from the Building America Performance Analysis Procedures for Existing Homes, and dividing it by the number of days per year (365). The fraction of hot water use during the winter peak hour to total daily water usage is 0.1: $0.1/365 = 0.000274$. The summer peak hour to total daily water usage is 0.04: $0.04/365 = 0.000110$.

Figure 9: Shower, Bath, and Sink Hot Water Use Profile



Source: Building America Performance Analysis Procedures for Existing Homes.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of a low-flow showerhead is established at 10 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[250]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Recovery efficiency (RE) or COP, if available
- Flow rate in gallons per minute (GPM) of showerhead installed
- Water heater type (e.g., heat pump, electric resistance)

References and Efficiency Standards

Petitions and Rulings

- Docket No. 41722. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Sharyland Utilities, L.P., Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company to Approve Revisions to Residential Deemed Savings to Incorporate Winter Peak Demand Impacts and Update Certain Existing Deemed Savings Values. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

[250] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer2013-update-for-2014-codes.

Document Revision History

Table 270: Residential Low-flow Showerheads Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor edits to language.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. No revision.
v3.1	11/05/2015	TRM v3.1 update. Provided clarification that savings are to be awarded per showerhead. Supplemented reference for water heater setpoint temperature.
v4.0	10/10/2016	TRM v4.0 update. Updated methodology to calculate energy and demand savings.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	11/2019	TRM v7.0 update. No revision.

2.4.3 Water Heater Pipe Insulation Measure Overview

TRM Measure ID: R-WH-PI

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure requires the installation of pipe insulation on uninsulated water heater pipes that are served by an electric water heater.

Eligibility Criteria

Water heaters plumbed with heat traps are not eligible to receive incentives for this measure. It is recommended that the installer (or contractor) checks to see if the water heater heat trap works properly before declaring the water heater ineligible.

Water heater pipe insulation is a residential retrofit measure. New construction and retrofits involving the installation of new water heaters are not eligible for this measure, because they must meet current code requirements. To use these deemed savings, the fuel type of the water heater must be electricity.

Baseline Condition

The baseline is assumed to be a typical electric water heater with no heat traps and no insulation on water heater pipes.

Table 271: Water Heater Pipe Insulation—Baseline Standard

Baseline
Un-insulated hot water pipes

High-efficiency Condition

The efficiency standard requires an insulation thickness R-3. The International Residential Code (IRC) 2009 section N1103.3: Mechanical system piping insulation requires R-3 insulation.

Table 272: Water Heater Pipe Insulation—Efficiency Standard

Efficiency Standard
Minimum insulation of R-3

All visible hot water piping must be insulated. Savings are based on a maximum allowable insulation length of 6 feet of piping.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Hot water pipe insulation energy savings are calculated using the following formula:

$$Energy\ savings\ per\ year = \left(U_{pre} - U_{post}\right) \times A \times \left(T_{pipe} - T_{ambient\ annual}\right) \times \left(\frac{1}{RE}\right) \times \frac{Hours_{Total}}{conversion\ factor}$$

Equation 83

Where:

U_{pre}[251] = $\frac{1}{2.03} = 0.49\ {}^{Btu}/_{hr \cdot sq.ft. \cdot {}^{\circ}F}$

U_{post} = $\frac{1}{2.03 + R_{Insulation}}$

$R_{Insulation}$ = *R-value of installed insulation*

A = *Pipe surface area insulated in square feet* (πDL) *with L (length) and D (pipe diameter) in feet. The maximum length allowable for insulation is 6 feet. If the pipe area is unknown, use the following table:*

[251] 2.03 is the R-value representing the film coefficients between water and the inside of the pipe, and between the surface and air. Mark's Standard Handbook for Mechanical Engineers, 8th edition.

Table 273: Estimated Pipe Surface Area

Pipe Diameter (inches)	Pipe Surface Area (square feet)[252]
0.5	0.16 x required input "Pipe Length insulated (feet)"
0.75	0.23 x required input "Pipe Length insulated (feet)"
1.0	0.29 x required input "Pipe Length insulated (feet)"

T_{pipe}*(°F)* = *120°F*[253]

$T_{ambientannual}$ *(°F)* = *Ambient annual temperature (see Table 274)*

RE = *Recovery efficiency (or in the case of heat pump water heaters, COP). If unknown, use 0.98 as a default for electric resistance water heaters or 2.2 for heat pump water heaters.*[254]

$Hours_{Total}$ = *8,760 hr. per year*

Conversion factor = *3,412 Btu per kWh*

Demand Savings Algorithms

$$Pipe\ Insulation\ Demand\ Savings\ (kW) = \left(U_{pre} - U_{post}\right) \times A \times \left(T_{Pipe} - T_{ambient\ seasonal}\right) \times \left(\frac{1}{RE}\right) \times \frac{1}{conversion\ factor}$$

Equation 84

Where:

$T_{ambientseasonal}$*(°F)* = *Ambient seasonal temperature (see Table 274)*

[252] Factors used in the calculation for pipe area were determined by using the outside diameter of the pipe in inches, converting it to feet, and multiplying by π as shown below.

Nominal Diameter (inches)	Outside Diameter (inches)	Factor to Calculate Pipe Area
0.5	0.625	0.16
0.75	0.875	0.23
1.0	1.125	0.29

[253] 120°F represents the assumed water heater setpoint. New York Department of Public Service recommends using water heater setpoint as a default value, see "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs" October 2010, page 102.
Data collection discussed in Appendix D of the EM&V team's Annual Statewide Portfolio Report for Program Year 2014-Volume 1, Project Number 40891 (August 2015), also supports a default value of 120°F.

[254] Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at http://www.ahrinet.org.

Table 274: Ambient Temperatures per Climate Zone

Climate Zone		Ambient Temperature (°F)					
		Water Heater Location: Unconditioned Space*			Water Heater Location: Conditioned Space**		
		Annual	Peak Seasonal		Annual	Peak Seasonal	
			Summer	Winter		Summer	Winter
1	Panhandle	65.5	106	32			
2	North	73.1	108.1	42			
3	South	76.3	108.2	46	72.7	75.1	69.3
4	Valley	78.4	103	55			
5	West	71.8	108	41.1			

* Average ambient temperatures were taken from TMY3 data, with a 7°F increase in winter and an 11°F increase in summer based on ASHRAE 152 Heating System and Cooling System Location Temperatures (Garage).

** Weighted average reported thermostat setpoints from RECS. Times associated with these set points are assumed to be the same as those assumed by ENERGY STAR®: http://www.energystar.gov/index.cfm?c=thermostats.pr_thermostats_guidelines.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of water heater pipe insulation installed for an electric water heater is established at 13 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[255]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- The R-value of the installed insulation
- Recovery efficiency (RE) or COP, if available
- Pipe length insulated (feet)
- The pipe surface area insulated in square feet (at least the pipe diameter in inches)

References and Efficiency Standards

Petitions and Rulings

- Docket No. 41722. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Sharyland Utilities, L.P., Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company to Approve Revisions to Residential Deemed Savings to Incorporate Winter Peak Demand Impacts and Update Certain Existing Deemed Savings Values. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

[255] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer2013-update-for-2014-codes.

Document Revision History

Table 275: Residential Water Heater Pipe Insulation Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor edits to language.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. No revision.
v3.1	11/05/2015	TRM v3.1 update. Supplemented reference for water heater setpoint temperature.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	11/2019	TRM v7.0 update. No revision.

2.4.4 Water Heater Tank Insulation Measure Overview

TRM Measure ID: R-WH-TI

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure requires the installation of tank insulation on uninsulated water heater tanks that are served by an electric water heater.

Eligibility Criteria

Water heaters meeting the National Appliance Energy Conservation Act standards with respect to insulation and standby loss requirements are not eligible for this measure. To ensure compliance, the contractor shall inspect the build date listed on the existing water heater label and verify that the listed build date is before 1991.

Water heater pipe insulation is a residential retrofit measure. New construction and water heater replacements are not eligible for this measure because they must meet current code requirements. In order to be awarded these deemed savings, the fuel type of the water heater must be electricity.

Baseline Condition

The baseline is assumed to be a typical electric water heater with no insulation.

High-efficiency Condition

There is no minimum insulation requirement. The manufacturer's instructions on the water heater jacket and the water heater itself should be followed. Thermostat and heating element access panels must be left uncovered.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Hot water tank insulation energy savings are calculated using the following formula:

$$Energy\ savings\ per\ year = (U_{pre} - U_{post}) \times A \times (T_{tank} - T_{ambient\ annual}) \times \left(\frac{1}{RE}\right) \times \frac{Hours_{Total}}{conversion\ factor}$$

Equation 85

Where:

U_{pre} = *1/ (5) Btu/hr sq.ft. °F*

U_{post} = *1/ (5+*$R_{Insulation}$*)*

$R_{Insulation}$ = *R-value of installed insulation*

A = *Tank surface area insulated in square feet* (πDL) *with L (length) and D (tank diameter) in feet. If the tank area is not known, use Table 276.*

Table 276: Estimated Tank Area

Volume (gal)	A (sf.) *
30	17.45
40	21.81
50	22.63
60	26.94
80	30.36
120	38.73

* Tank area was obtained from a survey of electric water heater manufacturer data. Dimensions for each tank size were collected and averaged to determine typical square footage of each size water heater. Accessed April 2013: http://www.hotwater.com/water-heaters/residential/conventional/electric/promax/standard/. Accessed April 2013: http://www.whirlpoolwaterheaters.com/products/electric-water-heaters/es40r92-45d/.

T_{tank}(°F) = *Average temperature of the tank, default use 120°F* [256]

$T_{ambientannual}$ (°F) = *Ambient annual temperature (see Table 277)*

RE = *Recovery efficiency (or in the case of heat pump water heaters, COP). If unknown, use 0.98 as a default for electric resistance water heaters or 2.2 for heat pump water heaters.* [257]

$Hours_{Total}$ = *8,760 hours per year*

Conversion factor = *3,412 Btu per kWh*

Demand Savings Algorithms

$$Tank\ Insulation\ Demand\ Savings\ (kW) = (U_{pre} - U_{post}) \times A \times (T_{Tank} - T_{ambient\ seasonal}) \times \frac{1}{RE} \times \frac{1}{conversion\ factor}$$

Equation 86

Where:

$T_{ambientseasonal}$(°F) = *Ambient seasonal temperature (see Table 277)*

Table 277: Ambient Temperatures per Climate Zone

Climate Zone		Ambient Temperature (°F)					
		Water Heater Location: Unconditioned Space			Water Heater Location: Conditioned Space		
		Annual	Peak Seasonal		Annual	Peak Seasonal	
			Summer	Winter		Summer	Winter
1	Panhandle	65.5	106	32	72.7	75.1	69.3
2	North	73.1	108.1	42			
3	South	76.3	108.2	46			
4	Valley	78.4	103	55			
5	West	71.8	108	41.1			

* Average ambient temperatures were taken from TMY3 data, with a 7°F increase in winter and an 11°F increase in summer based on ASHRAE 152 Heating System and Cooling System Location Temperature (Garage).

** Weighted average reported thermostat setpoints from RECS. Times associated with these set points a assumed to be the same as those assumed by ENERGY STAR®: http://www.energystar.gov/index.cfm?c=thermostats.pr_thermostats_guidelines.

[256] 120°F represents the assumed water heater setpoint. New York Department of Public Service recommends using water heater setpoint as a default value, see "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs" October 2010, page 99.
Data collection discussed in Appendix D of the EM&V team's Annual Statewide Portfolio Report for Program Year 2014-Volume 1, Project Number 40891 (August 2015), also supports a default value of 120°F.

[257] Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at http://www.ahrinet.org.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for storage water heater tank insulation is established at 7 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[258]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Recovery Efficiency (RE) or COP, if available
- The R-value of the installed insulation
- Tank surface area insulated in square feet (πDL) with L (length) and D (tank diameter) in feet; if unable to determine tank area, tank volume must be recorded

[258] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer2013-update-for-2014-codes.

References and Efficiency Standards

Petitions and Rulings

- Docket No. 41722. Petition of AEP Texas Central Company, AEP Texas North Company, CenterPoint Energy Houston Electric, LLC, El Paso Electric Company, Entergy Texas, Inc., Oncor Electric Delivery Company LLC, Sharyland Utilities, L.P., Southwestern Electric Power Company, Southwestern Public Service Company, and Texas-New Mexico Power Company to Approve Revisions to Residential Deemed Savings to Incorporate Winter Peak Demand Impacts and Update Certain Existing Deemed Savings Values. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 278: Residential Water Heater Tank Insulation Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor edits to language.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. No revision.
v3.1	11/05/2015	TRM v3.1 update. Supplemented reference for water heater setpoint temperature.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	11/2019	TRM v7.0 update. No revision.

2.4.5 Water Heater Installations—Electric Tankless and Fuel Substitution Measure Overview

TRM Measure ID: R-WH-WH

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Replace-on-burnout, early retirement, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure involves installing a new electric tankless or gas-fueled water heater (storage or tankless) in place of an electric storage water heater.[259]

Eligibility Criteria

This measure involves installing a gas storage, gas tankless (instantaneous), or electric tankless water heater in place of an electric storage water heater, and which meets all the additional requirements described below. HPWHs are not eligible for installation through this measure (see separate Heat Pump Water Heater measure). Currently, there are no conventional, electrically fueled storage units that sufficiently exceed the new federal standard to merit inclusion as an efficient condition in these deemed savings; therefore, deemed savings are only calculated for new gas storage, gas tankless, and electric tankless systems. Electric tankless water heaters may only replace systems with tanks less than 55 gallons. For the installation of an electric water heater with a tank size greater than 55 gallons, please refer to the Heat Pump Water Heater measure.

These deemed savings are for water heater replacements installed as a replace-on-burnout, new construction, or early retirement measure. However, savings are calculated under the assumption of replace-on-burnout or new construction. Savings may be awarded for installations in newly constructed homes where customer and utility representatives provide

[259] Previous versions of this measure included an incentive for installing high-efficiency conventional (electric resistance) storage water heaters. Increments to the federal standard for electric storage water heaters went into effect on April 16, 2015, eliminating the feasibility of continuing to provide deemed savings for these units.

written indication that an electric storage water heater would otherwise have been installed, along with relevant design documentation showing an electric storage water heater.

Baseline Condition

For most installations, the baseline condition is an electric storage water heater with baseline efficiency determined by tank size according to the amended federal energy efficiency standards for residential water heaters with tank sizes from 20 to 120 gallons, which took effect April 16, 2015, as published in 10 CFR Part 430.32 of the Federal Register (see Table 279).[260]

Table 279: Federal Standard for Residential Electric Storage Water Heaters

Rated Storage Volume	Draw Pattern	First Hour Rating (FHR)[261,262]	Uniform Energy Factor (UEF)[263]
≥ 20 gal and ≤ 55 gal	Very Small Usage	0 ≤ FHR < 18	$0.8808 - (0.0008 \times V_r)$
	Low Usage	18 ≤ FHR < 51	$0.9254 - (0.0003 \times V_r)$
	Medium Usage	51 ≤ FHR < 75	$0.9307 - (0.0002 \times V_r)$
	High Usage	75 ≤ FHR	$0.9349 - (0.0001 \times V_r)$
> 55 gal and ≤ 120 gal	Very Small Usage	0 ≤ FHR < 18	$1.9236 - (0.0011 \times V_r)$
	Low Usage	18 ≤ FHR < 51	$2.0440 - (0.0011 \times V_r)$
	Medium Usage	51 ≤ FHR < 75	$2.1171 - (0.0011 \times V_r)$
	High Usage	75 ≤ FHR	$2.2418 - (0.0011 \times V_r)$

The new DOE efficiency standard effectively requires HPWHs (assuming electric water heating) for electric storage water heaters with tank size greater than 55 gallons. As such, electric water heaters with tanks greater than 55 gallons are not eligible for this measure. Instead, see the Heat Pump Water Heater measure. Furthermore, gas water heaters greater than 55 gallons must use HPWH baseline consumption to calculate savings.

For smaller systems, the baseline technology remains an electric storage water heater with electric resistance as the primary heat source. This baseline assumes a replace-on-burnout scenario.

High-efficiency Condition

For water heater replacement and fuel substitution, the new unit must meet the following federal minimum energy factor shown in Table 280. Water heaters must be installed in accordance with local code requirements.

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[260] 10 CFR Part 430.32 Energy and water conservation standards and their effective dates. Accessed February 2014. Available online: http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-32.pdf.

[261] "The Revised Method of Test for Residential Water Heating and Its Impact on Incentive Programs" presentation, Glanville, Paul. ACEEE Hot Water Forum. February 24, 2015. https://aceee.org/sites/default/files/pdf/conferences/hwf/2015/6B-Glanville.pdf.

[262] Assume FHR equal to that of installed water heater.

[263] Vr is the Rated Storage Volume (in gallons), as determined pursuant to 10 CFR 429.17.

Table 280: Water Heater Replacement—Efficiency Standards

DHW Type	Rated Storage Volume	Draw Pattern	FHR	UEF[264]
Electric Tankless	< 2 gal	Very Small Usage	0 ≤ FHR < 18	0.91
		Low Usage	18 ≤ FHR < 51	0.91
		Medium Usage	51 ≤ FHR < 75	0.91
		High Usage	75 ≤ FHR	0.92
Gas Tankless	< 2 gal and > 50,000 Btuh	Very Small Usage	0 ≤ FHR < 18	0.80
		Low Usage	18 ≤ FHR < 51	0.81
		Medium Usage	51 ≤ FHR < 75	0.81
		High Usage	75 ≤ FHR	0.81
Gas Storage	≥ 20 gal and ≤ 55 gal	Very Small Usage	0 ≤ FHR < 18	0.3456 – (0.0020 x V_r)
		Low Usage	18 ≤ FHR < 51	0.5982 – (0.0019 x V_r)
		Medium Usage	51 ≤ FHR < 75	0.6483 – (0.0017 x V_r)
		High Usage	75 ≤ FHR	0.6920 – (0.0013 x V_r)
	> 55 gal and ≤ 100 gal	Very Small Usage	0 ≤ FHR < 18	0.6470 – (0.0006 x V_r)
		Low Usage	18 ≤ FHR < 51	0.7689 – (0.0005 x V_r)
		Medium Usage	51 ≤ FHR < 75	0.7897 – (0.0004 x V_r)
		High Usage	75 ≤ FHR	0.8072 – (0.0003 x V_r)

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

All deemed savings values are calculated using the following standard algorithms for water heating. These algorithms assume a replace-on-burnout or new construction scenario but may be used to award savings for early retirement projects.

Electric Tankless Water Heater

Energy Savings Algorithm

$$kWh_{savings} = \frac{\rho \times C_p \times GPY \times (T_{setpoint} - T_{supply,annual}) \times \left(\frac{1}{EF_{pre}} - \frac{1}{EF_{post}}\right)}{3{,}412}$$

Equation 87

Where:

264 Vr is the Rated Storage Volume (in gallons), as determined pursuant to 10 CFR 429.17.

ρ = *Water density (= 8.33 lbs/gallons)*

C_p = *Specific heat of water (= 1 Btu/lb·°F)*

GPY = *Estimated annual hot water use in gallons/year, specified by number of bedrooms in the home (see Table 281)*

Table 281: Water Heater Consumption (Gal/Year)*

Climate Zone		Number of Bedrooms			
		1	2	3	4
1	Panhandle	15,476	20,171	24,866	29,561
2	North	14,778	19,244	23,710	28,177
3	South	14,492	18,864	23,236	27,608
4	Valley	14,213	18,494	22,775	27,056
5	West	14,905	19,412	23,920	28,427

* Building America Research Benchmark Definition. December 2009. Available online: http://www.nrel.gov/docs/fy10osti/47246.pdf.

$T_{SetPoint}$ = *Water heater setpoint (= 120°F)*[265]

$T_{Supply,ann}$ = *Annual average mains temperature from Table 282*

EF_{pre} = *Baseline energy factor (calculate per* Table 280*)*[266]

EF_{post} = *Energy factor of new water heater (must exceed values from Table 280)*

3,412 = *Constant to convert from Btu to kWh*

[265] 120°F represents the assumed water heater setpoint. The New York Department of Public Service recommends using the water heater setpoint as a default value, see "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs." Page 99. October 2010. The data collection discussed in Appendix D of the EM&V team's Annual Statewide Portfolio Report for Program Year 2014-Volume 1, Project Number 40891 (August 2015) also supports a default value of 120°F.

[266] Note that for efficient water heater installations in newly-constructed homes, the baseline energy factor is the efficiency of the electric storage water heater that would otherwise have been installed, according to appropriate design documentation.

Table 282: Water Mains Temperature*

Climate Zone		Water Mains Temperature (°F)		
		$T_{supply,annual}$	$T_{supply,seasonal}$	
			Summer	Winter
1	Panhandle	62.9	73.8	53.7
2	North	71.8	84.0	60.6
3	South	74.7	84.5	65.5
4	Valley	77.2	86.1	68.5
5	West	70.4	81.5	60.4

* Based on TMY3 dataset: http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/.

Demand Savings Algorithm

$$kW_{savings,summer} = Ratio_{daily\ gal}^{summer\ peak\ gal} \frac{\rho \times C_p \times GPY \times (T_{setpoint} - T_{supply,summer}) \times \left(\frac{1}{EF_{pre}} - \frac{1}{EF_{post}}\right)}{365 \times 3{,}412}$$

Equation 88

$$kW_{savings,winter} = Ratio_{daily\ gal}^{winter\ peak\ gal} \frac{\rho \times C_p \times GPY \times (T_{setpoint} - T_{supply,winter}) \times \left(\frac{1}{EF_{pre}} - \frac{1}{EF_{post}}\right)}{365 \times 3{,}412}$$

Equation 89

Where:

$\mathrm{Ratio}_{\mathrm{dailygal}}^{\mathrm{Sumpeakgal}}$ = *Ratio of hot water use during the typical summer peak hour (4:00 p.m. to 5:00 p.m.) to daily hot water use (= 0.0436)*

$\mathrm{Ratio}_{\mathrm{dailygal}}^{\mathrm{Winpeakgal}}$ = *Ratio of average hot water use during the winter peak hour (7:00 a.m. to 8:00 a.m.) to daily hot water use (= 0.0794)*

$\mathrm{T}_{\mathrm{Supply,sum}}$ = *Summer average water mains temperature (see Table 282)*

$\mathrm{T}_{\mathrm{Supply,win}}$ = *Winter average water mains temperature (see Table 282)*

Gas Storage or Tankless Water Heater (Fuel Substitution)

Energy and demand savings awarded for replacing an electric water heater with a gas storage or gas tankless water heater are equal to the consumption of the unit replaced.

For gas storage water heaters with a tank size greater than 55 gallons, or gas tankless water heaters replacing a unit greater than 55 gallons, the appropriate baseline is a HPWH. The baseline consumption values are calculated using the federal standard baseline condition specified in the Heat Pump Water Heater measure.

Energy Savings Algorithm for Units Less than 55 Gallons

$$kWh_{savings} = \frac{\rho \times C_p \times GPY \times (T_{setpoint} - T_{supply,annual}) \times \left(\frac{1}{EF_{pre}}\right)}{3{,}412}$$

Equation 90

Demand Savings Algorithm for Units Less than 55 Gallons

$$SummerkW_{savings} = Ratio_{daily\ gal}^{summer\ peak\ gal} \times \frac{\rho \times C_p \times GPY \times (T_{setpoint} - T_{supply,summer}) \times \left(\frac{1}{EF_{pre}}\right)}{365 \times 3{,}412}$$

Equation 91

$$WinterkW_{savings} = Ratio_{daily\ gal}^{winter\ peak\ gal} \times \frac{\rho \times C_p \times GPY \times (T_{setpoint} - T_{supply,winter}) \times \left(\frac{1}{EF_{pre}}\right)}{365 \times 3{,}412}$$

Equation 92

Examples

Example 1. An old 40-gallon electric water heater in a two-bedroom home in Dallas is replaced with a new, tankless electric water heater with a first-hour rating of 60 gal/hr and a uniform energy factor of 0.99.

$$kWh_{savings} = \frac{\left[8.33 \times 1 \times 19{,}244 \times (120 - 71.8) \times \left(\frac{1}{0.9227} - \frac{1}{0.99}\right)\right]}{3{,}412} = 167\ kWh$$

$$kW_{savings,summer} = 0.0436 \times \frac{\left[8.33 \times 1 \times 19{,}244 \times (120 - 84) \times \left(\frac{1}{0.9227} - \frac{1}{0.99}\right)\right]}{365 \times 3{,}412} = 0.01\ kW$$

$$kW_{savings,winter} = 0.0794 \times \frac{\left[8.33 \times 1 \times 19{,}244 \times (120 - 60.6) \times \left(\frac{1}{0.9227} - \frac{1}{0.99}\right)\right]}{365 \times 3{,}412} = 0.04\ kW$$

Example 2. An old 30-gallon electric water heater in a one-bedroom house in El Paso is replaced with a new gas storage water heater with a first-hour rating of 51 gal/hr and a uniform energy factor of 0.81.

$$kWh_{savings} = \frac{\left[8.33 \times 1 \times 14{,}905 \times (120 - 70.4) \times \left(\frac{1}{0.9247}\right)\right]}{3{,}412} = 1{,}952\ kWh$$

$$kW_{savings,summer} = 0.0436 \times \frac{\left[8.33 \times 1 \times 14{,}905 \times (120 - 81.5) \times \left(\frac{1}{0.9247}\right)\right]}{365 \times 3{,}412} = 0.18\ kW$$

$$kW_{savings,winter} = 0.0794 \times \frac{\left[8.33 \times 1 \times 14{,}905 \times (120 - 60.4) \times \left(\frac{1}{0.9247}\right)\right]}{365 \times 3{,}412} = 0.51\ kW$$

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The average EULs for installed equipment are: 20 years for a tankless water heater (gas or electric) and 11 years for a high-efficiency gas water heater.

These values are consistent with the EULs reported in the 2014 California DEER.[267]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Volume of the replacement water heater (gallons, zero if tankless)
- Volume of the existing water heater (gallons)
- First hour rating of replacement water heater (gal/hr)

[267] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer-versions/deer2013-update-for-2014-codes.

- Energy factor of the replacement water heater
- Number of bedrooms
- Proof of purchase – with date of purchase and quantity
  - Alternative: photo of unit installed or another pre-approved method of installation verification.

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 283: Residential Water Heater Installations Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	04/18/2014	TRM v2.0 update. Updated measure to require electric tankless rather than electric storage water heater installation for non-fuel-switching option. Updated by Frontier Associates, March 2014, based on new federal standards.
v2.1	01/30/2015	TRM v2.1 update. Updated to reflect that new construction permitted to claim savings subject to documentation requirements and that gas-fueled tankless water heaters are eligible for installation.
v3.0	04/10/2015	TRM v3.0 update. Amended fuel substitution savings to reflect the full consumption of the electric unit being replaced. Revised demand savings for installing an electric tankless unit to reflect daily usage patterns.
v3.1	11/05/2015	TRM v3.1 update. Clarified the baseline for water heaters greater than 55 gallons.
v4.0	10/10/2016	TRM v4.0 update. Updated HPWH baseline usage for gas storage water heaters larger than 55 gallons.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	11/2019	TRM v7.0 update. Implemented new baseline and high-efficiency standards.

2.4.6 Heat Pump Water Heaters Measure Overview

TRM Measure ID: R-WH-HW

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity and gas

Decision/Action Type(s): Replace-on-burnout

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

The residential heat pump water heater (HPWH) measure involves the installation of an integrated or “drop-in” ENERGY STAR® HPWH. Deemed savings values are presented on a per unit basis. Deemed savings variables include storage tank volume, first-hour rating, and HPWH installation location (in conditioned or unconditioned space). In addition, this measure accounts for the interactive air conditioning energy savings and heating penalty associated with the HPWH when installed inside conditioned space.[268]

These deemed savings are calculated using the amended federal standards for electric consumer water heaters effective April 16, 2015.

Eligibility Criteria

This measure applies to residential, electric, and storage-type heat pump water heaters. Heat pump add-ons to existing storage water heaters are ineligible. The measure does not apply to the replacement of gas water heaters.

These deemed savings are for heat pump water heaters installed as a replace-on-burnout measure or as an early retirement measure in existing homes. However, savings are calculated under the assumption of replace-on-burnout.

[268] Interaction with space heating equipment only affects deemed savings for units below 55 gallons. This is because the measure assumes replace on burnout and because the latest manufacturer standards effectively require heat pump water heaters (assuming electric water heating) for residential units with storage tank size greater than 55 gallons. For these units any interaction with the space conditioning systems are essentially the same for base and change case systems, so they cancel each other out.

Baseline Condition

The baseline condition is an electric storage water heater (EWH) with baseline efficiency (UEF: uniform energy factor) determined by tank size and draw pattern – a proxy for first hour rating – based on the amended federal energy efficiency standards for residential water heaters with tank sizes 20–120 gallons, as published in 10 CFR Part 430.32 of the Federal Register:[269]

Table 284: Federal Standard for Residential Water Heaters

Rated Storage Volume	Draw Pattern	First Hour Rating (FHR) [270]	Uniform Energy Factor[271]
≥ 20 gal and ≤ 55 gal	Very Small Usage	$0 \le FHR < 18$	$0.8808 - (0.0008 \times V_r)$
	Low Usage	$18 \le FHR < 51$	$0.9254 - (0.0003 \times V_r)$
	Medium Usage	$51 \le FHR < 75$	$0.9307 - (0.0002 \times V_r)$
	High Usage	$75 \le FHR$	$0.9349 - (0.0001 \times V_r)$
> 55 gal and ≤ 120 gal	Very Small Usage	$0 \le FHR < 18$	$1.9236 - (0.0011 \times V_r)$
	Low Usage	$18 \le FHR < 51$	$2.0440 - (0.0011 \times V_r)$
	Medium Usage	$51 \le FHR < 75$	$2.1171 - (0.0011 \times V_r)$
	High Usage	$75 \le FHR$	$2.2418 - (0.0011 \times V_r)$

Because there are no listed ENERGY STAR® water heaters in the *very small usage* and *low usage* draw pattern categories, they are not relevant to this measure. Discarding these draw patterns and applying average tank volumes within four strata of storage tank sizes, the application of this equation provides the following baseline efficiency levels for residential electric storage water heaters.

Table 285: Heat Pump Water Heaters—Minimum Required Uniform Energy Factors

Usage Rate	Tank Size (Gallons)			
	45	65	75	82
Medium Usage	0.922	2.046	2.035	2.027
High Usage	0.930	2.170	2.159	2.152

The DOE efficiency standard effectively requires heat pump water heaters (assuming electric water heating) for storage water heaters with tank sizes greater than 55 gallons. As such, the baseline technology for water heaters with tanks greater than 55 gallons is a heat pump water heater. For smaller systems, the baseline technology remains an electric storage water heater with electric resistance as the primary heat source. This baseline assumes replace-on-burnout.

[269] 10 CFR Part 430.32 Energy and water conservation standards and their effective dates. Online. Available: www.ecfr.gov/cgi-bin/text-idx?SID=80dfa785ea350ebeee184bb0ae03e7f0&mc=true&node=se10.3.430_132&rgn=div8. Accessed September 2018.

[270] "The Revised Method of Test for Residential Water Heating and Its Impact on Incentive Programs" presentation, Glanville, Paul. ACEEE Hot Water Forum. February 24, 2015. https://aceee.org/sites/default/files/pdf/conferences/hwf/2015/6B-Glanville.pdf.

[271] Vr is the Rated Storage Volume (in gallons), as determined pursuant to 10 CFR 429.17.

High-efficiency Condition

The efficient condition is a heat pump water heater certified by ENERGY STAR® with uniform energy factor (UEF) greater than 2.3.[272] A complete list of certified ENERGY STAR® heat pump water heaters can be accessed via the ENERGY STAR® program website.[273]

Heat pump water heaters depend on adequate ventilation to properly function, including adequate space for both inlet and outlet airflow, and should be installed in spaces in where temperature does not drop below a certain level. The Department of Energy recommends installation in locations that remain above 40°F year-round and provide a minimum of 1,000 cubic feet of air space around the water heater.[274]

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

The following variables specify the appropriate deemed demand and energy savings values for a given project:

- Climate zone
- HPWH tank size
- HPWH first hour rating
- HPWH installed location (conditioned vs. unconditioned space)
- For HPWH installations in conditioned space, the building heating type (electric resistance, air-source heat pump, or gas furnace)

Deemed savings are estimated using the average uniform energy factor (UEF) of ENERGY STAR® certified systems with UEF > 2.3 by storage tank size strata and first-hour rating/usage draw pattern according to the list of certified products available in August 2018.[275]

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272 ENERGY STAR® Requirements (as of April 2015): HPWH must have nominal input of 75,000 BTU/h or less, a maximum current rating of 24 amperes, voltage no greater than 250 volts, and a transfer of thermal energy from one temperature to a higher temperature level for the purpose of heating water. Unit must have "integrated" or "drop-in" configuration. EF ≥ 2.0 for units ≤ 55 gal, EF ≥ 2.20 for units > 55 gal, first-hour rating (FHR) ≥ 50 gallons/hour, Warranty ≥ 6 years on sealed systems, Safety UL 174 and UL 1995. . See: https://www.energystar.gov/products/water_heaters/residential_water_heaters_key_product_criteria.

273 ENERGY STAR Certified Water Heaters. Online. Available: https://www.energystar.gov/productfinder/product/certified-water-heaters/?scrollTo=721.5999755859375&search_text=&fuel_filter=Electric&type_filter=Heat+Pump&brand_name_isopen=&input_rate_thousand_btu_per_hour_isopen=&markets_filter=United+States&zip_code_filter=&product_types=Select+a+Product+Category&sort_by=uniform_energy_factor_uef&sort_direction=asc&currentZipCode=1871&page_number=0&lastpage=0

274 Heat Pump Water Heaters. Department of Energy, May 2012. Online. Available: http://energy.gov/energysaver/articles/heat-pump-water-heaters. Accessed: February 22, 2013.

275 As of August 2018, the ENERGY STAR® products list includes 115 residential heat pump water heaters with UEF >2.3.

Deemed Energy Savings Tables

Deemed savings are developed for heat pump water heaters in four size ranges: less than or equal to 55 gallons, 56-69 gallons, 70-79 gallons, and 80 gallons or more. These sizes correspond to the four basic sizes of HPWHs commercially available at the time these deemed savings were developed, according to a review of manufacturer data provided on the ENERGY STAR® and AHRI websites. Table 286 presents the deemed energy savings tables for medium usage HPWHs for the five Texas climate zones. This table assumes a replace-on-burnout scenario but may be used for early retirement projects.

Table 286: Medium Usage Residential HPWH Deemed Annual Energy Savings (kWh)

Climate Zone		HPWH Tank Size Range (Gallons)	Conditioned Space			Unconditioned Space
			Gas Heat	Electric Resistance	Heat Pump	
1	Panhandle	<55	2,244	1,450	1,899	2,102
		55-69	592	592	592	616
		70-79	600	600	600	623
		80+	605	605	605	629
2	North	<55	1,985	1424	1,741	1,825
		55-69	496	496	496	500
		70-79	502	502	502	506
		80+	507	507	507	510
3	South	<55	1,897	1342	1,656	1,729
		55-69	465	465	465	457
		70-79	470	470	470	462
		80+	475	475	475	466
4	Valley	<55	1,840	1,510	1,696	1,649
		55-69	434	434	434	425
		70-79	439	439	439	430
		80+	443	443	443	434
5	West	<55	2,001	1,440	1,758	1,865
		55-69	511	511	511	515
		70-79	517	517	517	521
		80+	521	521	521	526

Table 287 presents the deemed energy savings tables for high usage HPWHs for the five Texas climate zones.

Table 287: High Usage Residential HPWH Deemed Annual Energy Savings (kWh)

Climate Zone		HPWH Tank Size Range (Gallons)	Conditioned Space			Unconditioned Space
			Gas Heat	Electric Resistance	Heat Pump	
1	Panhandle	55-69	652	652	652	677
		70-79	769	769	769	799
		80+	478	478	478	497
2	North	55-69	546	546	546	550
		70-79	644	644	644	649
		80+	401	401	401	404
3	South	55-69	511	511	511	502
		70-79	603	603	603	593
		80+	375	375	375	369
4	Valley	55-69	477	477	477	467
		70-79	563	563	563	551
		80+	351	351	351	343
5	West	55-69	562	562	562	566
		70-79	663	663	663	668
		80+	412	412	412	416

Deemed Summer Demand Savings Tables

Table 288 presents the deemed summer demand savings for medium usage heat pump water heaters across the five Texas climate zones.

Table 288: Medium Usage Residential HPWH Deemed Summer Demand Savings (kW)

Climate Zone		HPWH Tank Size Range (Gallons)	Conditioned Space	Unconditioned Space
1	Panhandle	<55	0.31	0.27
		55-69	0.07	0.06
		70-79	0.07	0.06
		80+	0.07	0.07
2	North	<55	0.24	0.20
		55-69	0.05	0.04
		70-79	0.05	0.04
		80+	0.05	0.04
3	South	<55	0.24	0.20
		55-69	0.05	0.04
		70-79	0.05	0.04
		80+	0.05	0.04
4	Valley	<55	0.23	0.19
		55-69	0.05	0.04
		70-79	0.05	0.04
		80+	0.05	0.04
5	West	<55	0.26	0.22
		55-69	0.05	0.05
		70-79	0.06	0.05
		80+	0.06	0.05

Table 289 presents the deemed summer demand savings for medium usage heat pump water heaters across the five Texas climate zones.

Table 289: High Usage Residential HPWH Deemed Summer Demand Savings (kW)

Climate Zone		HPWH Tank Size Range (Gallons)	Conditioned Space	Unconditioned Space
1	Panhandle	55-69	0.07	0.07
		70-79	0.09	0.08
		80+	0.05	0.05
2	North	55-69	0.05	0.05
		70-79	0.06	0.06
		80+	0.04	0.03
3	South	55-69	0.05	0.05
		70-79	0.06	0.06
		80+	0.04	0.04
4	Valley	55-69	0.05	0.05
		70-79	0.06	0.05
		80+	0.04	0.03
5	West	55-69	0.06	0.05
		70-79	0.07	0.06
		80+	0.04	0.04

Deemed Winter Demand Savings Tables

Table 290 presents the deemed winter demand savings for medium usage heat pump water heaters across the five Texas climate zones.

Table 290: Medium Usage Residential HPWH Deemed Winter Demand Savings (kW)

Climate Zone		HPWH Tank Size Range (Gallons)	Conditioned Space			Unconditioned Space
			Gas Heat	Electric Resistance	Heat Pump	
1	Panhandle	<55	0.57	0.00	0.44	0.54
		55-69	0.16	0.16	0.16	0.18
		70-79	0.16	0.16	0.16	0.18
		80+	0.17	0.17	0.17	0.18
2	North	<55	0.53	0.00	0.40	0.51
		55-69	0.15	0.15	0.15	0.16
		70-79	0.15	0.15	0.15	0.17
		80+	0.15	0.15	0.15	0.17
3	South	<55	0.48	0.00	0.36	0.47
		55-69	0.14	0.14	0.14	0.15
		70-79	0.14	0.14	0.14	0.15
		80+	0.14	0.14	0.14	0.15
4	Valley	<55	0.46	0.00	0.33	0.45
		55-69	0.13	0.13	0.13	0.14
		70-79	0.13	0.13	0.13	0.14
		80+	0.13	0.13	0.13	0.14
5	West	<55	0.52	0.00	0.39	0.51
		55-69	0.15	0.15	0.15	0.16
		70-79	0.15	0.15	0.15	0.16
		80+	0.15	0.15	0.15	0.16

Table 291 presents the deemed winter demand savings for high usage heat pump water heaters across the five Texas climate zones.

Table 291: High Usage Residential HPWH Deemed Winter Demand Savings (kW)

Climate Zone		HPWH Tank Size Range (Gallons)	Conditioned Space			Unconditioned Space
			Gas Heat	Electric Resistance	Heat Pump	
1	Panhandle	55-69	0.18	0.18	0.18	0.20
		70-79	0.21	0.21	0.21	0.23
		80+	0.13	0.13	0.13	0.15
2	North	55-69	0.17	0.17	0.17	0.18
		70-79	0.20	0.20	0.20	0.21
		80+	0.12	0.12	0.12	0.13
3	South	55-69	0.15	0.15	0.15	0.16
		70-79	0.18	0.18	0.18	0.19
		80+	0.11	0.11	0.11	0.12
4	Valley	55-69	0.14	0.14	0.14	0.15
		70-79	0.17	0.17	0.17	0.18
		80+	0.11	0.11	0.11	0.11
5	West	55-69	0.16	0.16	0.16	0.18
		70-79	0.19	0.19	0.19	0.21
		80+	0.12	0.12	0.12	0.13

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life for this measure is 13 years. This EUL is consistent with the judgment of the American Council for an Energy-Efficient Economy as listed on its website.[276]

[276] Water Heating. American Council for an Energy Efficient Economy. Online. Available: http://www.aceee.org/consumer/water-heating. Accessed: September 2011.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Approximate volume of the replacement heat pump water heater tank in gallons
- Baseline uniform energy factor (UEF)
- UEF of the replacement water heater
- First-hour rating (FHR) of the replacement water heater
- Water heater type (e.g., heat pump, electric resistance)
- Installed location (i.e., conditioned, unconditioned space)
- For heat pump water heater installations in conditioned space, the building heating type (electric resistance, air-source heat pump, or gas furnace)
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification.

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

This section is not applicable.

Document Revision History

Table 292: Residential Heat Pump Water Heaters Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	04/18/2014	TRM v2.0 update. Updated by Frontier Associates, March 2014, based on new federal standards.
v2.1	01/30/2015	TRM v2.1 update. No revision.
v3.0	04/10/2015	TRM v3.0 update. No revision.
v3.1	11/05/2015	TRM v3.1 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. Consolidated table formats.
v5.0	10/2017	TRM v5.0 update. No revision.

TRM Version	Date	Description of Change
v6.0	11/2018	TRM v6.0 update. Implementation of new baseline and update to the efficiency of qualifying HPWHs.
v7.0	10/2019	TRM v7.0 update. No revision.

2.4.7 Solar Water Heaters Measure Overview

TRM Measure ID: R-WH-SW

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

Solar water heating deemed savings values are calculated based on the Solar Rating and Certification Corporation's (SRCC) test for solar water heaters (test OG-300).

Eligibility Criteria

These deemed savings are for solar water heaters installed as a replace-on-burnout measure or as an early retirement measure in existing homes. However, savings are calculated under the assumption of replace-on-burnout.

Baseline Condition

This section is not applicable.

High-efficiency Condition

Only solar water heaters meeting the SRCC OG-300 standard (based on tank size and final Solar Energy Factor-SEF) qualify for these deemed savings estimates.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Solar water heating values are on a per-unit basis. Deemed savings variables include tank volume and installed unit solar energy factor (SEF) as rated in the Solar Rating and Certification

Corporation (SRCC) “Summary of SRCC Certified Solar Collector and Water Heating System Ratings.” The Solar Energy Factor (SEF) is determined under SRCC's Operating Guideline 300, "Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems" and was developed as a means to compare solar water heating systems with conventional water heating systems rated with an Energy Factor (EF) and listed in the Gas Appliance Manufacturers Association Directory of Certified Water Heating Products.

Both EF and SEF are based on the same environmental and hot water use conditions used in the DOE Test Procedures for Water Heaters. The only significant difference is that the DOE test does not specify solar radiation. So SRCC uses a 1500 Btu/sq.ft./day solar radiation profile—a value typical of Sunbelt states (note - the annual average solar radiation for Dallas is 1533 Btu/sq.ft./day. (Information on the SRCC can be found at http://www.solar-rating.org/.)

Examples

A passive Sun Earth CP-40 with a SEF of 1.4 would consume 2,133 kWh (2987/1.4), saving 1,323 kWh compared to a baseline 50-gallon water heater that consumes 3458 kWh (values based on Frontier data).

An active Heliotype HP 410 G 80 with a SEF of 2.0 would consume 1,494 kWh (2987/2), saving 1,965 kWh compared to the baseline 50-gallon water heater.

Use SRCC OG-300 Test to Obtain SEF

SRCC = Solar Rating and Certification Corporation

OG-300 = test standard for SWH systems

SEF = Solar Energy Factor

Calculate kWh Savings

$$kWh\ savings = standard\ load \times \left(1 - \frac{EF}{SEF}\right) = (3{,}458) \times \left(1 - \frac{0.864}{2}\right) = 1{,}965 kWh$$

Deemed Energy Savings Tables

The following table presents the energy savings for solar water heaters based on tank size and final Solar Energy Factor (SEF).

Table 293: Solar Water Heating Energy Savings (kWh)

Water Heating Replacements—Solar Water Heating Energy Savings			
Approximate Volume (gal)	**80**	**50**	**30**
Baseline (DOE Standard) EF	**0.82**	**0.86**	**0.89**
SRCC OG-300 Solar Energy Factor	**Energy Savings (kWh)**		
1.0	637	471	368
1.1	909	743	640

Water Heating Replacements—Solar Water Heating Energy Savings			
Approximate Volume (gal)	**80**	**50**	**30**
Baseline (DOE Standard) EF	**0.82**	**0.86**	**0.89**
SRCC OG-300 Solar Energy Factor	**Energy Savings (kWh)**		
1.2	1,135	969	866
1.3	1,326	1,160	1,057
1.4	1,490	1,324	1,221
1.5	1,633	1,467	1,364
1.6	1,757	1,591	1,488
1.7	1,867	1,701	1,598
1.8	1,965	1,799	1,696
1.9	2,052	1,886	1,783
2.0	2,131	1,965	1,862
2.1	2,202	2,036	1,933
2.2	2,266	2,100	1,997
2.3	2,325	2,159	2,056
2.4	2,379	2,213	2,110
2.5	2,429	2,263	2,160
2.6	2,475	2,309	2,206
2.7	2,518	2,352	2,249
2.8	2,557	2,391	2,288
2.9	2,594	2,428	2,325
3.0	2,628	2,462	2,359
3.1	2,660	2,494	2,391
3.2	2,691	2,525	2,422
3.3	2,719	2,553	2,450
3.4	2,745	2,579	2,476
3.5	2,771	2,605	2,502
3.6	2,794	2,628	2,525
3.7	2,817	2,651	2,548
3.8	2,838	2,672	2,569
3.9	2,858	2,692	2,589
4.0	2,877	2,711	2,608
4.1	2,895	2,729	2,626

Water Heating Replacements—Solar Water Heating Energy Savings			
Approximate Volume (gal)	**80**	**50**	**30**
Baseline (DOE Standard) EF	**0.82**	**0.86**	**0.89**
SRCC OG-300 Solar Energy Factor	**Energy Savings (kWh)**		
4.2	2,913	2,747	2,644
4.3	2,929	2,763	2,660
4.4	2,945	2,779	2,676
4.5	2,960	2,794	2,691
4.6	2,975	2,809	2,706
4.7	2,988	2,822	2,719
4.8	3,002	2,836	2,733
4.9	3,014	2,848	2,745
5.0	3,027	2,861	2,758

Source: Tim Kerrigan, National Renewable Energy Laboratory (2001).

Deemed Summer Demand Savings Tables

The following table presents the demand savings for solar water heaters.

Table 294: Solar Water Heating Demand Savings (kW)

Solar Water Heating Demand Savings kW
0.42

- Diversified value fully displaced during solar peak.
- This value is consistent with the University of Texas study (0.4).

Deemed Winter Demand Savings Tables

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of a solar water heater is established at 15 years.

This value is consistent with the EUL reported in the 2014 California Database for Energy Efficiency Resources (DEER).[277]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- The approximate volume of the replacement water heater in gallons
- SRCC OG-300 Solar Energy Factor of the replacement unit
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification.

References and Efficiency Standards

Petitions and Rulings

- Docket No. 22241, Item 62. Petition by Frontier Associates for Approval of Second Set of Deemed Savings Estimates. Public Utility Commission of Texas.
- Docket No. 27903. Order Adopting New §25.184 as Approved at the August 21, 2003, Open Meeting and Submitted to the Secretary of State. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

This section is not applicable.

[277] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer-versions/deer2013-update-for-2014-codes.

Document Revision History

Table 295: Residential Solar Water Heaters Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor edits to language.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. No revision.
v3.1	11/05/2015	TRM v3.1 update. No revision.
v4.0	10/10/2016	TRM v4.0 update. No revision
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.

2.4.8 Showerhead Temperature Sensitive Restrictor Valves Measure Overview

TRM Measure ID: R-WH-SV

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity, Gas

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure consists of installing a temperature sensitive restrictor valve (TSRV)[278] between the existing shower arm and showerhead. The valve will restrict hot water flow through the showerhead once the water reaches a set temperature (generally 95˚F) to prevent water from going down the drain prior to the user entering the shower, thereby eliminating behavioral waste.

Eligibility Criteria

The incentive is for the installment of a temperature sensitive restrictor valve between the existing shower arm and showerhead.

These deemed savings are for temperature sensitive restrictor valves installed in new construction or as a retrofit measure in existing homes. In order to use deemed savings, the fuel type of the water heater must be electricity or gas.

Baseline Condition

The baseline condition is the residential shower arm and standard (2.5 gpm) showerhead without a temperature sensitive restrictor valve installed.

[278] A temperature sensitive restrictor valve is any device that uses water temperature to regulate water flow in showers.

High-efficiency Condition

To qualify for temperature sensitive restrictor valve deemed savings, the installed equipment must be a temperature sensitive restrictor valve installed on a residential shower arm and showerhead with either a standard (2.5 gpm) or low-flow (2.0, 1.75, or 1.5 gpm) showerhead. If this measure is installed in conjunction with a low-flow showerhead, refer to the Low-flow Showerheads measure and claim additional savings as outlined in that measure.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Estimated Hot Water Usage Reduction

Baseline and efficiency-standard water usages per capita were derived from an analysis of metered studies of residential water efficiency retrofit projects conducted for Seattle, WA; the East Bay Municipal Utility District (CA); and Tampa, FL.[279,280,281]

To determine gallons of behavioral waste (defined as hot water that goes down the drain before the user enters the shower) per year, the following formula was used:

$$Annual\ Showerhead\ Behavioral\ Waste = SHFR \times BW \times n_S \times 365\ \frac{days}{year} \times \frac{n_O}{n_{SH}}$$

Equation 93

Where:

SHFR = *Showerhead flow rate, gallons per minute (gpm) (see Table 296)*

BW$\mathrm{C_P}$ = *Behavioral waste, minutes per shower (see Table 296)*

$n_S\mathrm{C_P}$ = *Number of showers per person per day (see Table 296)*

365$\mathrm{C_P}$ = *Constant to convert days to years (see Table 296)*

$n_O\mathrm{C_P}$ = *Number of occupants per home (see Table 296)*

$n_{SH}\mathrm{C_P}$ = *Number of showerheads per home (see Table 296)*

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[279] Seattle Home Water Conservation Study: “The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes.” December 2000. http://allianceforwaterefficiency.org/WorkArea/linkit.aspx?LinkIdentifier=idandItemID=856.

[280] Residential Indoor Water Conservation Study: “Evaluation of High Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes in the East Bay Municipal Utility District Service Area.” July 2003. http://www.ebmud.com/sites/default/files/pdfs/residential_indoor_wc_study_0.pdf.

[281] Tampa Water Department Residential Water Conservation Study: “The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes.” January 8, 2004. www.cuwcc.org/WorkArea/downloadasset.aspx?id=12162.

Applying the formula to the values used for Texas from Table 296 returns the following values for baseline behavioral waste in gallons per showerhead per year:

$$Showerhead\ (2.5\ GPM): 2.5 \times\ 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68} = 854\ gal$$

$$Showerhead\ (2.0\ GPM): 2.0 \times 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68} = 683\ gal$$

$$Showerhead\ (1.75\ GPM): 1.75 \times 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68} = 598\ gal$$

$$Showerhead\ (1.5\ GPM): 1.5 \times 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68} = 513\ gal$$

Gallons of hot water saved per year can be found by multiplying the baseline behavioral waste gallons per year by the percent of hot water from Table 296.

$$Gallons\ of\ hot\ water\ saved\ per\ year = \ Annual\ Behavioral\ Waste \times HW\%$$

Equation 94

Where:

HW% = *Hot water percentage (see Table 296)*

$$Gallons\ of\ hot\ water\ saved\ per\ year\ (2.5\ GPM): 854 \times\ 0.825 = 705\ gal$$

$$Gallons\ of\ hot\ water\ saved\ per\ year\ (2.0\ GPM): 683 \times\ 0.825 = 563\ gal$$

$$Gallons\ of\ hot\ water\ saved\ per\ year\ (1.75\ GPM): 598 \times\ 0.825 = 493\ gal$$

$$Gallons\ of\ hot\ water\ saved\ per\ year\ (1.5\ GPM): 513 \times\ 0.825 = 423\ gal$$

Table 296: Estimated Showerhead with TSRV Hot Water Usage Reduction

Description	2.5 gpm	2.0 gpm	1.75 gpm	1.5 gpm
Average behavioral waste (minutes per shower)[282]	0.783	0.783	0.783	0.783
Showers/person/day[283]	0.72	0.72	0.72	0.72
Occupants per home[284]	2.79	2.79	2.79	2.79
Showerheads per home[285]	1.68	1.68	1.68	1.68
Gallons behavioral waste per showerhead per year	1,018	814	713	611

[282] Average behavioral waste from Lutz (2004) Feasibility Study and Roadmap to Improve Residential Hot Water Distribution Systems and Sherman (2014) Disaggregating Residential Shower Warm-Up Waste. Derived by dividing 47 seconds by 60 seconds.

[283] Occupants per home for Texas from US Census Bureau, Texas, "Persons per household, 2007-2011." Accessed January 2013 http://quickfacts.census.gov/qfd/states/48000.html.

[284] Derivation of value for showers per person per day defined in the Low Flow Showerhead measure.

[285] Showerheads per home assumed to be equal to the number of full bathrooms per home, taken from 2009 RECS, Table HC2.10.

Description	2.5 gpm	2.0 gpm	1.75 gpm	1.5 gpm
Percent hot water[286]	82.5%	82.5%	82.5%	82.5%
Gallons hot water saved per year	705	563	493	423

Energy Savings Algorithms

Energy savings for this measure are calculated as follows:

$$Energy\ Savings\ per\ TSRV = \frac{\rho \times C_P \times V \times (T_{SetPoint} - T_{SupplyAverage})}{RE \times Conversion\ Factor}$$

Equation 95

Where:

ρ = *Water density, 8.33 lbs/gallon*

C_P = *Specific heat of water, 1 Btu/lb°F*

V = *Gallons of hot water saved per year per showerhead (see Table 296)*

$T_{SetPoint}$ = *Water heater setpoint: 120°F* [287]

T_{Supply} = *Average supply water temperature (see Table 297)*

RE = *Recovery Efficiency (or in the case of heat pump water heaters, COP). If unknown, use 0.98 as a default for electric resistance water heaters, 2.2 for heat pump water heaters, or 0.8 for gas hot water heaters.* [288]

$ConversionFactor$ = *3,412 Btu/kWh for electric or 100,000 Btu/therm for gas*

[286] Average percent hot water from (Lutz 2004) Feasibility Study and Roadmap to Improve Residential Hot Water Distribution Systems and (Sherman 2015) Calculating Savings For: Auto-Diverting Tub Spout System with ShowerStart TSV.

[287] 120°F represents the assumed water heater setpoint. New York Department of Public Service recommends using water heater setpoint as a default value, see "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs" October 2010, page 99.
Data collection discussed in Appendix D of the EM&V team's Annual Statewide Portfolio Report for Program Year 2014-Volume 1, Project Number 40891 (August 2015), also supports a default value of 120°F.

[288] Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at http://cafs.ahrinet.org/gama_cafs/sdpsearch/search.jsp?table=CWH.

Demand Savings Algorithms

Demand savings will be calculated using the following formula:

$$Demand\ Savings\ per\ TSRV = \frac{\rho \times C_P \times V \times (T_{SetPoint} - T_{SupplySeasonal})}{RE \times Conversion\ Factor} \times Ratio_{annual\ kWh}^{Peak_{seasonal}kW}$$

Equation 96

Where:

$T_{SupplySeasonal}$ = *Seasonal supply water temperature (see Table 297)*

$Ratio_{annual\ kWh}^{Peak_{seasonal}kW}$ = *Ratio of peak seasonal kW to annual kWh savings (see Table 298)*

Table 297: Water Mains Temperature

Climate Zone	Water Mains Temperature (°F)[289]		
	$T_{SupplyAverage}$	$T_{SupplySeasonal}$	
		Summer	Winter
Climate Zone 1: Panhandle	62.9	73.8	53.7
Climate Zone 2: North	71.8	84.0	60.6
Climate Zone 3: South	74.7	84.5	65.5
Climate Zone 4: Valley	77.2	86.1	68.5
Climate Zone 5: West	70.4	81.5	60.4

Table 298: Water Fixture Peak Demand Ratios

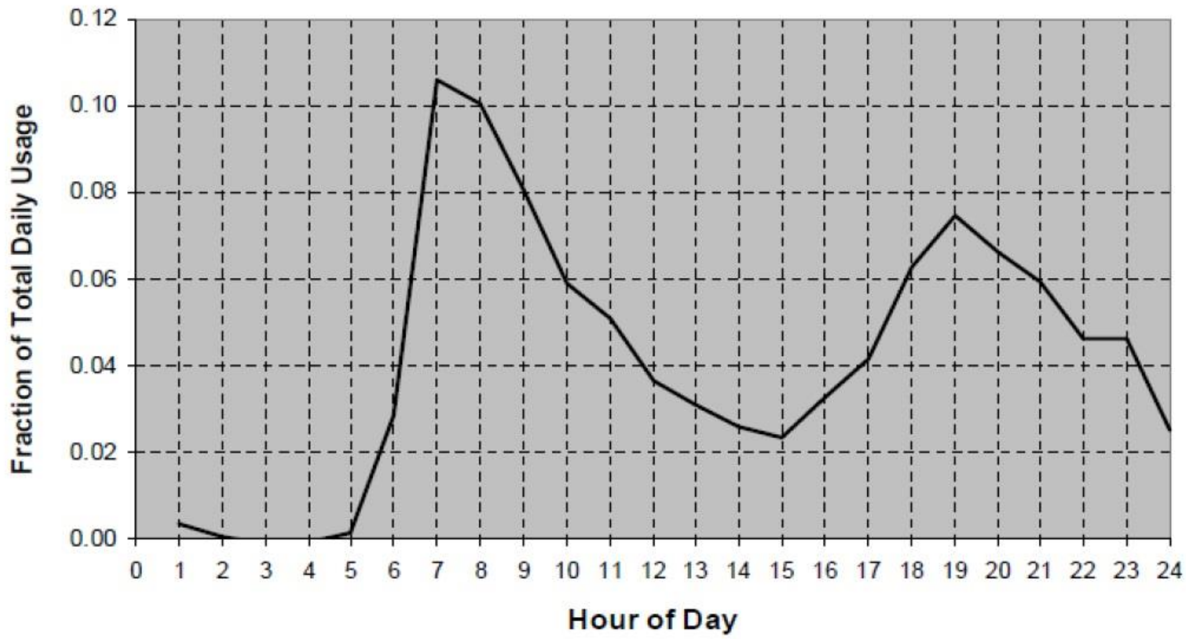
Peak Demand Ratios[290]	
Summer	Winter
0.000110	0.000274

The fixture peak demand ratios were derived by taking the fraction hot water use during the peak hour (summer: 4-5pm, winter: 7-8am) to the total daily usage from the Building America Performance Analysis Procedures for Existing Homes and dividing it by the number of days per year (365). The fraction of hot water use during the winter peak hour to total daily water usage is 0.1: $0.1/365 = 0.000274$. The summer peak hour to total daily water usage is 0.04: $0.04/365 = 0.000110$.

[289] Based on typical meteorological year (TMY) dataset for TMY3: http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/.

[290] US Department of Energy's "Building America Performance Analysis Procedures for Existing Homes" combined domestic hot water use profile (http://www.nrel.gov/docs/fy06osti/38238.pdf).

Figure 10: Shower, Bath, and Sink Hot Water Use Profile



Source: Building America Performance Analysis Procedures for Existing Homes.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for this measure is established at 10 years.

This value is consistent with the EUL reported for a low-flow showerhead in the 2014 California Database for Energy Efficiency Resources (DEER).[291]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Recovery efficiency (RE) or COP, if available
- Flow rate in gallons per minute (gpm) of showerhead installed
- Water heater type (e.g., heat pump, electric resistance)

Document Revision History

Table 299: Residential Showerhead Temperature Sensitive Restrictor Valves Revision History

TRM Version	Date	Description of Change
v5.0	10/2017	TRM v5.0 origin.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.

[291] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer2013-update-for-2014-codes.

2.4.9 Tub Spout and Showerhead Temperature Sensitive Restrictor Valves Measure Overview

TRM Measure ID: R-WH-TV

Market Sector: Residential

Measure Category: Water Heating

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity, gas

Decision/Action Type(s): Retrofit, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure consists of replacing existing tub spouts and showerheads with an automatically diverting tub spout and showerhead system with a temperature sensitive restrictor valve (TSRV) [292] between the existing shower arm and showerhead. The tub spout will contain temperature sensitive restrictor technology that will cause the tub spout to automatically engage the anti-leak diverter once the water reaches a set temperature (generally 95˚F). The water will divert to a showerhead with a normally closed valve that will prevent the hot water from going down the drain prior to the user entering the shower, thereby eliminating behavioral waste and tub spout leakage waste.

Eligibility Criteria

The incentive is for the installment of an automatically diverting tub spout and showerhead system with temperature sensitive restrictor technology.

These deemed savings are for tub spout and showerhead systems with temperature sensitive restrictor technology installed in new construction or as a retrofit measure in existing homes. In order to use these deemed savings, the fuel type of the water heater must be electricity or gas.

Baseline Condition

The baseline condition is the residential tub spout with a standard diverter and a standard (2.5 gpm) showerhead.

[292] A temperature sensitive restrictor valve is any device that uses water temperature to regulate water flow in showers.

High-efficiency Condition

To qualify for tub spout and showerhead system with temperature sensitive restrictor technology deemed savings, the installed equipment must be an anti-leak, automatically diverting tub spout system with temperature sensitive restrictor technology installed on a residential shower arm and showerhead with a standard (2.5 gpm) or low-flow (2.0, 1.75, or 1.5 gpm) showerhead. If this measure is installed in conjunction with a low-flow showerhead, refer to the Low-flow Showerheads measure and claim additional savings as outlined in that measure.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Estimated Hot Water Usage Reduction

Baseline and efficiency-standard water usages per capita were derived from an analysis of metered studies of residential water efficiency retrofit projects conducted for Seattle, WA; the East Bay Municipal Utility District (CA); and Tampa, FL.[293,294,295]

This system provides savings in two parts: elimination of behavioral waste (hot water that goes down the drain prior to the user entering the shower) and elimination of tub spout diverter leakage.

Part 1: To determine baseline gallons of behavioral waste per year, the following formula was used:

$$Annual\ Showerhead\ Behavioral\ Waste = \%WUE_{SH} \times SHFR \times BW \times n_S \times 365\ \frac{days}{year} \times \frac{n_O}{n_{SH}}$$

Equation 97

$$Annual\ Tub\ Spout\ Behavioral\ Waste = \%WUE_{TS} \times TSFR \times BW \times n_S \times 365\ \frac{days}{year} \times \frac{n_O}{n_{SH}}$$

Equation 98

Where:

$\%WUE_{SH}$ = *Showerhead percentage of warm-up events (see Table 300)*

$\%WUE_{TS}$ = *Tub spout percentage of warm-up events (see Table 300)*

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293 Seattle Home Water Conservation Study: “The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes.” December 2000. http://allianceforwaterefficiency.org/WorkArea/linkit.aspx?LinkIdentifier=idandItemID=856.

294 Residential Indoor Water Conservation Study: “Evaluation of High Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes in the East Bay Municipal Utility District Service Area.” July 2003. http://www.ebmud.com/sites/default/files/pdfs/residential_indoor_wc_study_0.pdf.

295 Tampa Water Department Residential Water Conservation Study: “The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes.” January 8, 2004. www.cuwcc.org/WorkArea/downloadasset.aspx?id=12162.

SHFR	=	*Showerhead flow rate, gallons per minute (gpm) (see Table 300)*
TSFR	=	*Tub spout flow rate, gallons per minute (gpm) (see Table 300)*
BWC_P	=	*Behavioral waste, minutes per shower (see Table 300)*
$n_S C_P$	=	*Number of showers per person per day (see Table 300)*
*365*C_P	=	*Constant to convert days to years (see Table 300)*
$n_O C_P$	=	*Number of occupants per home (see Table 300)*
$n_{SH} C_P$	=	*Number of showerheads per home (see Table 300)*

Applying the formula to the values used for Texas from Table 300 returns the following values:

$$Showerhead\ (1.5\ GPM): 0.6 \times \left(1.5 \times 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68}\right) = 308$$

$$Showerhead\ (1.75\ GPM): 0.6 \times \left(1.75 \times 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68}\right) = 359$$

$$Showerhead\ (2.0\ GPM): 0.6 \times \left(2.0 \times 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68}\right) = 410$$

$$Showerhead\ (2.5\ GPM): 0.6 \times \left(2.5 \times 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68}\right) = 513$$

$$Tub\ Spout\ (5.0\ GPM): 0.4 \times \left(5.0 \times 0.783 \times 0.72 \times 365 \times \frac{2.79}{1.68}\right) = 683$$

Part 2: To determine baseline gallons of diverter leakage per year, the following formula was used:

$$Annual\ Diverter\ Waste = DLR \times t_S \times n_S \times 365\ \frac{days}{year} \times \frac{n_O}{n_{SH}}$$

Equation 99

Where:

DLR	=	*Diverter leakage rate (gpm) (see Table 300)*
t_S	=	*Shower time (min/shower) (see Table 300)*

Applying the formula to the values used for Texas from Table 300 returns the following values:

$$Diverter\ (0.8\ GPM): 0.8 \times 5.68 \times 0.72 \times 365 \times \frac{2.79}{1.68} = 1{,}983$$

Part 3: To determine gallons of water saved per year can be found by multiplying the total waste by the percent of hot water from Table 300.

$$Gallons\ of\ hot\ water\ saved = (SHBW + TSBW) \times HW\%_{SH,TS} + DW \times HW\%_D$$

Equation 100

Where:

SHBW = *Showerhead behavioral waste (gal)*

TSBW = *Tub spout behavioral waste (gal)*

DW = *Diverter waste (gal)*

$HW\%_{SH,TS}$ = *Showerheads and tub spout hot water percentage (see Table 300)*

$HW\%_D$ = *Diverter hot water percentage (see Table 300)*

Applying the formula to the values used for Texas from Table 300 returns the following values:

$$Total\ Annual\ Waste\ (1.5\ gpm): (308 + 683) \times 0.825 + 1{,}983 \times 0.737 = 2{,}279$$

$$Total\ Annual\ Waste\ (1.75\ gpm): (359 + 683) \times 0.825 + 1{,}983 \times 0.737 = 2{,}321$$

$$Total\ Annual\ Waste\ (2.0\ gpm): (410 + 683) \times 0.825 + 1{,}983 \times 0.737 = 2{,}363$$

$$Total\ Annual\ Waste\ (2.5\ gpm): (513 + 683) \times 0.825 + 1{,}983 \times 0.737 = 2{,}448$$

Table 300: Estimated Tub Spout/Showerhead System with TSRV Hot Water Usage Reduction

Description	Part 1- Behavioral Waste		Part 2—Diverter Leakage	Part 3—Total
	Showerhead Warm-up	Tub spout Warm-up		
Baseline showerhead flow rate (gpm)	1.5, 1.75, 2.0, or 2.5	N/A		
Tub spout flow rate (gpm)[296]	N/A	5.0	N/A	
Percent of warm-up events[297]	60	40	N/A	
Average behavioral waste (minutes per shower)[298]	0.783	0.783	N/A	
Average diverter leak rate (gpm)[299]	N/A		0.80	N/A

[296] Assumption from (Sherman 2015) Calculating Savings For: Auto-Diverting Tub Spout System with ShowerStart TSV.

[297] Percent of warm-up events from (Sherman 2014) Disaggregating Residential Shower Warm-Up Waste (Appendix B, Question 8).

[298] Average behavioral waste from Lutz (2004) Feasibility Study and Roadmap to Improve Residential Hot Water Distribution Systems and Sherman (2014) Disaggregating Residential Shower Warm-Up Waste. Derived by dividing 47 seconds by 60 seconds.

[299] Average diverter leak rate from (Taitem 2011) Taitem Tech Tip – Leaking Shower Diverters.

Description	Part 1- Behavioral Waste		Part 2—Diverter Leakage	Part 3—Total
	Showerhead Warm-up	Tub spout Warm-up		
Average shower time (minutes)[300]	N/A		5.68	N/A
Showers/person/day[301]	0.72	0.72	0.72	0.72
Occupants per home[302]	2.79	2.79	2.79	2.79
Showerheads per home[303]	1.68	1.68	1.68	1.68
Gallons behavioral waste per tub spout/showerhead per year (1.5 gpm)	308	683	1,983	2,974
Gallons behavioral waste per tub spout/showerhead per year (1.75 gpm)	359	683	1,983	3,025
Gallons behavioral waste per tub spout/showerhead per year (2.0 gpm)	410	683	1,983	3,076
Gallons behavioral waste per tub spout/showerhead per year (2.5 gpm)	513	683	1,983	3,179
Percent hot water[304]	82.5%	82.5%	73.7%	N/A
Gallons hot water saved per year (1.5 gpm)	N/A	N/A	N/A	2,279
Gallons hot water saved per year (1.75 gpm)	N/A	N/A	N/A	2,321
Gallons hot water saved per year (2.0 gpm)	N/A	N/A	N/A	2,363
Gallons hot water saved per year (2.5 gpm)	N/A	N/A	N/A	2,448

Energy Savings Algorithms

Energy savings for this measure are calculated as follows:

$$Energy\ Savings\ per\ TS\ System = \frac{\rho \times C_P \times V \times (T_{SetPoint} - T_{SupplyAverage})}{RE \times Conversion\ Factor}$$

Equation 101

Where:

ρ = *Water density, 8.33 lbs/gallon*

300 Average shower time from (REUWS 1999) Residential End Uses of Water Study and (Sherman 2015) Calculating Savings For: Auto-Diverting Tub Spout System with ShowerStart TSV.
301 Derivation of value for showers per person per day defined in the Low Flow Showerhead measure.
302 Occupants per home for Texas from US Census Bureau, Texas, "Persons per household, 2007-2011." Accessed January 2013 http://quickfacts.census.gov/qfd/states/48000.html.
303 Showerheads per home assumed to be equal to the number of full bathrooms per home, taken from 2009 RECS, Table HC2.10.
304 Average percent hot water for warm up events from (Lutz 2004) Feasibility Study and Roadmap to Improve Residential Hot Water Distribution Systems and (Sherman 2015) Calculating Savings For: Auto-Diverting Tub Spout System with ShowerStart TSV.

C_P = *Specific heat of water, 1 Btu/lb°F*

V = *Gallons of hot water saved per year per showerhead (see Table 300)*

$T_{SetPoint}$ = *Water heater setpoint: 120°F* [305]

T_{Supply} = *Average supply water temperature (see Table 301)*

RE = *Recovery Efficiency (or in the case of heat pump water heaters, COP). If unknown, use 0.98 as a default for electric resistance water heaters, 2.2 for heat pump water heaters, or 0.8 for gas hot water heaters.* [306]

$ConversionFactor$ = *3,412 Btu/kWh for electric or 100,000 Btu/therm for gas*

Demand Savings Algorithms

Demand savings will be calculated using the following formula:

$$Demand\ Savings\ per\ TS\ System = \frac{\rho \times C_P \times V \times (T_{SetPoint} - T_{SupplySeasonal})}{RE \times Conversion\ Factor} \times Ratio_{annual\ kWh}^{Peak_{seasonal}kW}$$

Equation 102

Where:

$T_{SupplySeasonal}$ = *Seasonal supply water temperature (see Table 301)*

$Ratio_{annual\ kWh}^{Peak_{seasonal}kW}$ = *Ratio of peak seasonal kW to annual kWh savings (see Table 302)*

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305 120°F represents the assumed water heater setpoint. New York Department of Public Service recommends using water heater setpoint as a default value, see "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs" October 2010, page 99.
Data collection discussed in Appendix D of the EM&V team's Annual Statewide Portfolio Report for Program Year 2014-Volume 1, Project Number 40891 (August 2015), also supports a default value of 120°F.

306 Default values based on median recovery efficiency of residential water heaters by fuel type in the AHRI database, at http://cafs.ahrinet.org/gama_cafs/sdpsearch/search.jsp?table=CWH.

Table 301: Water Mains Temperature

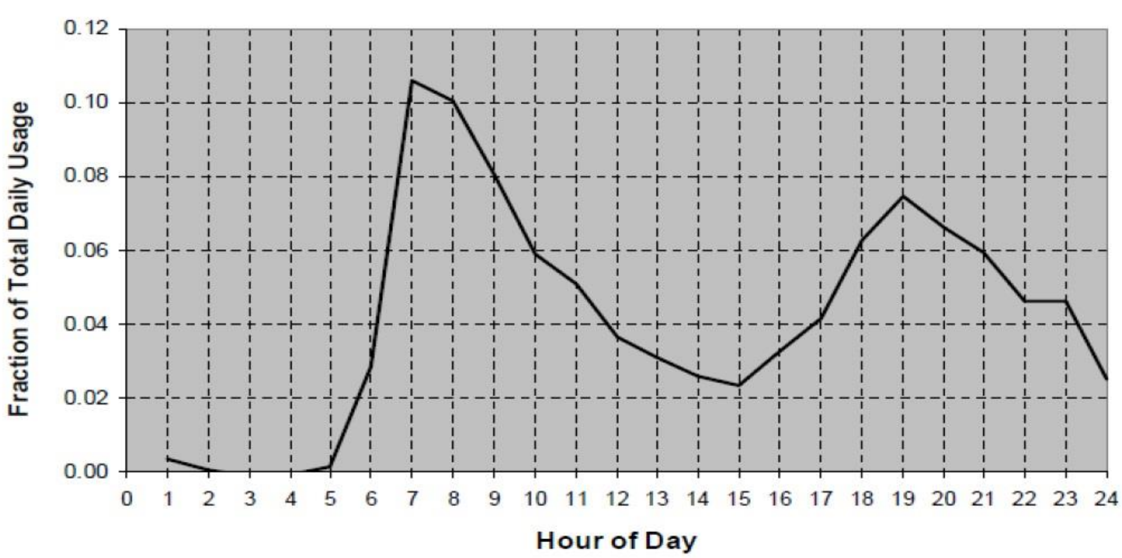
Climate Zone	Water Mains Temperature (°F)[307]		
	$T_{SupplyAverage}$	$T_{SupplySeasonal}$	
		Summer	Winter
Climate Zone 1: Panhandle	62.9	73.8	53.7
Climate Zone 2: North	71.8	84.0	60.6
Climate Zone 3: South	74.7	84.5	65.5
Climate Zone 4: Valley	77.2	86.1	68.5
Climate Zone 5: West	70.4	81.5	60.4

Table 302: Water Fixture Peak Demand Ratios

Peak Demand Ratios[308]	
Summer	Winter
0.000110	0.000274

The fixture peak demand ratios were derived by taking the fraction hot water use during the peak hour (summer: 4-5pm, winter: 7-8am) to the total daily usage from the Building America Performance Analysis Procedures for Existing Homes and dividing it by the number of days per year (365). The fraction of hot water use during the winter peak hour to total daily water usage is 0.1: $0.1/365 = 0.000274$. The summer peak hour to total daily water usage is 0.04: $0.04/365 = 0.000110$.

Figure 11: Shower, Bath, and Sink Hot Water Use Profile



307 Based on typical meteorological year (TMY) dataset for TMY3: http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/.

308 US Department of Energy's "Building America Performance Analysis Procedures for Existing Homes" combined domestic hot water use profile (http://www.nrel.gov/docs/fy06osti/38238.pdf).

Source: Building America Performance Analysis Procedures for Existing Homes.

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for this measure is established at 10 years.

This value is consistent with the EUL reported for a low-flow showerhead in the 2014 California Database for Energy Efficiency Resources (DEER).[309]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Recovery Efficiency (RE) or COP, if available
- Flow rate in gallons per minute (GPM) of showerhead installed
- Water heater type (e.g., heat pump, electric resistance)

[309] 2014 California Database for Energy Efficiency Resources. http://www.deeresources.com/index.php/deer2013-update-for-2014-codes.

Document Revision History

Table 303: Residential Tub Spout and Showerhead Temperature Sensitive Restrictor Valves Revision History

TRM Version	Date	Description of Change
v5.0	10/2017	TRM v5.0 origin.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.

2.5 RESIDENTIAL: APPLIANCES

2.5.1 ENERGY STAR® Ceiling Fans Measure Overview

TRM Measure ID: R-AP-CF

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the accepted deemed savings awarded for the installation of an ENERGY STAR® ceiling fan and light kit. Savings are awarded at a flat per-unit rate, both for energy and demand savings. This measure will apply to existing homes and new construction.

Eligibility Criteria

Savings values in this measure are based on indoor usage patterns and are not applicable to outdoor applications.

Baseline Condition

The baseline is a conventional non-ENERGY STAR® labeled ceiling fan and light kit.

High-efficiency Condition

Table 304 displays the ENERGY STAR® requirements for eligible ceiling fans as of June 16, 2018. These values are subject to updates in ENERGY STAR® specifications; energy efficiency service providers are expected to comply with the latest ENERGY STAR® specification.[310]

[310] ENERGY STAR® Ceiling Fan Specification: https://www.energystar.gov/products/lighting_fans/ceiling_fans/ceiling_fans_key_product_criteria.

Table 304: ENERGY STAR® Ceiling Fan Definitions

Fan Type	Description
Ceiling fan	A non-portable device designed for home use that is suspended from the ceiling for circulating air via the rotation of fan blades; for which the lowest point on fan blades is greater than 10 inches from the ceiling.
Hugger ceiling fan	A ceiling fan for which the lowest point on the fan blades is less than or equal to 10 inches from the ceiling. Hugger ceiling fans can be safely installed on low ceilings, and some are sold with ceiling fan light kits.

Table 305: ENERGY STAR® Ceiling Fan Efficiency Requirements

Type	Diameter (inches)	Minimum Efficiency (cfm/W)	Minimum High Speed Airflow (cfm)
Ceiling fan	D ≤ 36	≥ 0.72 x D + 41.93	≥ 1,767
	36 < D < 78	≥ 2.63 x D – 26.83	≥ 250 x π x $(D/24)^2$
	D ≥ 78		≥ 8,296
Hugger ceiling fan	D ≤ 36	≥ 0.31 x D + 36.84	≥ 1,414
	36 < D < 78	≥ 1.75 x D – 15	≥ 200 x π x $(D/24)^2$
	D ≥ 78		≥ 6,637

Table 306: ENERGY STAR® Ceiling Fan Light Kit Efficacy Requirements

Type	Minimum Efficacy (lumens/W)	Minimum Light Output (lumens)
Shipped with ENERGY STAR certified light bulbs	65.0	N/A
Separable light source	65.0	800
Integrated light source	70.0	

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings were calculated using the ENERGY STAR® Ceiling Fan Savings Calculator found on the ENERGY STAR® website.[311] Default values were taken directly from the ENERGY STAR® Ceiling Fan Savings Calculator, unless otherwise specified.

[311] ENERGY STAR® Ceiling Fan Savings Calculator (updated September 2013). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products.

$$kWh_{savings} = (kWh_{baseline} - kWh_{ES})_{fan} + (kWh_{baseline} - kWh_{ES})_{lgt} \times IEF_E$$

Equation 103

$$kWh_{baseline,Fan} = \frac{W_{Fan,baseline} \times AOH_{Fan}}{1{,}000}$$

Equation 104

$$kWh_{ES,Fan} = \frac{W_{Fan,ES} \times AOH_{Fan}}{1{,}000}$$

Equation 105

$$W_{Fan} = (W_{LS} \times OP_{LS}) + (W_{MS} \times OP_{MS}) + (W_{HS} \times OP_{HS})$$

Equation 106

$$kWh_{baseline,Lgt} = \frac{W_{Lgt,baseline} \times AOH_{Lgt}}{1{,}000}$$

Equation 107

$$kWh_{ES,Lgt} = \frac{W_{Lgt,ES} \times AOH_{Lgt}}{1{,}000}$$

Equation 108

Where:

$kWh_{baseline}$ = *Non-ENERGY STAR® baseline energy usage*

kWh_{ES} = *ENERGY STAR® average energy usage*

IEF_E = *Energy Interactive Effects Factor from Table 307 assuming heating/cooling unknown*[312]

$W_{Lgt,baseline}$ = *Conventional lighting total wattage = 115 W (160 W default value from ENERGY STAR® calculator reduced to comply with EISA 2007 baseline wattages)*[313]

$W_{Lgt,ES}$ = *Actual wattage of installed ENERGY STAR® lighting; assume one high-efficiency 32 W lamp*

$W_{Fan,baseline}$ = *Conventional fan motor wattage*

$W_{Fan,ES}$ = *ENERGY STAR® fan motor wattage*

$W_{LS,MS,HS}$ = *Fan motor wattage at low, medium, and high speed; see Table 308*

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[312] The assumed energy interactive effects factors are taken from the residential lighting measure.

[313] Assumes a mix of 40 and 60 W incandescent lamps. EISA 2007 baseline wattages are approximately 72 percent of standard incandescent wattages.

$OP_{LS,MS,HS}$	=	*Fan operating percentage at low, medium, and high speed; see Table 309*
AOH_{Lgt}	=	*Annual lighting operating hours = 803 hours/year (assuming 2.2 hours/day and 365 days/year operation)*[314]
AOH_{Fan}	=	*Annual fan operating hours = 1,095 hours/year (assuming 3.0 hours/day and 365 days/year operation)*[315]
$1{,}000$	=	*Constant to convert from W to kW*

Table 307: ENERGY STAR® Ceiling Fans—Interactive Effects Factor for Cooling Energy Savings and Heating Energy Penalties[316]

IEF_E					
Heating/Cooling Type*	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Heating/Cooling Unknown[317]	0.88	0.98	1.04	1.07	0.95

[314] The assumed annual operating hours are taken from the residential lighting measure.

[315] The assumed annual operating hours are taken from the ENERGY STAR® Light Fixture and Ceiling Fan Calculator. https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products.

[316] Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60-watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: $1 + HVAC_{savings}/Lighting_{savings}$.

[317] Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Table 308: Ceiling Fan Motor Wattages

Fan Type	Fan Speed	Fan Motor Wattage (W)
Conventional	Low	15
	Medium	34
	High	67
ENERGY STAR®	Low	6
	Medium	23
	High	56

Table 309: Ceiling Fan Operating Percentages

Fan Speed	Operating Percentage (OP)
Low	40%
Medium	40%
High	20%

Demand Savings Algorithms

Peak demand savings were calculated using separate coincidence factors for the lighting and the fan motor portion of the ceiling fan savings. For lighting the coincidence factor varies based on climate zone. For the fan motor a coincidence factor of 0.446 was applied (derived from the EnergyGauge software ceiling fan profiles).

$$kW_{savings} = kW_{Fan} + kW_{Lgt}$$

Equation 109

$$kW_{Fan} = \frac{W_{Fan,baseline} - W_{Fan,ES}}{1{,}000} \times CF_{Fan}$$

Equation 110

$$kW_{Lgt} = \frac{W_{Lgt,baseline} - W_{Lgt,ES}}{1{,}000} \times CF_{Lgt} \times IEF_D$$

Equation 111

Where:

kW_{Fan} = *Fan demand savings*

CF_{Fan} = *Fan motor coincidence factor = 0.446*

kW_{Lgt} = *Lighting demand savings*

CF_{Lgt} = *Lighting coincidence factor (Table 310)*

IEF_D = *Demand Interactive Effects Factor from Table 311 assuming heating/cooling unknown*[318]

Table 310 ENERGY STAR® Ceiling Fans—Lighting Coincidence Factors[319]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone5: El Paso
Summer	0.060	0.053	0.063	0.059	0.032
Winter	0.277	0.232	0.199	0.267	0.357

Table 311: ENERGY STAR® Ceiling Fans—Interactive Effects Factor for Cooling Demand Savings and Heating Demand Penalties[320]

$IEF_{D,summer}$					
Heating/Cooling Type*	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Heating/cooling unknown[321]	1.39	1.28	1.58	1.20	1.38
$IEF_{D,winter}$					
Heating/Cooling Type*	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Heating/cooling unknown[322]	0.76	0.72	0.73	0.75	0.80

Deemed Energy Savings Tables

Table 312: Ceiling Fans Deemed Energy Savings

Deemed Energy Savings (kWh/Year)				
Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
69.8	76.5	80.5	82.5	74.5

318 The assumed demand interactive effects factors are taken from the residential lighting measure.
319 See Volume 1, Appendix B.
320 Extracted from BEopt energy models used to estimate savings for envelope measures. Referencing the EISA baseline table, the typical lumen output was determined by taking the midpoint for the 60 watt equivalent lamp (900 lm), which was assumed to be the most typical installation. The resulting lumens were divided by the default wattage for incandescents (43 W), CFLs (13 W), and LEDs (10 W) resulting in an assumed efficacy for incandescents (21 lm/W), CFLs (70 lm/W), and LEDs (90 lm/W). IEF values were calculated using the following formula: 1 + $HVAC_{savings}/Lighting_{savings}$.
321 Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.
322 Calculated using IEFs from Cadmus report, weighted using TMY CDD and HDD for Texas, and adjusted to exclude 16 percent outdoor lighting except for upstream defaults. Cadmus report: Cadmus. Entergy Energy-Efficiency Portfolio Evaluation Report 2013 Program Year. Prepared for Entergy Arkansas, Inc. March 14, 2014. Docket No. 07-082-TF.

Deemed Summer Demand Savings Tables

Table 313: Ceiling Fans Deemed Demand Savings - Summer

Deemed Summer Demand Savings (kW)				
Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
0.011	0.010	0.013	0.010	0.008

Deemed Winter Demand Savings Tables

Table 314: Ceiling Fans Deemed Demand Savings - Winter

Deemed Winter Demand Savings (kW)				
Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
0.022	0.018	0.017	0.021	0.028

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is established at 10 years according to the ENERGY STAR® Ceiling Fan Savings Calculator.

This EUL is consistent with Docket No. 38025 approved in 2010.[323]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- The number of installed ENERGY STAR® ceiling fan and light kits
- Proof of purchase – with date of purchase and quantity

[323] Docket No. 38025. Petition of Electric Utility Marketing Managers of Texas to Amend Deemed Savings for ENERGY STAR® Appliance Measures. Public Utility Commission of Texas.

- Alternative: photo of unit installed or another pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

- Docket No. 38025. Petition of Electric Utility Marketing Managers of Texas to Amend Deemed Savings for ENERGY STAR® Appliance Measures. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

The applicable version of the ENERGY STAR® specifications and requirements for ceiling fans.

Document Revision History

Table 315: Residential ENERGY STAR® Ceiling Fans Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Minor edits to language and updates to the ENERGY STAR® specification table.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2014	TRM v3.0 update. Explanation of methodology and alignment with ENERGY STAR® calculator. Introduction of interactive effects factors and in-service rates. New peak savings calculated according to revised peak definition.
v3.1	11/05/2015	TRM v3.1 update. Revision of interactive effects factors to reflect indoor-specific values for additional heating and cooling equipment types.
v3.1	3/28/2016	TRM v3.1 March revision. Updated summer and winter coincidence factors.
v4.0	10/10/2016	TRM v4.0 update. Updated interactive effect values using building energy simulation.
v5.0	10/2017	TRM v5.0 update. Updated footnote reference to ENERGY STAR® calculator.
v6.0	11/2018	TRM v6.0 update. Updated interactive effect values.
v7.0	11/2019	TRM v7.0 update. Established deemed savings approach.

2.5.2 ENERGY STAR® Clothes Washers Measure Overview

TRM Measure ID: R-AP-CW

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the accepted deemed savings awarded for the installation of an ENERGY STAR® clothes washer. Savings are awarded at a flat per unit rate, both for energy and demand savings. This measure will apply to existing homes and new construction.

These deemed savings are calculated using the federal standards effective January 1, 2018.

Eligibility Criteria

This section is not applicable.

Baseline Condition

Effective January 1, 2018, the baseline is the Department of Energy (DOE) minimum efficiency standard[324] for top-loading clothes washers. While the DOE provides criteria for both top- and front-loading washers, only the standards for top-loading washers are listed below, as a top-loading unit is assumed to be the baseline equipment. This approach is consistent with the ENERGY STAR® appliance calculator.

[324] DOE minimum efficiency standard for residential clothes washers. https://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/39.

Table 316: Federal Standard for Clothes Washers

Product Type	Current Criteria as of January 1, 2018
Top-loading, Standard (1.6 ft³ or greater capacity)	IMEF ≥ 1.57 IWF≤ 6.5
Top-loading, Compact (less than 1.6 ft³ capacity)	IMEF ≥ 1.15 IWF≤ 12.0

High-efficiency Condition

The table below displays the ENERGY STAR® Final Version 8.0 requirements for eligible clothes washers effective February 5, 2018, with early certification available starting May 5, 2017.[325] These values are subject to updates in ENERGY STAR® specifications; energy efficiency service providers are expected to comply with the latest ENERGY STAR® requirements.

Table 317: ENERGY STAR® Specifications for Residential Clothes Washers

Product Type	Current Criteria as of February 5, 2018
ENERGY STAR® Residential Front-loading (> 2.5 ft³)	IMEF ≥ 2.76 IWF≤ 3.2
ENERGY STAR® Residential Top-loading (> 2.5 ft³)	IMEF ≥ 2.06 IWF ≤ 4.3
ENERGY STAR® Residential Small or Compact (< 2.5 ft³)	IMEF ≥ 2.07 IWF ≤ 4.2

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings for this measure were derived using the ENERGY STAR® Appliance Savings Calculator found on the ENERGY STAR® website.[326] This document will be updated regularly to apply the values provided in the latest available ENERGY STAR® appliance calculator. The most recent TRM version should be referenced to determine the savings for this measure.

[325] Available for download at: https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Final%20Version%208.0%20Clothes%20Washer%20Partner%20Commitments%20and%20Eligibility%20Criteria.pdf.

[326] ENERGY STAR® Appliance Savings Calculator (updated October 2016). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products.

$$kWh_{savings} = kWh_{baseline} - kWh_{ES}$$

Equation 112

Baseline Unit

$$kWh_{baseline} = kWh_{conv,machine} + kWh_{conv,WH} + kWh_{conv,dryer} + kWh_{conv,LPM}$$

Equation 113

$$kWh_{conv,machine} = MCF \times RUEC_{conv} \times \frac{LPY}{RLPY}$$

Equation 114

$$kWh_{conv,WH} = WHCF \times RUEC_{conv} \times \frac{LPY}{RLPY}$$

Equation 115

$$kWh_{conv,LPM} = kW_{conv,LPM} \times (8{,}760 - LPY)$$

Equation 116

$$kWh_{conv,dryer} = \left[\left(\frac{CAP_{conv}}{IMEF_{FS}} \times LPY\right) - \left(RUEC_{conv} \times \frac{LPY}{RLPY}\right) - kWh_{conv,LPM}\right] \times \frac{DU_{DW}}{DUF}$$

Equation 117

Where:

$kWh_{baseline}$ = *Federal standard baseline energy usage*

$kWh_{conv,machine}$ = *Conventional machine energy*

$kWh_{conv,WH}$ = *Conventional water heater energy*

$kWh_{conv,dryer}$ = *Conventional dryer energy*

$kWh_{conv,LPM}$ = *Conventional combined low-power mode energy*

$RUEC_{conv}$ = *Conventional rated unit electricity consumption = 381 kWh/year (top-loading, standard)* [327], 163 kWh/year top-loading, compact)

LPY = *Loads per year = 295*

RLPY = *Reference loads per year = 392*

$kW_{conv,LPM}$ = *Combined low-power mode wattage of conventional unit = 0.00115 kW (top-loading, standard), 0.00144 kW (top-loading, compact)*

[327] This value is taken from the ENERGY STAR® appliance calculator and corresponds with the federal standard after March 7, 2015.

CAP_{conv}	=	*Average machine capacity = 4.5 ft^3 (top-loading, standard), 2.1 ft^3 (top-loading, compact)*
$IMEF_{FS}$	=	*Federal standard integrated modified energy factor (Table 316)*
MCF	=	*Machine consumption factor = 20%*
WHCF	=	*Water heater consumption factor = 80%*
DU_{DW}	=	*Dryer usage in households with both a washer and a dryer = 95%*
DUF	=	*Dryer use factor (percentage of washer loads dried in machine) = 91%*

ENERGY STAR® Unit

$$kWh_{ES} = kWh_{ES,machine} + kWh_{ES,WH} + kWh_{ES,dryer} + kWh_{ES,LPM}$$

Equation 118

$$kWh_{ES,machine} = MCF \times RUEC_{ES} \times \frac{LPY}{RLPY}$$

Equation 119

$$kWh_{ES,WH} = WHCF \times RUEC_{ES} \times \frac{LPY}{RLPY}$$

Equation 120

$$kWh_{ES,LPM} = kW_{ES,LPM} \times (8{,}760 - LPY)$$

Equation 121

$$kWh_{ES,dryer} = \left[\left(\frac{CAP_{ES}}{IMEF_{ES}} \times LPY\right) - \left(RUEC_{ES} \times \frac{LPY}{RLPY}\right) - kWh_{ES,LPM}\right] \times \frac{DU_{DW,ES}}{DUF}$$

Equation 122

Where:

kWh_{ES}	=	*ENERGY STAR® average energy usage*
$kWh_{ES,machine}$	=	*ENERGY STAR® machine energy*
$kWh_{ES,WH}$	=	*ENERGY STAR® water heater energy*
$kWh_{ES,dryer}$	=	*ENERGY STAR® dryer energy*
$kWh_{ES,LPM}$	=	*ENERGY STAR® combined low-power mode energy*
$RUEC_{ES}$	=	*ENERGY STAR® rated unit electricity consumption (see Table 318)*

$kW_{ES,LPM}$	=	*Combined low-power mode wattage of ENERGY STAR® unit (see Table 318)*
$IMEF_{ES}$	=	*ENERGY STAR® integrated modified energy factor (Table 317)*
CAP_{ES}	=	*Average machine capacity (see Table 318)*

Table 318: ENERGY STAR® Clothes Washer Characteristics[328]

Product Type	ENERGY STAR® Rated Unit Electricity Consumption (kWh)	Average Capacity (ft^3)	Combined Low-Power Mode Wattage (kW)
Residential front-loading (> 2.5 ft^3)	127	4.0	0.00160
Residential top-loading (> 2.5 ft^3)	230	4.5	0.00115
Residential small or compact (< 2.5 ft^3)	109	2.1	0.00144

Summer Demand Savings Algorithms

$$kW_{savings} = \frac{kWh_{savings}}{AOH} \times CF$$

Equation 123

$$AOH = LPY \times d$$

Equation 124

Where:

AOH	=	*Annual operating hours*
CF	=	*Coincidence factor (Table 319)*
LPY	=	*Loads per year = 295*
d	=	*Average wash cycle duration = 1 hour*[329,330]

328 This value is taken from the ENERGY STAR® appliance calculator and corresponds with the ENERGY STAR® specification after March 7, 2015.

329 Weighted average of Consumer Reports Cycle Times for Top and Front-Loading Clothes Washers. Top: http://www.consumerreports.org/cro/appliances/laundry-and-cleaning/washing-machines/top-loading-washing-machine-ratings/ratings-overview.htm. Front: http://www.consumerreports.org/cro/appliances/laundry-and-cleaning/washing-machines/front-loading-washing-machine-ratings/ratings-overview.htm.

330 Consumer Reports. “Top-loading washers remain more popular with Americans”. April 13, 2010. Weighted average of 75 percent Top-Loading Clothes Washers and 25 percent Front-Loading Clothes Washers. http://news.consumerreports.org/home/2010/04/best-front-loaders-top-loaders-which-is-more-popular-mold-vibration-washing-machine-reviews.html. This publication is available for purchase only.

Table 319: ENERGY STAR® Clothes Washer Coincidence Factors[331]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.040	0.040	0.040	0.041	0.041
Winter	0.043	0.043	0.043	0.044	0.039

Deemed Energy Savings Tables

Table 320: ENERGY STAR® Clothes Washer Energy Savings (kWh)

ENERGY STAR® Clothes Washer—Annual Energy Savings			
Type	Water Heater Fuel Type	Dryer Fuel Type	kWh Savings
Front-loading > 2.5 ft^3	Electric	Electric	394
		Gas	187
	Gas	Electric	241
		Gas	34
Top-loading > 2.5 ft^3	Electric	Electric	193
		Gas	114
	Gas	Electric	102
		Gas	23
All $\leq$ 2.5 ft^3	Electric	Electric	222
		Gas	41
	Gas	Electric	189
		Gas	8

[331] See Volume 1, Appendix B.

Deemed Summer Demand Savings Tables

Table 321: ENERGY STAR® Clothes Washer Summer Peak Demand Savings (kW)

ENERGY STAR® Clothes Washer—Summer Demand Savings							
Washer Type	Fuel Type		Summer Demand Savings (kW)				
	Water Heater	Dryer	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Front-loading > 2.5 ft³	Electric	Electric	0.053	0.053	0.053	0.055	0.055
		Gas	0.025	0.025	0.025	0.026	0.026
	Gas	Electric	0.033	0.033	0.033	0.033	0.033
		Gas	0.005	0.005	0.005	0.005	0.005
Top-loading > 2.5 ft³	Electric	Electric	0.026	0.026	0.026	0.027	0.027
		Gas	0.015	0.015	0.015	0.016	0.016
	Gas	Electric	0.014	0.014	0.014	0.014	0.014
		Gas	0.003	0.003	0.003	0.003	0.003
All ≤ 2.5 ft³	Electric	Electric	0.030	0.030	0.030	0.031	0.031
		Gas	0.006	0.006	0.006	0.006	0.006
	Gas	Electric	0.026	0.026	0.026	0.026	0.026
		Gas	0.001	0.001	0.001	0.001	0.001

Deemed Winter Demand Savings Tables

Table 322: All Climate Zones—ENERGY STAR® Clothes Washer Winter Demand Savings (kW)

ENERGY STAR® Clothes Washer—Winter Demand Savings							
Washer Type	Fuel Type		Winter Demand Savings (kW)				
	Water Heater	Dryer	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5
Front-loading > 2.5 ft^3	Electric	Electric	0.057	0.057	0.057	0.059	0.052
		Gas	0.027	0.027	0.027	0.028	0.025
	Gas	Electric	0.035	0.035	0.035	0.036	0.032
		Gas	0.005	0.005	0.005	0.005	0.005
Top-loading > 2.5 ft^3	Electric	Electric	0.028	0.028	0.028	0.029	0.026
		Gas	0.017	0.017	0.017	0.017	0.015
	Gas	Electric	0.015	0.015	0.015	0.015	0.014
		Gas	0.003	0.003	0.003	0.003	0.003
All ≤ 2.5 ft^3	Electric	Electric	0.032	0.032	0.032	0.033	0.029
		Gas	0.006	0.006	0.006	0.006	0.005
	Gas	Electric	0.028	0.028	0.028	0.028	0.025
		Gas	0.001	0.001	0.001	0.001	0.001

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of an ENERGY STAR® clothes washer is established at 11 years based on the Technical Support Document for the current DOE Final Rule standards for residential clothes washers.[332]

[332] The median lifetime was calculated using the survival function outlined in the DOE Technical Support Document. Final Rule: Standards, Federal Register, 77 FR 32308 (May 31, 2012) and associated Technical Support Document. Accessed 08/15/2019. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=68&action=viewliveDownload TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0019-0047.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of units installed
- Type of unit (top-loading, front-loading, or compact)
- Fuel type of water heater (gas or electric)
- Fuel type of dryer (gas or electric)
- Proof of purchase – with date of purchase and quantity
  - Alternative: photo of unit installed or another pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- The applicable version of the ENERGY STAR® specifications and requirements for clothes washers.

Document Revision History

Table 323: Residential ENERGY STAR® Clothes Washers Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Updated by Frontier Associates, March 2014, based on new federal standards.
v2.1	1/30/2015	TRM v2.1 update. New ENERGY STAR® standards incorporated.
v3.0	4/10/2015	TRM v3.0 update. Updated EUL to align with median lifetime. New peak savings calculated according to revised peak definition.
v3.1	11/05/2015	TRM v3.1 update. New ENERGY STAR® algorithms and default assumptions incorporated.
v3.1	3/28/2016	TRM v3.1 March revision. Updated winter coincidence factors and winter and summer demand savings tables.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. Updated baseline IMEF to reflect changes in Federal Standard. Updated Front Load Washer IMEF to reflect changes in

TRM Version	Date	Description of Change
		ENERGY STAR Specification. Added baseline for compact units to reflect Federal Standard for compact washers.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	11/2019	TRM v7.0 update. Updated links and dates.

2.5.3 ENERGY STAR® Clothes Dryers Measure Overview

TRM Measure ID: R-AP-CD

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the accepted deemed savings awarded for the installation of an ENERGY STAR® electric clothes dryer. Savings are awarded at a flat per-unit rate, both for energy and demand savings. This measure will apply to existing homes and new construction.

Eligibility Criteria

Gas dryers are ineligible to claim savings under this measure. Savings may be claimed for the replacement of gas dryers if the decision to switch fuels predates the decision to install efficient equipment.

Baseline Condition

Effective January 1, 2015, the baseline is the Department of Energy (DOE) minimum federal efficiency standard[333], adjusted to reflect recent Combined Energy Factor (CEF) definition updates for vented and ventless clothes dryers. These adjusted baselines consider calculated differences between CEF values under original clothes dryer testing procedures of 10 CFR 430, Subpart B, Appendix D1, and those amended procedures outlined in Appendix D2; a change indicated in detail in the September 5, 2013, ENERGY STAR® stakeholder webinar[334]. These values are consistent with the current ENERGY STAR® Appliance Savings Calculator.

[333] DOE minimum efficiency standard for residential clothes dryers. https://www.regulations.gov/document?D=EERE-2007-BT-STD-0010-0050

[334] Available for download at: https://www.energystar.gov/sites/default/files/specs/Clothes%20Dryers%20Draft%202%20V1%200%20Stakeholder%20Webinar%20Final.pdf

Table 324: Federal Standard for Residential Clothes Dryers

Product Type	Average Capacity (ft³)	Amended Minimum CEF: Calculations	Minimum CEF levels (lbs/kWh)
Vented Electric, Standard	≥ 4.4	3.73 – (3.73 x 0.166)	3.11
Vented Electric, Compact (120 V)	< 4.4	3.61 – (3.61 x 0.166)	3.01
Vented Electric, Compact (240 V)	< 4.4	3.27 – (3.27 x 0.166)	2.73
Ventless Electric, Compact (240 V)	< 4.4	2.55 – (2.55 x 0.166)	2.13

High-efficiency Condition

The table below displays the ENERGY STAR® Final Version 1.1 requirements for eligible clothes dryers effective January 1, 2015.[335] These values are subject to updates in ENERGY STAR® specifications; energy efficiency service providers are expected to comply with the latest ENERGY STAR® requirements.

Table 325: ENERGY STAR® Specifications for Residential Clothes Dryers

Product Type	Average Capacity (ft³)	Minimum CEF levels (lbs/kWh)
ENERGY STAR® Ventless or Vented Electric, Standard	≥ 4.4	3.93
ENERGY STAR® Ventless or Vented Electric, Compact (120V)	< 4.4	3.80
ENERGY STAR® Vented Electric, Compact (240 V)	< 4.4	3.45
ENERGY STAR® Ventless Electric, Compact (240 V)	< 4.4	2.68

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings for this measure were derived using the ENERGY STAR® Appliance Savings Calculator found on the ENERGY STAR® website.[336] This document will be updated regularly to apply the values provided in the latest available ENERGY STAR® appliance calculator. The most recent TRM version should be referenced to determine the savings for this measure.

335 Available for download at: https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Final%20Version%201.1%20Clothes%20Dryers%20Specification%20-%20Program%20Commitment%20Criteria%20and%20Eligibility%20Criteria.pdf.

336 ENERGY STAR® Appliance Savings Calculator (updated October 2016). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products.

Table 326: Default Average Load for Clothes Dryers in Pounds

Product Type	Average Load (lbs)
Vented Electric, Standard	8.45
Vented Electric, Compact (120 V)	3.00
Vented Electric, Compact (240 V)	3.00
Ventless Electric, Compact (240 V)	3.00

$$kWh_{savings} = kWh_{baseline} - kWh_{ES}$$

Equation 125

Baseline Unit

$$kWh_{baseline} = \frac{AvgLoad \times LPY}{CEF_{baseline}}$$

Equation 126

Where:

$kWh_{baseline}$ = *Federal standard baseline energy usage*

$AvgLoad$ = *Average load in lbs (Table 326)*

LPY = *Loads per year = 283*

$CEF_{baseline}$ = *Amended Baseline Combined Energy Factor (See* Table 324*)*

ENERGY STAR® Unit

$$kWh_{ES} = \frac{AvgLoad \times LPY}{CEF_{ES}}$$

Equation 127

Where:

kWh_{ES} = *ENERGY STAR® average energy usage*

$AvgLoad$ = *Average load in lbs (See Table 326)*

LPY = *Loads per Year = 283*

CEF_{ES} = *ENERGY STAR® Minimum Combined Energy Factor (See* Table 325*)*

Demand Savings Algorithms

$$kW_{savings} = \frac{kWh_{savings}}{AOH} \times CF$$

Equation 128

Where:

AOH = *Annual operating hours = (8760 – 8463) = 297 hours*[337]

CF = *Coincidence factor (*Table 327*)*

Table 327: ENERGY STAR® Clothes Dryer Coincidence Factors[338]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.041	0.041	0.041	0.041	0.042
Winter	0.045	0.045	0.041	0.048	0.047

337 Concerning annual operating hours: Minute-by-minute field data shows "96.6% ± 0.5% idle time, or about 8463 hours." Hannas, Benjamin and Gilman, Lucinda. *Dryer Field Study*, 39. Available for download at (last accessed August 29, 2019): https://neea.org/img/uploads/neea-clothes-dryer-field-study.pdf

338 See Volume 1, Appendix B.

Deemed Energy Savings Tables

Table 328: ENERGY STAR® Clothes Dryer Energy Savings (kWh/Year)

ENERGY STAR® Clothes Dryer—Annual Energy Savings		
Product Type	**Average Capacity (ft³)**	**Energy Savings (kWh)**
Ventless or Vented Electric, Standard	≥ 4.4	160
Ventless or Vented Electric, Compact (120V)	< 4.4	59
Vented Electric, Compact (240 V)	< 4.4	65
Ventless Electric, Compact (240 V)	< 4.4	82

Deemed Summer Demand Savings Tables

Table 329: ENERGY STAR® Clothes Dryer Summer Peak Demand Savings (kW)

ENERGY STAR® Clothes Dryer—Summer Demand Savings						
Product Type	**Average Capacity (ft³)**	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Ventless or Vented Electric, Standard	≥ 4.4	0.022	0.022	0.022	0.022	0.023
Ventless or Vented Electric, Compact (120V)	< 4.4	0.008	0.008	0.008	0.008	0.008
Vented Electric, Compact (240 V)	< 4.4	0.009	0.009	0.009	0.009	0.009
Ventless Electric, Compact (240 V)	< 4.4	0.011	0.011	0.011	0.011	0.012

Deemed Winter Demand Savings Tables

Table 330: ENERGY STAR® Clothes Dryer Winter Demand Savings (kW)

ENERGY STAR® Clothes Dryer—Winter Demand Savings						
Product Type	**Average Capacity (ft³)**	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Ventless or Vented Electric, Standard	≥ 4.4	0.024	0.024	0.022	0.026	0.025
Ventless or Vented Electric, Compact (120V)	< 4.4	0.009	0.009	0.008	0.009	0.009
Vented Electric, Compact (240 V)	< 4.4	0.010	0.010	0.009	0.011	0.010
Ventless Electric, Compact (240 V)	< 4.4	0.012	0.013	0.011	0.013	0.013

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) of an ENERGY STAR® clothes dryer is established at 16 years based on the current DOE Final Rule standards for clothes dryers[339].

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of units installed
- Type of unit (vented or ventless)
- Capacity (≥ 4.4 ft^3/standard or < 4.4 ft^3/compact)
- Proof of purchase – including date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- The applicable version of the ENERGY STAR® specifications and requirements for clothes washers.

Document Revision History

Table 331: Residential ENERGY STAR® Clothes Dryers Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

[339] Technical Support Document (April 2011) accessed 09/03/2019. See "Appendix 8C.Lifetime Distributions": https://www.regulations.gov/document?D=EERE-2007-BT-STD-0010-0053

2.5.4 ENERGY STAR® Dishwashers Measure Overview

TRM Measure ID: R-AP-DW

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the accepted deemed savings awarded for the installation of an ENERGY STAR® dishwasher. Savings are awarded at a flat per-unit rate, both for energy and demand savings. This measure will apply to existing homes and new construction.

Eligibility Criteria

This measure applies to both standard and compact dishwasher types.

Baseline Condition

Effective May 30, 2013, the baseline is the Department of Energy (DOE) minimum efficiency standard[340] for dishwashers.

[340] DOE minimum efficiency standard for residential dishwashers. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=38&action=viewlive..

Table 332 Federal Standard for Dishwashers

Product Type	Estimated Annual Energy Use (kWh/year)	Water Consumption (gallons/cycle)
Standard (≥ 8 place settings)	≤ 307	≤ 5.0
Compact (< 8 place settings)	≤ 222	≤ 3.5

High-efficiency Condition

The following table displays the ENERGY STAR® Final Version 6.0 requirements for eligible dishwashers effective January 29, 2016.[341] These values are subject to updates in ENERGY STAR® specifications; energy efficiency service providers are expected to comply with the latest ENERGY STAR® requirements.

Table 333 ENERGY STAR® Specifications for Dishwashers

Product Type	Estimated Annual Energy Use (kWh/year)	Water Consumption (gallons/cycle)
Standard (≥ 8 place settings + 6 serving pieces)	≤ 270	≤ 3.5
Compact (< 8 place settings + 6 serving pieces)	≤ 203	≤ 3.1

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings for this measure were derived using the ENERGY STAR® Appliance Savings Calculator found on the ENERGY STAR® website and the revised ENERGY STAR® specification in Table 333.[342] Default values were taken directly from the ENERGY STAR® calculator. This document will be updated regularly to apply the values provided in the latest available ENERGY STAR® specification and appliance calculator. The most recent TRM version should be referenced to determine measure savings for this measure.

341 Available for download at: http://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Residential%20Dishwasher%20Version%206.0%20Final%20Program%20Requirements_0.pdf.

342 ENERGY STAR® Appliance Savings Calculator (updated October 2016). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products.

$$kWh_{savings} = kWh_{baseline} - kWh_{ES}$$

Equation 129

$$kWh_{baseline} = kWh_{conv,machine} + kWh_{conv,WH}$$

Equation 130

$$kWh_{conv,machine} = RUEC_{conv} \times MCF$$

Equation 131

$$kWh_{conv,WH} = RUEC_{conv} \times WHCF$$

Equation 132

$$kWh_{ES} = kWh_{ES,machine} + kWh_{ES,WH}$$

Equation 133

$$kWh_{ES,machine} = RUEC_{ES} \times MCF$$

Equation 134

$$kWh_{ES,WH} = RUEC_{ES} \times WHCF$$

Equation 135

Where:

$kWh_{baseline}$	=	*Federal standard baseline energy usage*
kWh_{ES}	=	*ENERGY STAR® average energy usage*
$kWh_{conv,machine}$	=	*Conventional machine energy*
$kWh_{conv,WH}$	=	*Conventional water heater energy*
$kWh_{ES,machine}$	=	*ENERGY STAR® machine energy*
$kWh_{ES,WH}$	=	*ENERGY STAR® water heater energy*
$RUEC_{conv}$	=	*Conventional rated use electricity consumption = 307 kWh/year for standard and 222 kWh/year for compact (Table 332)*
$RUEC_{ES}$	=	*ENERGY STAR® rated use electricity consumption = 270 kWh/year for standard and 203 kWh/year for compact (Table 333)*
MCF	=	*Machine consumption factor = 44%*
WHCF	=	*Water heater consumption factor = 56%*

Demand Savings Algorithms

$$kW_{savings} = \frac{kWh_{savings}}{AOH} \times CF$$

Equation 136

$$AOH = CPY \times d$$

Equation 137

Where:

AOH = *Annual operating hours*

CF = *Coincidence factor = (Table 334)*

CPY = *Cycles per year = 215*

d = *Average wash cycle duration = 2.1 hours*[343]

Table 334: ENERGY STAR® Dishwasher Coincidence Factors[344]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.042	0.041	0.042	0.041	0.042
Winter	0.106	0.104	0.090	0.112	0.129

Deemed Energy Savings Tables

Table 335: ENERGY STAR® Dishwasher Energy Savings

ENERGY STAR® Dishwasher—Energy Savings (kWh)		
Product Type	**Electric Water Heating**	**Gas Water Heating**
Standard	37	16
Compact	19	8

343 Average of Consumer Reports Cycle Times for Dishwashers. http://www.consumerreports.org/cro/appliances/kitchen-appliances/dishwashers/dishwasher-ratings/ratings-overview.htm.

344 See Volume 1, Appendix B.

Deemed Summer Demand Savings Tables

Table 336: ENERGY STAR® Dishwasher Summer Peak Demand Savings (kW)

ENERGY STAR® Dishwasher—Summer Demand Savings (kW)						
Dishwasher Type	**Water Heating Fuel**	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Standard	Electric	0.003	0.003	0.003	0.003	0.003
	Gas	0.002	0.001	0.002	0.001	0.002
Compact	Electric	0.002	0.002	0.002	0.002	0.002
	Gas	0.001	0.001	0.001	0.001	0.001

Deemed Winter Demand Savings Tables

Table 337: ENERGY STAR® Dishwasher Winter Peak Demand Savings (kW)

ENERGY STAR® Dishwasher—Winter Demand Savings (kW)						
Dishwasher Type	**Water Heating Fuel**	**Climate Zone 1**	**Climate Zone 2**	**Climate Zone 3**	**Climate Zone 4**	**Climate Zone 5**
Standard	Electric	0.009	0.009	0.007	0.009	0.011
	Gas	0.004	0.004	0.003	0.004	0.005
Compact	Electric	0.004	0.004	0.004	0.005	0.005
	Gas	0.002	0.002	0.002	0.002	0.002

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is established at 15 years based on the Technical Support Document for the current DOE Final Rule standards for residential dishwashers.[345]

[345] The median lifetime was calculated using the survival function outlined in the DOE Technical Support Document. Final Rule: Standards, Federal Register, 77 FR 31918 (May 30, 2012) and associated Technical Support Document. Accessed 08/15/2019. https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=38&action=viewlive.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of units installed
- Type of dishwasher (standard or compact)
- Fuel type of water heater (gas or electric)
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- The applicable version of the ENERGY STAR® specifications and requirements for dishwashers.

Document Revision History

Table 338: Residential ENERGY STAR® Dishwashers Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin.
v2.0	4/18/2014	TRM v2.0 update. Updated by Frontier Associates, March 2014, based on new federal standards.
v2.1	1/30/2015	TRM v2.1 update. No revision.
v3.0	4/10/2015	TRM v3.0 update. New ENERGY STAR® specifications incorporated into the measure. New peak savings calculated according to revised peak definition.
v3.1	11/05/2015	TRM v3.1 update. Final ENERGY STAR® specification incorporated into the measure. Consolidated table formats.
v3.1	3/28/2016	TRM 3.1 March revision. Updated summer and winter coincidence factors and demand savings tables.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. Updated footnote reference to ENERGY STAR® calculator.

TRM Version	Date	Description of Change
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Updated links and dates.

2.5.5 ENERGY STAR® Refrigerators Measure Overview

TRM Measure ID: R-AP-RF

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction, early retirement

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure applies to all ENERGY STAR® refrigerators that meet the criteria for the ENERGY STAR® label specified below.

Eligibility Criteria

To qualify for early retirement, the ENERGY STAR® unit must replace an existing, full-size unit with a maximum age of 20 years. To determine the remaining useful life of an existing unit, see Table 342. All retired refrigerators must be dismantled in an environmentally safe manner in accordance with applicable federal, state, and local regulations. The installer will provide documentation of proper disposal of refrigerators. In order to receive early retirement savings, the unit to be replaced must be functioning at the time of removal.

Newly installed refrigerators must meet current ENERGY STAR® efficiency levels.

Baseline Condition

For new construction or replace-on-burnout, the baseline is the Department of Energy (DOE) minimum efficiency standard[346] for refrigerators, effective September 15, 2014.

For early retirement, the baseline for refrigerators is the annual unit energy consumption of an assumed refrigerator's adjusted energy usage rating based on an average of values reported by

[346] DOE minimum efficiency standard for residential refrigerators and freezers. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43.

the Midwest Energy Performance Analytics (MwEPA) Refrigerator and Freezer Energy Rating Database.[347]

High-efficiency Condition

Table 339 displays the ENERGY STAR® requirements for eligible refrigerators, which went into effect on September 15, 2014. These values are subject to updates in ENERGY STAR® specifications; energy efficiency service providers are expected to comply with the latest ENERGY STAR® requirements.

Table 339: ENERGY STAR® Specifications for Refrigerators

ENERGY STAR® Refrigerator		
Product Type	**Volume**	**Criteria as of September 15, 2014**
Full-size Refrigerators and Refrigerator-Freezers	7.75 cubic feet or greater	Approximately 10 percent more energy efficient than the minimum federal standard (see Table 340)

[347] Refrigerator and Freezer Energy Rating Database. Midwest Energy Performance Analytics, Inc. in combination with the State of Wisconsin and US Department of Energy's Weatherization Assistance Program. http://www.kouba-cavallo.com/refmods.htm.

Table 340: Formulas to Calculate the ENERGY STAR® Criteria for each Refrigerator Product Category by Adjusted Volume[348]

Product Number	Product Class	Baseline Energy Usage Federal Standard as of Sept 15, 2014 (kWh/year)[349]	Average ENERGY STAR® Energy Usage (kWh/year)[350]	Adjusted Volume[351] (cubic feet)	Baseline Energy Usage (kWh/year)	ENERGY STAR® Energy Usage (kWh/year)
3	Refrigerator freezers—automatic defrost with top-mounted freezer without an automatic icemaker	8.07 × AV + 233.7	7.26 × AV + 210.3	16.9	370.1	333.0
5	Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker	8.85 × AV + 317.0	7.97 × AV + 285.3	18.6	481.5	433.5
5A	Refrigerator-freezers—automatic defrost with bottom-mounted	9.25 × AV + 475.4	8.33 × AV + 436.3	32.1	772.1	703.5

348 Available for download at http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-32.pdf. Select product classes excluded.

349 http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-32.pdf.

350 Approximately 10 percent more efficient than baseline, as specified in the ENERGY STAR® Appliance Savings Calculator (updated September 2015). http://www.energystar.gov/sites/default/files/asset/document/appliance_calculator.xlsx.

351 AV is calculated as a simple average across all refrigerators in the corresponding Product Class utilizing data provided by https://www.energystar.gov/productfinder/product/certified-residential-refrigerators/results

	freezer with an automatic icemaker with TTD ice service					
7	Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker with TTD ice service	8.54 × AV + 432.8	7.69 × AV + 397.9	30.4	692.1	631.4

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

New Construction or Replace-on-burnout

Energy Savings Algorithms

$$kWh_{savings} = kWh_{baseline} - kWh_{ES}$$

Equation 138

Where:

$kWh_{baseline}$ = *Federal standard baseline energy usage (see Table 340)*

kWh_{ES} = *ENERGY STAR average energy usage (see (see Table 340)*

Demand Savings Algorithms

$$kW_{savings} = \frac{kWh_{savings}}{8{,}760\ hrs} \times LSAF$$

Equation 139

Where:

LSAF = *Load Shape Adjustment Factor (see Table 341)*

Table 341: ENERGY STAR® Refrigerator Load Shape Adjustment Factors[352]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	1.112	1.099	1.108	1.100	1.081
Winter	0.929	0.966	0.924	0.941	0.966

Early Retirement

Annual energy (kWh) and peak demand (kW) savings must be calculated separately for two time periods:

1. The estimated remaining life of the equipment that is being removed, designated the remaining useful life (RUL), and
2. The remaining time in the EUL period (16—RUL)

[352] See Volume 1, Appendix B.

Annual energy and peak demand savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

Where:

RUL = *Remaining useful life (see Table 342); if unknown, assume the age of the replaced unit is equal to the EUL resulting in a default RUL of 5.0 years*

EUL = *Estimated useful life = 16 years*

Table 342: Remaining Useful Life (RUL) of Replaced Refrigerator

Age of Replaced Refrigerator (years)	RUL (years)	Age of Replaced Refrigerator (years)	RUL (years)
1	15.2	12	7.0
2	14.2	13	6.6
3	13.2	14	6.3
4	12.2	15	6.0
5	11.2	16	5.0
6	10.3	17	4.0
7	9.6	18	3.0
8	8.9	19	2.0
9	8.3	20	1.0
10	7.8	21[353,354]	0.0
11	7.4		

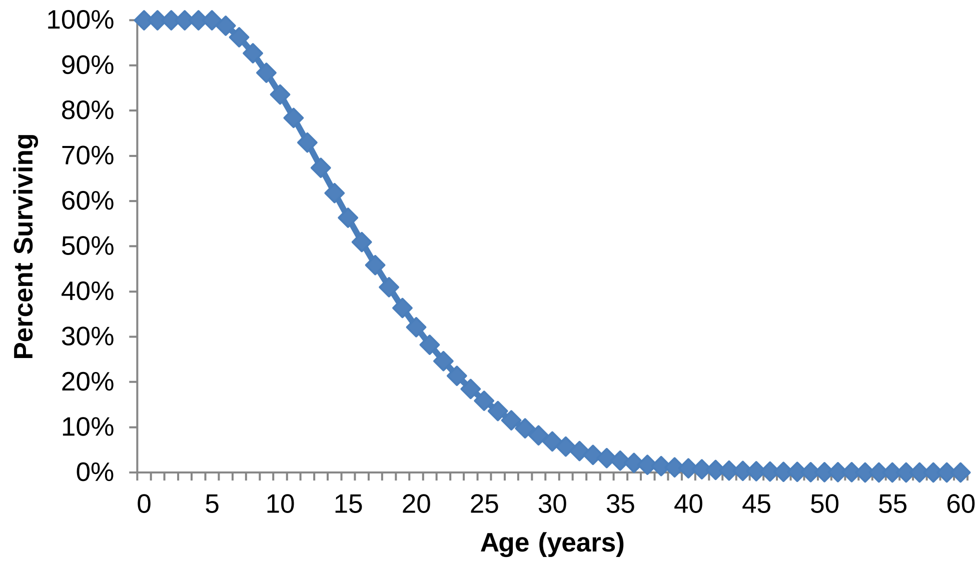
Derivation of RULs

ENERGY STAR® refrigerators have an estimated useful life of 16 years. This estimate is consistent with the age at which approximately 50 percent of the refrigerators installed in a given year will no longer be in service, as described by the survival function in Figure 12.

[353] RULs are capped at the 75th percentile of equipment age, 21 years, as determined based on DOE survival curves (see Figure 12). Systems older than 21 years should use the ROB baseline. See the January 2015 memo, "Considerations for early replacement of residential equipment," for further detail.

[354] Ward, B., Bodington, N., Farah, H., Reeves, S., and Lee, L. "Considerations for early replacement of residential equipment." Prepared by the Evaluation, Measurement, and Verification (EM&V) team for the Electric Utility Marketing Managers of Texas (EUMMOT). January 2015. This document has been made available to all Texas investor-owned utilities through the EM&V team's SharePoint.

Figure 12: Survival Function for ENERGY STAR® Refrigerators[355]



The method to estimate the remaining useful life (RUL) of a replaced system uses the age of the existing system to re-estimate the projected unit lifetime based on the survival function shown in Figure 12. The age of the refrigerator being replaced is found on the horizontal axis, and the corresponding percentage of surviving refrigerators is determined from the chart. The surviving percentage value is then divided in half, creating a new estimated useful lifetime applicable to the current unit age. Then, the age (year) that corresponds to this new percentage is read from the chart. RUL is estimated as the difference between that age and the current age of the system being replaced.

For example, assume a refrigerator being replaced is 15 years old. The corresponding percent surviving value is 56 percent. Half of 56 percent is 28 percent. The age corresponding to 28 percent on the chart is 21 years. Therefore, the RUL of the refrigerator being replaced is (21–15) = 6 years.

Energy Savings Algorithms

For the RUL time period:

$$kWh_{savings,ER} = kWh_{manf} - kWh_{ES}$$

Equation 140

For the remaining time in the EUL period., calculate annual savings as you would for a replace-on-burnout project:

[355] Department of Energy, Federal Register, 76 Final Rule 57516, Technical Support Document: 8.2.3.1 Estimated Survival Function. September 15, 2011. http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrig_finalrule_tsd.pdf.

$$kWh_{savings,ROB} = kWh_{baseline} - kWh_{ES}$$

Equation 141

Where:

kWh_{manf} = *968 kWh/Year*[356]

$kWh_{baseline}$ = *Federal standard baseline energy usage (see Table 340)*

kWh_{ES} = *ENERGY STAR® average energy usage (see Table 340)*

Demand Savings Algorithms

To calculate demand savings for the early retirement of a refrigerator, a similar methodology is used as for replace-on-burnout installations, with separate savings calculated for the remaining useful life of the unit, and the remainder of the EUL as outlined in the section above.

For the RUL time period:

$$kW_{savings,ER} = \frac{kWh_{savings,ER}}{8{,}760\ hrs} \times LSAF$$

Equation 142

For the remaining time in the EUL period, calculate annual savings as you would for a replace-on-burnout project:

$$kW_{savings,ROB} = \frac{kWh_{savings,ROB}}{8{,}760\ hrs} \times LSAF$$

Equation 143

Where:

LSAF = *Load shape adjustment factor (Table 341)*

Annual deemed summer peak demand savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

356 This is the weighted average of Adjusted annual unit energy consumption, derived from the MwEPA Refrigerator and Freezer Energy Rating Database (or from metering). Weights are calculated from the millions-of-households measurements obtained from the Residential Energy Consumption Survey, or RECS, (https://www.eia.gov/consumption/residential/data/2015/hc/php/hc3.6.php) corresponding to the year range classifications of refrigerators greater than 15 years old (specifically, 15-to-19-years-old and 20-or-more-years-old). Data in which refrigerators' model years were older than 1975 were excluded.

Where:

RUL	=	*Remaining useful life (see Table 342)*
EUL	=	*Estimated useful life = 16 years*[357]

[357] Department of Energy, Federal Register, 76 Final Rule 57516, Technical Support Document: 8.2.3.1 Estimated Survival Function. September 15, 2011. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0012-0128.

Deemed Energy Savings Tables

Table 343: ENERGY STAR® Refrigerators Energy Savings (kWh) by Refrigerator Type

Through-the-Door Ice?	Door Type	Product Class	ROB Savings (kWh/year)	ER Savings (kWh/year)
No	Top Freezer	3: Refrigerator freezers—automatic defrost with a top-mounted freezer without an automatic icemaker	37	224
	Bottom Freezer	5: Refrigerator-freezers—automatic defrost with a bottom-mounted freezer without an automatic icemaker	48	200
Yes	Bottom Freezer	5A: Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker with TTD ice service	69	147
	Side-by-Side	7: Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker with TTD ice service	61	130
Unknown or Average Refrigerator[358]			44	205

[358] An "Unknown or Average" refrigerator's savings are calculated as the difference between the weighted average of baseline energy usage ratings and the weighted average of ENERGY STAR® energy usage ratings for the four selected refrigerator categories, with weights ascertained from averages of refrigerators in 10-14 year-old, 5-9 year-old, and 2-4 year-old age groups. The data used to calculate weights is hosted by Natural Resources Canada (NRCAN) at the following link which contains a table of the distribution of refrigerator types in households

Deemed Summer Demand Savings Tables

Table 344: ENERGY STAR® Refrigerators Replace-on-burnout Summer Demand Savings (kW) by Refrigerator Type

Through-the-Door Ice?	Door Type	Product Class	Replace-on-burnout Savings (kW – Summer)				
			Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
No	Top Freezer	3: Refrigerator freezers—automatic defrost with top-mounted freezer without an automatic icemaker	0.0047	0.0047	0.0047	0.0047	0.0046
	Bottom Freezer	5: Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker	0.0061	0.0060	0.0061	0.0060	0.0059
Yes	Bottom Freezer	5A: Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker with TTD ice service	0.0087	0.0086	0.0087	0.0086	0.0085
	Side-by-Side	7: Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker with TTD ice service	0.0077	0.0076	0.0077	0.0076	0.0075
Unknown or Average Refrigerator			0.0056	0.0056	0.0056	0.0056	0.0055

by year: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CM&sector=aaa&juris=ca&rn=3&page=1. Weights were similarly calculated utilizing data from RECS (data which is summarized, i.e. not yearly, and located here: https://www.eia.gov/consumption/residential/data/2015/hc/php/hc3.6.php). While the reported distribution of refrigerator types between the two sets of data varies, we prefer the year-level granularity of the data from NRCAN considering that the differences between both sets of weighted average baseline energy usage and weighted average ENERGY STAR® energy usage were nearly identical. Hence, we elect to utilize the more detailed weightings derived from the data hosted by NRCAN.

Table 345: ENERGY STAR® Refrigerators Early Retirement Summer Demand Savings (kW) by Refrigerator Type

Through-the-Door Ice?	Door Type	Product Class	Early-Retirement Savings (kW – Summer)				
			Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
No	Top Freezer	3: Refrigerator freezers—automatic defrost with top-mounted freezer without an automatic icemaker	0.028	0.028	0.028	0.028	0.028
	Bottom Freezer	5: Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker	0.025	0.025	0.025	0.025	0.025
Yes	Bottom Freezer	5A: Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker with TTD ice service	0.016	0.016	0.016	0.016	0.016
	Side-by-Side	7: Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker with TTD ice service	0.019	0.018	0.019	0.018	0.018
Unknown or Average Refrigerator			0.026	0.026	0.026	0.026	0.025

Deemed Winter Demand Savings Tables

Table 346: ENERGY STAR® Refrigerators Replace-on-burnout Winter Demand Savings (kW) by Refrigerator Type

Through-the-Door Ice?	Door Type	Product Class	Replace-on-burnout Savings (kW – Winter)				
			Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
No	Top Freezer	3: Refrigerator freezers—automatic defrost with top-mounted freezer without an automatic icemaker	0.0039	0.0041	0.0039	0.0040	0.0041
	Bottom Freezer	5: Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker	0.0051	0.0053	0.0051	0.0052	0.0053
Yes	Bottom Freezer	5A: Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker with TTD ice service	0.0073	0.0076	0.0072	0.0074	0.0076
	Side-by-Side	7: Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker with TTD ice service	0.0064	0.0067	0.0064	0.0065	0.0067
Unknown or Average Refrigerator			0.0047	0.0049	0.0047	0.0048	0.0049

Table 347: ENERGY STAR® Refrigerators Early Retirement Winter Demand Savings (kW) by Refrigerator Type

Through-the-Door Ice?	Door Type	Product Class	Early-Retirement Savings (kW – Winter)				
			Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
No	Top Freezer	3: Refrigerator freezers—automatic defrost with top-mounted freezer without an automatic icemaker	0.024	0.025	0.024	0.024	0.025
	Bottom Freezer	5: Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker	0.021	0.022	0.021	0.021	0.022
Yes	Bottom Freezer	5A: Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker with TTD ice service	0.014	0.014	0.014	0.014	0.014
	Side-by-Side	7: Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker with TTD ice service	0.016	0.016	0.015	0.016	0.016
Unknown or Average Refrigerator			0.022	0.023	0.022	0.022	0.023

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is established at 16 years based on the current DOE Final Rule standards for residential refrigerators.[359]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of units installed
- The project type of the installation (new construction, replace-on-burnout, or early retirement)
- Installed refrigerator model number
- Photograph demonstrating functionality of existing equipment and/or customer responses to survey questionnaire documenting the condition of the replaced unit and their motivation for measure replacement for early retirement eligibility determination (early retirement only)
- Document proper disposal of the existing refrigerator (early retirement only)
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

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[359] Final Rule: Standards, Federal Register, 76 FR 57516 (Sept. 15, 2011) and associated Technical Support Document. Accessed 10/10/2014. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/43. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0012-0128.

Relevant Standards and Reference Sources

- The applicable version of the ENERGY STAR® specifications and requirements for refrigerators.

Document Revision History

Table 348: Residential ENERGY STAR® Refrigerators Revision History

TRM Version	Date	Description of Change
v1.0	11/25/2013	TRM v1.0 origin
v2.0	4/18/2014	TRM v2.0 update. Low-income and hard-to-reach Market Transformation section merged with the main measure as “early retirement” option. Updated by Frontier Associates, March 2014, based on new federal standards.
v2.1	1/30/2015	TRM v2.1 update. New ENERGY STAR® standards incorporated.
v3.0	4/10/2015	TRM v3.0 update. early retirement savings may be claimed through any appropriately designed program in accordance with the EM&V team’s memo, “Considerations for early replacement of residential equipment.” Remaining useful lifetimes updated. LSAF updated to align with new peak demand methodology.
v3.1	11/05/2015	TRM v3.1 update. Correction to legacy LSAF. Revision to align with ENERGY STAR® calculator and specification.
v3.1	3/28/2016	TRM v3.1 March revision. Updated summer and winter coincidence factors.
v4.0	10/10/2016	TRM v4.0 update. Updated RUL value for units with the age of seven years and added RUL values for units with an age of one to five years. Added a default RUL value for when the age of the unit is unknown. Eliminated the eligibility requirement of the existing unit to have an age of minimum of five years.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. Updated database reference.
v7.0	10/2019	TRM v7.0 update. Established deemed savings approach.

2.5.6 ENERGY STAR® Freezers Measure Overview

TRM Measure ID: R-AP-FZ

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction, early retirement

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure applies to all ENERGY STAR® freezers that meet the criteria for the ENERGY STAR® label specified below.

Eligibility Criteria

To qualify for early retirement, the ENERGY STAR® unit must replace an existing, full-size unit with a maximum age of 27 years. To determine the remaining useful life of an existing unit, see Table 352. All retired freezers must be dismantled in an environmentally safe manner in accordance with applicable federal, state, and local regulations. The installer will provide documentation of proper disposal of freezers. In order to receive early retirement savings, the unit to be replaced must be functioning at the time of removal.

Newly-installed freezers must meet current ENERGY STAR® efficiency levels.

Baseline Condition

For new construction or replace-on-burnout, the baseline is the Department of Energy (DOE) minimum efficiency standard[360] for freezers, effective September 15, 2014.

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[360] DOE minimum efficiency standard for residential refrigerators and freezers. https://www.ecfr.gov/cgi-bin/text-idx?SID=48f64e166fe3561666f871e521996e13&mc=true&node=se10.3.430_132&rgn=div8.

For early retirement, the baseline for freezers is the annual unit energy consumption of a freezer's adjusted energy usage rating based on an average of values reported by the Midwest Energy Performance Analytics (MwEPA) Refrigerator and Freezer Energy Rating Database.[361]

Alternatively, the baseline annual energy usage of the freezer being replaced may be estimated by metering for a period of at least two hours using the measurement protocol specified in the DOE report, "Incorporating Refrigerator Replacement into the Weatherization Assistance Program."[362]

To determine annual kWh of the freezer being replaced, use the following formula:

$$Annual\ kWh\ Usage = \frac{WH \times 8{,}760}{h \times 1{,}000}$$

Equation 144

Where:

WH	=	*Watt-hours metered during a time period*
h	=	*Measurement time period (hours)*
8,760	=	*Hours in a year*
1,000 Watt-hours	=	*1 kWh*

High-efficiency Condition

Table 349 displays the ENERGY STAR® requirements for eligible freezers, which went into effect on September 15, 2014. These values are subject to updates in ENERGY STAR® specifications; energy efficiency service providers are expected to comply with the latest ENERGY STAR® requirements.

Table 349: ENERGY STAR® Specifications for Freezers[363]

ENERGY STAR® Freezer		
Product Type	**Volume**	**Criteria as of September 15, 2014**
Freezers	7.75 cubic feet or greater	Approximately 10 percent more energy efficient than the minimum federal standard (see Table 340)
Compact Freezers	Less than 7.75 cubic feet	Approximately 10 percent more energy efficient than the minimum federal standard (see Table 340)

[361] Refrigerator and Freezer Energy Rating Database. Midwest Energy Performance Analytics, Inc. in combination with the State of Wisconsin and US Department of Energy's Weatherization Assistance Program. http://www.kouba-cavallo.com/refmods.htm.

[362] Alex Moore, DandR International, Ltd. "Incorporating Refrigerator Replacement into the Weatherization Assistance Program" Information Tool Kit." Department of Energy. November 19, 2001. https://aceee.org/files/proceedings/2002/data/papers/SS02_Panel2_Paper16.pdf.

[363] https://www.energystar.gov/products/appliances/refrigerators/key_product_criteria

Table 350: Formulas to Calculate the ENERGY STAR® Criteria for Select Freezer Product Categories by Adjusted Volume[364]

Product Number	Full Product Name[365]	Product Class	Baseline Energy Usage Federal Standard (kWh/year)[366]	Average ENERGY STAR® Energy Usage (kWh/year)[367]	Adjusted Volume[368] (cubic feet)	Baseline Energy Usage (kWh/year)	ENERGY STAR® Energy Usage (kWh/year)
8	Upright freezers with manual defrost	Upright (Manual Defrost)	5.57 × AV + 193.7	5.01 × AV + 174.3	16.12	283.5	255.1
9	Upright freezers with automatic defrost without an automatic icemaker	Upright (Auto Defrost)	8.62 × AV + 228.3	7.76 × AV + 205.5	29.96	486.6	438.0
10	Chest freezers and all other freezers except compact freezers	Chest	7.29 × AV + 107.8	6.56 × AV + 97	25.25	291.8	262.6
16	Compact upright freezers with manual defrost	Compact Upright (Manual Defrost)	8.65 × AV + 225.7	7.79 × AV + 203.1	5.34	271.9	244.7
17	Compact upright freezers with automatic defrost	Compact Upright (Auto Defrost)	10.17 × AV + 351.9	9.15 × AV + 316.7	7.95	432.7	389.4
18	Compact chest freezers	Compact Chest	9.25 × AV + 136.8	8.33 × AV + 123.1	9.06	220.6	198.6

[364] Available for download at http://www.gpo.gov/fdsys/pkg/CFR-2012-title10-vol3/pdf/CFR-2012-title10-vol3-sec430-32.pdf. Select product classes excluded.

[365] Note that when calculating deemed savings for upright freezers, we calculated a weighted average of adjusted energy usage of manual versus automatic defrost upright freezers, with weights based on the number of millions-of-households which contain these types of freezers, obtained from the Residential Energy Consumption Survey, or RECS, (https://www.eia.gov/consumption/residential/data/2015/hc/php/hc3.6.php), thus eliminating this input from consideration.

[366] https://www.ecfr.gov/cgi-bin/text-idx?SID=48f64e166fe3561666f871e521996e13&mc=true&node=se10.3.430_132&rgn=div8

[367] Approximately 10 percent more efficient than baseline, as specified in the ENERGY STAR® Appliance Savings Calculator (updated September 2015). http://www.energystar.gov/sites/default/files/asset/document/appliance_calculator.xlsx.

[368] AV is calculated as a simple average per selected freezer product type in the corresponding Product Class utilizing data provided by https://www.energystar.gov/productfinder/product/certified-residential-freezers/results

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

New Construction or Replace-on-burnout

Energy Savings Algorithms

$$kWh_{savings} = kWh_{baseline} - kWh_{ES}$$

Equation 145

Where:

$kWh_{baseline}$	=	*Federal standard baseline energy usage (see* Table 350*)*
kWh_{ES}	=	*ENERGY STAR® average energy usage (see* Table 350*)*

Demand Savings Algorithms

$$kW_{savings} = \frac{kWh_{savings}}{8{,}760\ hrs} \times LSAF$$

Equation 146

Where:

LSAF	=	*Load Shape Adjustment Factor (see* Table 351*)*

Table 351: ENERGY STAR® Freezer Load Shape Adjustment Factors[369]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	1.112	1.099	1.108	1.100	1.081
Winter	0.929	0.966	0.924	0.941	0.966

Early Retirement

Annual energy (kWh) and peak demand (kW) savings must be calculated separately for two time periods:

1. The estimated remaining life of the equipment that is being removed, designated the remaining useful life (RUL), and
2. The remaining time in the EUL period (22—RUL)

[369] See Volume 1, Appendix B.

Annual energy and peak demand savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

Where:

RUL = *Remaining useful life (see* Table 350*); if unknown, assume the age of the replaced unit is equal to the EUL resulting in a default RUL of 5.0 years.*

EUL = *Estimated useful life = 22 years*

Table 352: Remaining Useful Life (RUL) of Replaced Freezer

Age of Replaced Freezer (years)	RUL (years)	Age of Replaced Freezer (years)	RUL (years)	Age of Replaced Freezer (years)	RUL (years)
1	20.7	10	12.1	19	6.6
2	19.7	11	11.3	20	6.2
3	18.7	12	10.6	21	5.9
4	17.7	13	9.9	22	5.0
5	16.7	14	9.2	23	4.0
6	15.7	15	8.6	24	3.0
7	14.8	16	8.1	25	2.0
8	13.8	17	7.5	26	1.0
9	13.0	18	7.1	27[370,371]	0.0

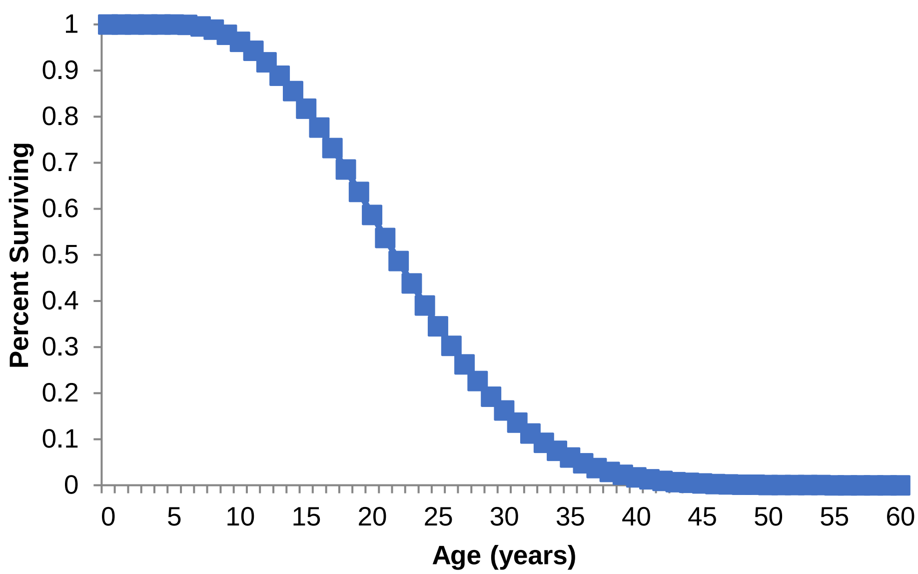
Derivation of RULs

ENERGY STAR® freezers have an estimated useful life of 22 years. This estimate is consistent with the age at which approximately 50 percent of the freezers installed in a given year will no longer be in service, as described by the survival function in Figure 12.

370 RULs are capped at the 75th percentile of equipment age, 27 years, as determined based on DOE survival curves (see Figure 12). Systems older than 27 years should use the ROB baseline. See the January 2015 memo, “Considerations for early replacement of residential equipment,” for further detail.

371 Ward, B., Bodington, N., Farah, H., Reeves, S., and Lee, L. “Considerations for early replacement of residential equipment.” Prepared by the Evaluation, Measurement, and Verification (EM&V) team for the Electric Utility Marketing Managers of Texas (EUMMOT). January 2015. This document has been made available to all Texas investor-owned utilities through the EM&V team’s SharePoint.

Figure 13: Survival Function for ENERGY STAR® Freezers[372]



The method for estimating the remaining useful life (RUL) of a replaced system uses the age of the existing system to re-estimate the projected unit lifetime based on the survival function shown in Figure 12. The age of the freezer being replaced is found on the horizontal axis, and the corresponding percentage of surviving freezers is determined from the chart. The surviving percentage value is then divided in half, creating a new estimated useful lifetime applicable to the current unit age. Then, the age (year) that corresponds to this new percentage is read from the chart. RUL is estimated as the difference between that age and the current age of the system being replaced.

For example, assume a freezer being replaced is 22 years old (the estimated useful life). The corresponding percent surviving value is approximately 50 percent. Half of 50 percent is 25 percent. The age corresponding to 25 percent on the chart is approximately 27 years. Therefore, the RUL of the freezer being replaced is 27-22 = 5 years.

Energy Savings Algorithms

For the RUL time period:

$$kWh_{savings,ER} = kWh_{manf} - kWh_{ES}$$

Equation 147

For the remaining time in the EUL period., calculate annual savings as you would for a replace-on-burnout project:

[372] Department of Energy, Federal Register, 76 Final Rule 57516, Technical Support Document: 8.2.3.1 Estimated Survival Function. September 15, 2011. http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrig_finalrule_tsd.pdf.

$$kWh_{savings,ROB} = kWh_{baseline} - kWh_{ES}$$

Equation 148

Where:

kWh_{manf} = *841 kWh/Year*[373]

$kWh_{baseline}$ = *Federal standard baseline energy usage (see* Table 350*)*

kWh_{ES} = *ENERGY STAR® average energy usage (see* Table 350*)*

Demand Savings Algorithms

To calculate demand savings for the early retirement of a freezer, a similar methodology is used as for replace-on-burnout installations, with separate savings calculated for the remaining useful life of the unit, and the remainder of the EUL as outlined in the section above.

For the RUL time period:

$$kW_{savings,ER} = \frac{kWh_{savings,ER}}{8{,}760\ hrs} \times LSAF$$

Equation 149

For The remaining time in the EUL period., calculate annual savings as you would for a replace-on-burnout project:

$$kW_{savings,ROB} = \frac{kWh_{savings,ROB}}{8{,}760\ hrs} \times LSAF$$

Equation 150

Where:

LSAF = *Load shape adjustment factor (*Table 351

Annual deemed summer peak demand savings are calculated by weighting the early retirement and replace-on-burnout savings by the RUL of the unit and the remainder of the EUL period, as outlined in the Volume 3 appendices.

[373] This is the weighted average of adjusted annual unit energy consumption, a metric obtained from the MwEPA Refrigerator and Freezer Energy Rating Database (if from metering, substitute recorded value in lieu of this weighted average). Weights are calculated from the millions-of-households measurements obtained from RECS, (https://www.eia.gov/consumption/residential/data/2015/hc/php/hc3.6.php) corresponding to the year range classifications of freezers greater than 15 years old (specifically, 15-to-19-years-old and 20-or-more-years-old). The oldest freezers for which we had data were from 1979.

Where:

RUL = *Remaining Useful Life (see Table 342)*

EUL = *Estimated Useful Life = 22 years*[374]

Deemed Energy Savings Tables

Table 353: ENERGY STAR® Freezers Energy Savings (kWh) by Freezer Type

Freezer Type	Size	ROB Savings (kWh/year)	ER Savings (kWh/year)
Chest	Standard (≥ 7.75 ft^3)	29	154
	Compact (< 7.75 ft^3)	22	163
Upright	Standard (≥ 7.75 ft^3)	48	130
	Compact (< 7.75 ft^3)	32	151

[374] Department of Energy, Federal Register, 76 Final Rule 57516, Technical Support Document: 8.2.3.1 Estimated Survival Function. September 15, 2011. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0012-0128.

Deemed Summer Demand Savings Tables

Table 354: ENERGY STAR® Freezers Replace-on-burnout Summer Demand Savings (kW) by Freezer Type

Freezer Type	Product Class	Replace-on-burnout Savings (kW – Summer)				
		Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Chest	Standard (≥ 7.75 ft^3)	0.004	0.004	0.004	0.004	0.004
	Compact (< 7.75 ft^3)	0.003	0.003	0.003	0.003	0.003
Upright	Standard (≥ 7.75 ft^3)	0.006	0.006	0.006	0.006	0.006
	Compact (< 7.75 ft^3)	0.004	0.004	0.004	0.004	0.004

Table 355: ENERGY STAR® Freezers Early Retirement Summer Demand Savings (kW) by Freezer Type

Freezer Type	Product Class	Early-Retirement Savings (kW – Summer)				
		Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Chest	Standard (≥ 7.75 ft^3)	0.020	0.019	0.019	0.019	0.019
	Compact (< 7.75 ft^3)	0.021	0.020	0.021	0.020	0.020
Upright	Standard (≥ 7.75 ft^3)	0.017	0.016	0.016	0.016	0.016
	Compact (< 7.75 ft^3)	0.019	0.019	0.019	0.019	0.019

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on summer peak demand savings and methodology.

Deemed Winter Demand Savings Tables

Table 356: ENERGY STAR® Freezers Replace-on-burnout Winter Demand Savings (kW) by Freezer Type

Freezer Type	Product Class	Replace-on-burnout Savings (kW – Winter)				
		Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Chest	Standard (≥ 7.75 ft^3)	0.003	0.003	0.003	0.003	0.003
	Compact (< 7.75 ft^3)	0.002	0.002	0.002	0.002	0.002
Upright	Standard (≥ 7.75 ft^3)	0.005	0.005	0.005	0.005	0.005
	Compact (< 7.75 ft^3)	0.003	0.003	0.003	0.003	0.003

Table 357: ENERGY STAR® Freezers Early Retirement Winter Demand Savings (kW) by Freezer Type

Freezer Type	Product Class	Early-Retirement Savings (kW – Winter)				
		Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Chest	Standard (≥ 7.75 ft^3)	0.016	0.017	0.016	0.017	0.017
	Compact (< 7.75 ft^3)	0.017	0.018	0.017	0.018	0.018
Upright	Standard (≥ 7.75 ft^3)	0.014	0.014	0.014	0.014	0.014
	Compact (< 7.75 ft^3)	0.016	0.017	0.016	0.016	0.017

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on winter peak demand savings and methodology.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is established at 22 years based on the current DOE Final Rule standards for residential freezers.[375]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of units installed
- The project type of the installation (new construction, replace-on-burnout, or early retirement)
- Installed freezer type (upright or chest)
- Installed freezer size (standard, i.e. ≥ 7.75 ft^3, or compact, i.e. < 7.75 ft^3)
- Photograph demonstrating functionality of existing equipment and/or customer responses to survey questionnaire documenting the condition of the replaced unit and their motivation for measure replacement for early retirement eligibility determination (early retirement only)
- The installer will provide documentation of proper disposal of freezers in accordance with applicable federal, state, and local regulations. (early retirement only)

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

[375] Final Rule: Standards, Federal Register, 76 FR 57516 (Sept. 15, 2011) and associated Technical Support Document. Accessed 09/03/2019. https://www.ecfr.gov/cgi-bin/text-idx?SID=48f64e166fe3561666f871e521996e13&mc=true&node=se10.3.430_132&rgn=div8. Download TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0012-0128.

Relevant Standards and Reference Sources

The applicable version of the ENERGY STAR® specifications and requirements for freezers.

Document Revision History

Table 358: Residential ENERGY STAR® Clothes Dryers Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

2.5.7 ENERGY STAR® Pool Pumps Measure Overview

TRM Measure ID: R-AP-PP

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction, early retirement

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure involves the replacement of a single-speed pool pump with an ENERGY STAR® certified variable-speed or multi-speed pool pump.

Eligibility Criteria

This measure applies to all residential applications of in-ground pools or above-ground pools. Pools that serve multiple tenants in a common area are not eligible for this measure. Ineligible pump products include waterfall, integral cartridge filter, integral sand filter, storable electric spa, and rigid electric spa[376].

Multi-speed pool pumps are an alternative to variable speed pumps. The multi-speed pump uses an induction motor that functions as two motors in one, with full-speed and half-speed options. Multi-speed pumps may enable significant energy savings. However, if the half-speed motor is unable to complete the required water circulation task, the larger motor will operate exclusively. Having only two speed-choices limits the ability of the pump motor to fine-tune the flow rates required for maximum energy savings.[377] Therefore, multi-speed pumps must have a high-speed override capability to revert back to low speed after a period not to exceed 24 hours.

[376] These product types are excluded by the ENERGY STAR® specifications.

[377] Hunt, A. and Easley, S., 2012, "*Measure Guideline: Replacing Single-Speed Pool Pumps with Variable Speed Pumps for Energy Savings.*" Building America Retrofit Alliance (BARA), U.S. U.S. DOE. May/. http://www.nrel.gov/docs/fy12osti/54242.pdf.

Baseline Condition

The baseline condition is a 1 to 3 horsepower (hp) standard efficiency single-speed pool pump.

High-efficiency Condition

The high-efficiency condition is a 1 to 3 hp ENERGY STAR® certified variable speed pump (VSP) or ENERGY STAR® certified multi-speed pool pump.

Energy and Demand Savings Methodology

Savings for this measure are based on methods and input assumptions from the ENERGY STAR® Pool Pump Savings Calculator. ENERGY STAR® has not published updates to the calculator for version 2.0, and therefore, the deemed input assumptions that follow are based on certification version 1.0. This measure will be updated when the ENERGY STAR® Pool Pump Savings Calculator is updated to version 2.0.

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings for this measure were derived using the ENERGY STAR® Pool Pump Savings Calculator with Texas selected as the applicable location, so Texas-specific assumptions were used.[378]

$$kWh_{Savings} = kWh_{conv} - kWh_{ES}$$

Equation 151

Where:

kWh_{conv}= Conventional single-speed pool pump energy (kWh)

kWh_{ES}= ENERGY STAR® variable speed pool pump energy (kWh)

Algorithms to calculate the above parameters are defined as:

$$kWh_{conv} = \frac{PFR_{conv} \times 60 \times hours_{conv} \times days}{EF_{conv} \times 1000}$$

Equation 152

$$kWh_{ES} = kWh_{HS} + kWh_{LS}$$

Equation 153

$$kWh_{HS} = \frac{PFR_{HS} \times 60 \times hours_{HS} \times days}{EF_{HS} \times 1000}$$

[378] The ENERGY STAR® Pool Pump Savings Calculator, updated February 2013, can be found on the ENERGY STAR® website at: https://www.energystar.gov/products/certified-products/detail/pool-pumps.

Equation 154

$$kWh_{LS} = \frac{PFR_{LS} \times 60 \times hours_{LS} \times days}{EF_{LS} \times 1000}$$

Equation 155

Where:

kWh_{HS}	=	*ENERGY STAR® variable speed pool pump energy at high speed [kWh]*
kWh_{LS}	=	*ENERGY STAR® variable speed pool pump energy at low speed [kWh]*
$hours_{conv}$	=	*Conventional single-speed pump daily operating hours (Table 359)*
$hours_{HS}$	=	*ENERGY STAR® variable speed pump high speed daily operating hours (Table 360)*
$hours_{LS}$	=	*ENERGY STAR® variable speed pump low speed daily operating hours (Table 360)*
days	=	*Operating days per year = 365 days (default)*
PFRconv	=	*Conventional single-speed pump flow rate [gal/min] (Table 359)*
PFR_{HS}	=	*ENERGY STAR® variable speed pump high speed flow rate [gal/min] (Table 360)*
PFR_{LS}	=	*ENERGY STAR® variable speed pump low speed flow rate [gal/min] (Table 360)*
EFconv	=	*Conventional single-speed pump energy factor [gal/W·hr] (Table 359)*
EF_{HS}	=	*ENERGY STAR® variable speed pump high speed energy factor [gal/W·hr] (Table 360)*
EF_{LS}	=	*ENERGY STAR® variable speed pump low speed energy factor [gal/W·hr] (Table 360)*
60	=	*Constant to convert between minutes and hours*
1,000	=	*Constant to convert from kilowatts to watts*

Table 359: Conventional Pool Pumps Assumptions[379]

Rated Pump HP (New)	$Hours^{380}_{conv}$	PFR_{conv}(gal/min)	EF_{conv} (gal/W·h)
≤ 1.25	9.1062	60.0631	2.3964
1.25 < hp ≤ 1.75		64.3846	2.0885
1.75 < hp ≤ 2.25		65.4375	1.9451
2.25 < hp ≤ 2.75		68.4000	1.8805
2.75 < hp ≤ 3		73.1111	1.6453

Table 360: ENERGY STAR® Pool Pumps Assumptions[381,382]

Rated Pump HP (New)	$Hours_{LS}$	$Hours_{HS}$	PFR_{HS} (gal/min)	EF_{HS} (gal/W·h)	PFR_{LS} (gal/min)	EF_{LS} (gal/W·h)
≤ 1.25	9.7	4.3	56.0	2.398	31.0	5.407
1.25 < hp ≤ 1.75			61.0	2.267	31.9	5.433
1.75 < hp ≤ 2.25			66.4	1.954	33.0	5.221
2.25 < hp ≤ 2.75			66.0	2.024	34.0	4.796
2.75 < hp ≤ 3			74.0	1.617	37.0	4.764

Demand Savings Algorithms

$$kW_{Savings} = \left[\frac{kWh_{conv}}{hours_{conv}} - \left(\frac{kWh_{HS} + kWh_{LS}}{hours_{HS} + hours_{LS}}\right)\right] \times \frac{DF}{days}$$

Equation 156

Where:

kWh_{conv} = *Conventional single-speed pool pump energy (kWh)*

$hours_{conv}$ = *Conventional single-speed pump daily operating hours (Table 360)*

kWh_{HS} = *ENERGY STAR® variable speed pool pump energy at high speed [kWh]*

kWh_{LS} = *ENERGY STAR® variable speed pool pump energy at low speed [kWh]*

379 Conventional pump PFR and EF values are taken from pump curves found in the ENERGY STAR® Pool Pump Savings Calculator.

380 The daily average operating hours for conventional single-speed pumps, based on 2014 residential pool pump program survey results from CenterPoint Energy.

381 ENERGY STAR® PFR and EF values are taken from pump curves found in the ENERGY STAR® Pool Pump Savings Calculator.

382 The daily average operating hours for low and high VSP settings, based on 2016 residential pool pump program data from CenterPoint Energy.

$hours_{HS}$	=	*ENERGY STAR® variable speed pump high speed daily operating hours (Table 360)*
$hours_{LS}$	=	*ENERGY STAR® variable speed pump low speed daily operating hours (Table 360)*
DF	=	*Demand Factor (Table 361)*
days	=	*Operating days per year = 365 days (default)*

Table 361: Demand Factors

Climate Zone	Summer DF	Winter DF
1	0.258	-0.002
2	0.329	0.025
3	0.276	0.108
4	0.266	0.036
5	0.497	-0.143

Deemed Energy Savings Tables

Table 362: ENERGY STAR® Variable Speed Pool Pump Energy Savings[383]

Rated Pump hp (New)	kWh Savings
≤ 1.25	1,581
1.25 < hp ≤ 1.75	2,367
1.75 < hp ≤ 2.25	2,166
2.25 < hp ≤ 2.75	2,677
2.75 < hp ≤ 3	2,902

Deemed Summer Demand Savings Tables[384]

Table 363: ENERGY STAR® Variable Speed Pool Pump Summer Demand Savings

Rated Pump HP (New)	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
≤ 1.25	0.216	0.275	0.231	0.222	0.415
1.25 < hp ≤ 1.75	0.287	0.365	0.307	0.295	0.552
1.75 < hp ≤ 2.25	0.292	0.371	0.312	0.300	0.562
2.25 < hp ≤ 2.75	0.333	0.423	0.356	0.342	0.640

[383] The results in this table may vary slightly from results produced by the ENERGY STAR® calculator because of rounding of default savings coefficients throughout the measure and pool volume.
[384] Ibid.

Rated Pump HP (New)	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
2.75 < hp ≤ 3	0.388	0.493	0.414	0.399	0.746

Deemed Winter Demand Savings Tables

Table 364: ENERGY STAR® Variable Speed Pool Pump Winter Demand Savings

Rated Pump HP (New)	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
≤ 1.25	-0.001	0.021	0.091	0.030	(0.119)
1.25 < hp ≤ 1.75	-0.002	0.028	0.120	0.040	(0.159)
1.75 < hp ≤ 2.25	-0.002	0.028	0.122	0.040	(0.161)
2.25 < hp ≤ 2.75	-0.002	0.032	0.140	0.046	(0.184)
2.75 < hp ≤ 3	-0.002	0.037	0.163	0.054	(0.214)

Claimed Peak Demand Savings

Table 365: ENERGY STAR® Variable Speed Pool Pump Claimed Demand Savings

Rated Pump HP (New)	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
≤ 1.25	0.216	0.275	0.231	0.222	0.415
1.25 < hp ≤ 1.75	0.287	0.365	0.307	0.295	0.552
1.75 < hp ≤ 2.25	0.292	0.371	0.312	0.300	0.562
2.25 < hp ≤ 2.75	0.333	0.423	0.356	0.342	0.640
2.75 < hp ≤ 3	0.388	0.493	0.414	0.399	0.746

Additional Calculators and Tools

ENERGY STAR® Pool Pump Savings Calculator, updated February 2013, can be found on the ENERGY STAR® website at https://www.energystar.gov/products/certified-products/detail/pool-pumps.

Measure Life and Lifetime Savings

According to DEER 2014, the estimated useful life for this measure is 10 years.[385]

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

[385] Database for Energy Efficient Resources (2014). http://www.deeresources.com/.

For all projects

- Rated horsepower of new pool pump
- Climate zone
- Proof of purchase – with date of purchase and quantity
    - Alternative: photo of unit installed or other pre-approved method of installation verification
- Make and model information

For a significant sample of projects where attainable (e.g., those projects that are selected for inspection, not midstream or retail programs):

- Items listed for all projects above
- Decision/action type: early retirement, replace-on-burnout, or new construction
- Rated horsepower of existing pool pump
- Existing and new pool pump operating hours

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- The applicable version of the ENERGY STAR® specifications and requirements for pool pumps.
- Document Revision History

Table 366: Residential ENERGY STAR® Pool Pumps Revision History

TRM Version	Date	Description of Change
v5.0	10/2017	TRM v5.0 origin.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. Updated eligibility to include above ground pool pumps now eligible for ENERGY STAR® certification. Acknowledged the forthcoming ENERGY STAR® version 2.0.

2.5.8 ENERGY STAR® Air Purifiers Measure Overview

TRM Measure ID: R-AP-AP

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Replace-on-burnout, new construction

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This document presents the accepted deemed savings awarded for the installation of an ENERGY STAR® air purifier. Savings are awarded at a flat per-unit rate, both for energy and demand savings. This measure will apply to existing homes and new construction.

Eligibility Criteria

This measure applies to floor, tabletop, and wall-mounted air purifiers/room air cleaners.

Baseline Condition

The baseline condition is defined as 1.0 cfm/W for a conventional air purifier unit's efficiency, a value from EPA research conducted in 2011, as cited in the ENERGY STAR® Appliance Savings Calculator[386].

High-efficiency Condition

The following table displays the ENERGY STAR® Final Version 1.2 requirements for eligible air purifiers effective July 1, 2004.[387] These values are subject to updates in ENERGY STAR®

[386] ENERGY STAR® Appliance Savings Calculator (updated October 2016). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products.

[387] Available for download at: https://www.energystar.gov/ia/partners/prod_development/revisions/downloads/room_aircleaners/Room_Air_Cleaners_Final_V1.2_Specification.pdf?6ec0-9f1a.

specifications; energy efficiency service providers are expected to comply with the latest ENERGY STAR® requirements.

Table 367 ENERGY STAR® Specifications for Air Purifiers

Product Type	Clean Air Delivery Rate (CADR)	Minimum Performance Requirement	Standby Power Requirement	Ozone Production
Air Purifiers or Room Air Cleaners	≥ 50 cu ft/min	2.0 cfm/watt	2.0 W	≤ 50 ppb

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings Algorithms

Energy savings for this measure were derived using the ENERGY STAR® Appliance Savings Calculator and the revised ENERGY STAR® specification in Table 333.[388] Default values were taken directly from the ENERGY STAR® calculator. This document will be updated regularly to apply the values provided in the latest available ENERGY STAR® specification and appliance calculator. The most recent TRM version should be referenced to determine measure savings for this measure.

$$kWh_{savings} = (kWh_{baseline,OP} + kWh_{baseline,SB}) - (kWh_{ES,OP} + kWh_{ES,SB})$$

Equation 157

$$kWh_{baseline,OP} = \left(\frac{CADR_{baseline}}{Eff_{baseline}}\right)/1000 \times Hours_{OP} \times Days_{OP}$$

Equation 158

$$kWh_{baseline,SB} = (8760 - Hours_{OP} \times Days_{OP}) \times W_{baseline,SB}/1000$$

Equation 159

$$kWh_{ES,OP} = \left(\frac{CADR_{ES}}{Eff_{ES}}\right)/1000 \times Hours_{OP} \times Days_{OP}$$

Equation 160

$kWhES,SB$= 8760−$HoursOP$×$DaysOP$×WES,SB/1000

Equation 161

Where:

Quantitative definitions of product criteria: https://www.energystar.gov/products/appliances/air_purifiers_cleaners/key_product_criteria

[388] ENERGY STAR® Appliance Savings Calculator (updated October 2016). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products.

$kWh_{baseline,OP}$ = *Baseline/conventional operating energy usage*

$kWh_{baseline,SB}$ = *Baseline/conventional standby energy usage*

$kWh_{ES,OP}$ = *ENERGY STAR® average operating energy usage*

$kWh_{ES,SB}$ = *ENERGY STAR® average standby energy usage*

$CADR_{baseline}$ = *Baseline unit clean air delivery rate (cu ft/min)*

$CADR_{ES}$ = *ENERGY STAR® unit clean air delivery rate (cu ft/min)*

$Eff_{baseline}$ = *Baseline clean air delivery efficiency = 1.0 cfm/watt*

Eff_{ES} = *ENERGY STAR® air delivery efficiency = 3.0 cfm/watt*

$Hours_{OP}$ = *Average hours of operation per day = 16*

$Days_{OP}$ = *Average days of operation per year = 365*

$W_{baseline,SB}$ = *Conventional model standby power = 1.0 watt*

$W_{ES,SB}$ = *ENERGY STAR® model standby power = 0.6 watts*

8760 = *Total hours per year*

Demand Savings Algorithms

$$kW_{savings} = \frac{kWh_{savings}}{Hours_{OP} \times Days_{OP}} \times CF$$

Equation 162

Where:

$Hours_{OP}$ = *Average hours of operation per day = 16*

$Days_{OP}$ = *Average days of operation per year = 365*

CF = *Coincidence factor = (*Table 368*)*

Table 368: ENERGY STAR® Air Purifiers Coincidence Factors[389]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.636	0.617	0.631	0.620	0.564
Winter	0.882	0.907	0.829	0.876	0.926

Deemed Energy Savings Tables

Table 369: ENERGY STAR® Air Purifiers Energy Savings (kWh)

ENERGY STAR® Air Purifiers—Energy Savings (kWh)		
Dust CADR Range (cu ft/min)	Dust CADR Midpoint	Energy Savings
51-100	75	293
101-150	125	488
151-200	175	683
201-250	225	877
> 250	275	1,072

389 See Volume 1, Appendix B.

Deemed Summer Demand Savings Tables

Table 370: ENERGY STAR® Air Purifiers Summer Peak Demand Savings (kW)

ENERGY STAR® Air Purifiers — Summer Demand Savings (kW)					
CADR Range (cu ft/min)	**Climate Zone 1: Amarillo**	**Climate Zone 2: Dallas**	**Climate Zone 3: Houston**	**Climate Zone 4: Corpus Christi**	**Climate Zone 5: El Paso**
51-100	0.03	0.03	0.03	0.03	0.03
101-150	0.05	0.05	0.05	0.05	0.05
151-200	0.07	0.07	0.07	0.07	0.07
201-250	0.10	0.09	0.09	0.09	0.08
> 250	0.12	0.11	0.12	0.11	0.10

Deemed Winter Demand Savings Tables

Table 371: ENERGY STAR® Air Purifiers Winter Peak Demand Savings (kW)

ENERGY STAR® Air Purifiers — Winter Demand Savings (kW)					
CADR Range (cu ft/min)	**Climate Zone 1: Amarillo**	**Climate Zone 2: Dallas**	**Climate Zone 3: Houston**	**Climate Zone 4: Corpus Christi**	**Climate Zone 5: El Paso**
51-100	0.04	0.05	0.04	0.04	0.05
101-150	0.07	0.08	0.07	0.07	0.08
151-200	0.10	0.11	0.10	0.10	0.11
201-250	0.13	0.14	0.12	0.13	0.14
> 250	0.16	0.17	0.15	0.16	0.17

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is established at 9 years; a figure cited as obtained from the Appliance Magazine's Portrait of the U.S. Appliance Industry, 1998 on the ENERGY STAR® Appliance Savings Calculator[390].

[390] ENERGY STAR® Appliance Savings Calculator (updated October 2016). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of units installed
- Clean air delivery rate (CADR) in cu ft/min (cfm)
- Proof of purchase – including date of purchase and quantity
  - Alternative: photo of unit installed or another pre-approved method of installation verification.

References and Efficiency Standards

Petitions and Rulings

This section is not applicable.

Relevant Standards and Reference Sources

- The applicable version of the ENERGY STAR® specifications and requirements for air purifiers.

Document Revision History

Table 372: Residential ENERGY STAR® Air Purifiers Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

2.5.9 Advanced Power Strips Measure Overview

TRM Measure ID: R-AP-APS

Market Sector: Residential

Measure Category: Appliances

Applicable Building Types: Single-family, duplex, and triplex; Multifamily; Manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Retrofit

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings values

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure involves the installation of a multi-plug advanced power strip (APS) with the ability to automatically disconnect specific loads depending on the power draw of a specified, or "master," load.

For a Tier 1 APS, a load sensor in the strip disconnects power from the control outlets when the master power draw is below a certain threshold. This feature allows for a reduction of power draw from peripheral consumer electronics, which usually maintain some load even when in the off or standby position. Therefore, when the master device (e.g., television) is turned off, the power supply is cut to other related equipment (e.g., set-top boxes, speakers, video game consoles).

A Tier 2 APS uses an external sensor paired with a configurable countdown timer to manage both active and standby power loads for controlled devices in a complete system. A Tier 2 APS may operate either with or without a master control socket. Those without a master control socket sense power of all devices connected to the controlled sockets, while those with a master control socket sense power for the device connected to the master control socket. The external sensor of a Tier 2 APS may use an infrared-only sensor, or it may use a "multi-sensor," which detects both infrared (IR) remote control signals and motion to determine device inactivity and deliver additional savings as compared to a Tier 1 APS. Both versions of external sensors use IR filtering to prevent inappropriate switching events that may have otherwise resulted from natural interference, such as sunlight or CFL light bulbs.

Eligibility Criteria

This measure applies to all residential applications. For Tier 2 applications, the APS must control at least two audiovisual devices.

Baseline Condition

The baseline condition is assumed to be uncontrolled peripheral loads, each plugged into a traditional surge protector or wall outlet.

High-efficiency Condition

The high-efficiency condition is peripheral loads controlled by a Tier 1 or Tier 2 APS.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Savings were developed based on reported plug load electricity consumption and hourly use data. A set of home entertainment and home office peripheral equipment and related performance data are presented in the following table. “Daily Standby Hours” and “Daily Off Hours” represent the average number of hours the device is left in standby or off mode. For each device, a weighted watt per hour value is calculated based on projected watts consumed in either mode.

There are three savings paths available for Tier 1. Savings can be estimated by:

1. Complete system type (home entertainment or home office)
2. Per APS for an average complete system if the type is unknown
3. Per individual peripheral device

Tier 2 savings are determined using the average component uses for a complete system and an energy reduction percentage.

Table 373: APS – Peripheral Watt Consumption Breakdown[391]

System Type	Peripheral Device	Daily Standby Hours	Daily Off Hours	Standby Power (W)	Off Power (W)	Weighted W/hr	Annual APS Hours
Home Entertainment	Audio Equipment: AV Receiver	0.0	18.0	19.2	3.1	3.1	6,570
	Audio Equipment: Speakers	0.0	18.0	3.0	0.0	0.0	6,570
	Audio Equipment: Subwoofer	0.0	18.0	7.8	0.6	0.6	6,570
	Media Player: BluRay	2.5	20.8	7.0	0.1	0.8	8,505
	Media Player: DVD	2.5	20.8	5.0	2.0	2.3	8,505
	Media Player: DVD-R	2.5	20.8	7.0	3.0	3.4	8,505
	Media Player: DVD/VCR	2.5	20.4	8.0	4.0	4.4	8,359
	Media Player: VCR	2.2	21.4	6.0	3.0	3.3	8,614
	Set-Top Box: Cable	0.0	16.5	25.0	16.0	16.0	6,023
	Set-Top Box: Cable with DVR	0.0	16.5	45.0	43.0	43.0	6,023
	Set-Top Box: Satellite	0.0	15.1	10.0	15.0	15.0	5,512
	Set-Top Box: Satellite with DVR	0.0	15.1	27.0	28.0	28.0	5,512
	Set-Top Box: Stand Alone DVR	0.0	18.3	27.0	27.0	27.0	6,680
	Television: CRT	0.0	18.7	5.3	1.6	1.6	6,826
	Television: LCD	0.0	18.7	2.2	0.5	0.5	6,826
	Television: Plasma	0.0	18.7	0.9	0.6	0.6	6,826
	Television: Projection	0.0	18.7	4.4	7.0	7.0	6,826
	Video Game Console: Nintendo Wii	1.5	21.4	10.5	1.9	2.5	8,359
	Video Game Console: Wii U	1.5	21.4	34.0	0.4	2.6	8,359

[391] Derived from New York State Energy Research and Development Authority (NYSERDA), “Advanced Power Strip Research Report”. August 2011.

System Type	Peripheral Device	Daily Standby Hours	Daily Off Hours	Standby Power (W)	Off Power (W)	Weighted W/hr	Annual APS Hours
	Video Game Console: Playstation 2	1.5	21.4	17.0	0.2	1.3	8,359
	Video Game Console: Playstation 3	1.5	21.4	152.9	1.1	11.0	8,359
	Video Game Console: Playstation 4	1.5	21.4	137.0	6.4	14.9	8,359
	Video Game Console: XBOX	1.5	21.4	68.0	2.0	6.3	8,359
	Video Game Console: XBOX 360	1.5	21.4	117.5	3.1	10.6	8,359
	Video Game Console: XBOX One	1.5	21.4	112.0	11.9	18.4	8,359
Home Office	Computer: Desktop	4.1	16.7	11.6	3.3	4.9	7,592
	Computer: Laptop	4.1	16.7	7.6	4.4	5.0	7,592
	Computer Monitor: CRT	2.4	16.5	7.6	1.5	2.3	6,899
	Computer Monitor: LCD	2.4	16.5	1.9	1.1	1.2	6,899
	Computer Speakers	0.0	18.7	3.7	2.3	2.3	6,826
	Copier	0.0	23.5	2.8	1.5	1.5	8,578
	Fax Machine: Inkjet	0.5	23.3	6.0	5.3	5.3	8,687
	Fax Machine: Laser	0.5	23.3	5.3	2.2	2.3	8,687
	Printer: Inkjet	4.4	19.5	2.5	1.3	1.5	8,724
	Printer: Laser	4.4	19.5	9.0	3.3	4.3	8,724
	Scanner	0.0	23.5	3.6	2.1	2.1	8,578

Energy Savings

Tier 1 APS

Energy savings for a Tier 1 APS in use for home entertainment or home office are calculated using the following algorithm, where kWh saved is calculated and summed for all peripheral devices.

$$\Delta kWh = \sum \frac{W_i \times H_i}{1{,}000}$$

Equation 163

Where:

W	=	*Weighted watts per hour consumed in standby/off mode for each peripheral device (see* Table 373*)*
H	=	*Annual hours per year controlled by APS (see* Table 373*)*
$1{,}000$	=	*Constant to convert from watts to kilowatts*

Tier 2 APS

Energy savings for a Tier 2 APS are calculated using the average household home entertainment and home office usages, multiplied by an assumed energy reduction percentage.

$$\Delta kWh_{Home\ Entertainment} = kWh_{TV} \times ERP \times ISR$$

Equation 164

$$\Delta kWh_{Home\ Office} = kWh_{Comp} \times ERP \times ISR$$

Equation 165

$$\Delta kWh_{Unspecified} = \frac{kWh_{TV} + kWh_{Comp}}{2} \times ERP \times ISR$$

Equation 166

Where:

kWh_{TV}	=	*Average annual energy consumption of Tier 2 qualifying TV systems; default = 602.8 kWh*[392]
kWh_{Comp}	=	*Average annual energy consumption of Tier 2 qualifying computer systems; default = 197.9 kWh*[393]

[392] New York State Energy Research and Development Authority (NYSERDA), "Advanced Power Strip Research Report". August 2011. Page 30.

[393] New York State Energy Research and Development Authority (NYSERDA), "Advanced Power Strip Research Report". August 2011. Page 30.

ERP	=	*Energy reduction percentage (default = 47.5%[394])*
ISR	=	*In-service rate or the percentage of units rebated that are installed; default = 1.0*

Demand Savings

Tier 1 and Tier 2 APS

Demand savings for a Tier 1 APS in use for a home entertainment system or home office are calculated using the following algorithm, where kWh saved is calculated and summed for all peripheral devices. Demand savings for a Tier 2 APS are calculated using the average household home office and home entertainment center usages, multiplied by an assumed energy reduction percentage.

$$\Delta kW = \sum \frac{\Delta kWh}{H} \times CF$$

Equation 167

Where:

ΔkWh	=	*Annual kWh energy savings calculated as defined above*
H	=	*Annual hours per year controlled by APS (see* Table 373 *for Tier 1 APS; assume 4,380 for Tier 2 APS[395])*
CF	=	*Coincidence Factor (see* Table 374*)[396]*

Table 374: APS – Coincidence Factors[397]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	0.33	0.43	0.36	0.30	0.66
Winter	0.88	0.87	0.85	0.84	0.86

394 Average of ERP from Northeast Energy Efficiency Partnerships (NEEP), "Case Study: Tier 2 Advanced Power Strips and Efficiency Programs". April 2015.

395 Estimated based on assumption that approximately half of savings are during active hours (assumed to be 5.3 hours/day, or 1,936 hours/year) and half during standby hours (8,760-1,936 = 6,824 hours/year). The resulting weighted average is 4,380 hours/year.

396 Derived using Electric Power Research Institute (EPRI) End Use Load Shapes for Residential TV and PC. Accessed 9/19/2018. http://loadshape.epri.com/enduse

397 See Volume 1, Appendix B.

Deemed Energy Savings Tables

Refer to Table 375 and Table 376.

Deemed Summer Demand Savings Tables

Refer to Table 375 and Table 376.

Table 375: APS – Deemed Savings for Tier 1 Residential APS

System Type	Peripheral Device	kWh Savings	Summer kW Savings					Winter kW Savings				
			Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Home Entertainment	Audio Equipment: AV Receiver	20.4	0.0010	0.0013	0.0011	0.0009	0.0020	0.0027	0.0027	0.0026	0.0026	0.0027
	Audio Equipment: Speakers	0.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Audio Equipment: Subwoofer	3.9	0.0002	0.0003	0.0002	0.0002	0.0004	0.0005	0.0005	0.0005	0.0005	0.0005
	Media Player: BluRay	7.1	0.0003	0.0004	0.0003	0.0003	0.0006	0.0007	0.0007	0.0007	0.0007	0.0007
	Media Player: DVD	19.7	0.0008	0.0010	0.0008	0.0007	0.0015	0.0020	0.0020	0.0020	0.0020	0.0020
	Media Player: DVD-R	29.2	0.0011	0.0015	0.0012	0.0010	0.0023	0.0030	0.0030	0.0029	0.0029	0.0029
	Media Player: DVD/VCR	37.1	0.0015	0.0019	0.0016	0.0013	0.0029	0.0039	0.0039	0.0038	0.0037	0.0038
	Media Player: VCR	28.3	0.0011	0.0014	0.0012	0.0010	0.0022	0.0029	0.0029	0.0028	0.0028	0.0028
	Set-Top Box: Cable	96.4	0.0053	0.0069	0.0058	0.0048	0.0106	0.0141	0.0139	0.0136	0.0134	0.0138
	Set-Top Box: Cable with DVR	259.0	0.0142	0.0185	0.0155	0.0129	0.0284	0.0378	0.0374	0.0366	0.0361	0.0370
	Set-Top Box: Satellite	82.7	0.0050	0.0065	0.0054	0.0045	0.0099	0.0132	0.0131	0.0128	0.0126	0.0129
	Set-Top Box: Satellite with DVR	154.3	0.0092	0.0120	0.0101	0.0084	0.0185	0.0246	0.0244	0.0238	0.0235	0.0241
	Set-Top Box: Stand Alone DVR	180.3	0.0089	0.0116	0.0097	0.0081	0.0178	0.0238	0.0235	0.0230	0.0227	0.0232
	Television: CRT	10.9	0.0005	0.0007	0.0006	0.0005	0.0011	0.0014	0.0014	0.0014	0.0013	0.0014
	Television: LCD	3.4	0.0002	0.0002	0.0002	0.0002	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004
	Television: Plasma	4.1	0.0002	0.0003	0.0002	0.0002	0.0004	0.0005	0.0005	0.0005	0.0005	0.0005
	Television: Projection	47.8	0.0023	0.0030	0.0025	0.0021	0.0046	0.0062	0.0061	0.0060	0.0059	0.0060
	Video Game Console: Nintendo Wii	20.6	0.0008	0.0011	0.0009	0.0007	0.0016	0.0022	0.0021	0.0021	0.0021	0.0021
	Video Game Console: Wii U	21.7	0.0009	0.0011	0.0009	0.0008	0.0017	0.0023	0.0023	0.0022	0.0022	0.0022
	Video Game Console: Playstation 2	10.9	0.0004	0.0006	0.0005	0.0004	0.0009	0.0011	0.0011	0.0011	0.0011	0.0011

System Type	Peripheral Device	kWh Savings	Summer kW Savings					Winter kW Savings				
			Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
	Video Game Console: Playstation 3	92.3	0.0036	0.0047	0.0040	0.0033	0.0073	0.0097	0.0096	0.0094	0.0093	0.0095
	Video Game Console: Playstation 4	124.8	0.0049	0.0064	0.0054	0.0045	0.0099	0.0131	0.0130	0.0127	0.0125	0.0128
	Video Game Console: XBOX	52.9	0.0021	0.0027	0.0023	0.0019	0.0042	0.0056	0.0055	0.0054	0.0053	0.0054
	Video Game Console: XBOX 360	88.5	0.0035	0.0046	0.0038	0.0032	0.0070	0.0093	0.0092	0.0090	0.0089	0.0091
	Video Game Console: XBOX One	154.1	0.0061	0.0079	0.0066	0.0055	0.0122	0.0162	0.0160	0.0157	0.0155	0.0159
	Home Entertainment System[398]	**269.9**	**0.0133**	**0.0173**	**0.0145**	**0.0121**	**0.0265**	**0.0354**	**0.0350**	**0.0342**	**0.0338**	**0.0346**
Home Office	Computer: Desktop	37.5	0.0016	0.0021	0.0018	0.0015	0.0033	0.0043	0.0043	0.0042	0.0041	0.0042
	Computer: Laptop	38.2	0.0017	0.0022	0.0018	0.0015	0.0033	0.0044	0.0044	0.0043	0.0042	0.0043
	Computer Monitor: CRT	15.7	0.0008	0.0010	0.0008	0.0007	0.0015	0.0020	0.0020	0.0019	0.0019	0.0020
	Computer Monitor: LCD	8.3	0.0004	0.0005	0.0004	0.0004	0.0008	0.0011	0.0010	0.0010	0.0010	0.0010
	Computer Speakers	15.7	0.0008	0.0010	0.0008	0.0007	0.0015	0.0020	0.0020	0.0020	0.0019	0.0020
	Copier	12.9	0.0005	0.0006	0.0005	0.0005	0.0010	0.0013	0.0013	0.0013	0.0013	0.0013
	Fax Machine: Inkjet	46.2	0.0018	0.0023	0.0019	0.0016	0.0035	0.0047	0.0046	0.0045	0.0045	0.0046
	Fax Machine: Laser	19.7	0.0007	0.0010	0.0008	0.0007	0.0015	0.0020	0.0020	0.0019	0.0019	0.0019
	Printer: Inkjet	13.3	0.0005	0.0007	0.0005	0.0005	0.0010	0.0013	0.0013	0.0013	0.0013	0.0013
	Printer: Laser	37.9	0.0014	0.0019	0.0016	0.0013	0.0029	0.0038	0.0038	0.0037	0.0037	0.0037
	Scanner	18.0	0.0007	0.0009	0.0008	0.0006	0.0014	0.0018	0.0018	0.0018	0.0018	0.0018
	Home Office System[399]	**87.1**	**0.0038**	**0.0049**	**0.0041**	**0.0034**	**0.0075**	**0.0100**	**0.0099**	**0.0097**	**0.0096**	**0.0098**

398 Assuming Audio Equipment: AV Receiver, Media Player: Average, Set-Top Box: Average, and Video Game Console: Average.
399 Assuming Computer Monitor: LCD, Computer Speakers, Copier, Printer: Average, and Scanner.

System Type	Peripheral Device	kWh Savings	Summer kW Savings					Winter kW Savings				
			Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Upstream/ Midstream	**Unspecified System[400]**	**178.5**	**0.0085**	**0.0111**	**0.0093**	**0.0077**	**0.0170**	**0.0227**	**0.0224**	**0.0219**	**0.0217**	**0.0222**

Table 376: APS – Deemed Savings for Tier 2 Residential APS

System Type	kWh Savings	Summer kW Savings					Winter kW Savings				
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Home Entertainment	286.3	0.022	0.028	0.024	0.020	0.043	0.058	0.057	0.056	0.055	0.056
Home Office	94.0	0.007	0.009	0.008	0.006	0.014	0.019	0.019	0.018	0.018	0.018
Upstream/Midstream	190.2	0.014	0.019	0.016	0.013	0.029	0.038	0.038	0.037	0.036	0.037

400 Average of Home Entertainment and Home Office system averages.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

The estimated useful life (EUL) is 10 years for a Tier 1 APS, according to the 2011 NYSERDA Advanced Power Strip Research Report.[401] While Tier 2 APS is not covered by the NYSERDA report, assume the same 10-year EUL for Tier 2 APS.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Number of APS installed
- APS type (Tier 1 or Tier 2)
- System or peripheral type
- Climate zone
- Proof of purchase – including date of purchase and quantity
    - Alternative: photo of unit installed or another pre-approved method of installation verification.

References and Efficiency Standards

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Not applicable.

[401] New York State Energy Research and Development Authority (NYSERDA), "Advanced Power Strip Research Report". August 2011. Page 30.

Document Revision History

Table 377: Residential ENERGY STAR® Advanced Power Strips Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

2.5.10 ENERGY STAR® Electric Vehicle Supply Equipment (EVSE)

TRM Measure ID: R-AP-EV

Market Sector: Residential

Measure Category: Appliance

Applicable Business Types: Single-family

Fuels Affected: Electricity

Decision/Action Type: Replace-on-burnout, new construction

Program Delivery Type: Prescriptive

Deemed Savings Type: Look-up tables

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure applies to the installation of ENERGY STAR® certified Level 2 electric vehicle supply equipment (EVSE) at a residential site. EVSE is the infrastructure that enables plug-in electric vehicles (PEV) to charge onboard batteries. Level 2 EVSE require 240-volt electrical service. This measure provides deemed savings for the energy efficiency improvement of an ENERGY STAR EVSE over a standard or non-ENERGY STAR EVSE.

Eligibility Criteria

Eligible equipment includes an ENERGY STAR certified Level 2 EVSE installed at a residence. The EVSE may be installed for use on either an all-battery electric vehicle (BEV) or a plug-in hybrid electric vehicle (PHEV). Multifamily buildings are not eligible for deemed savings under this measure.

Baseline Condition

The baseline condition is a non-ENERGY STAR certified Level 2 EVSE.

High-efficiency Condition

The high-efficiency EVSE must be an ENERGY STAR® certified Level 2 EVSE.

Energy and Demand Savings Methodology

Savings for EVSE come from efficiency gains of the ENERGY STAR equipment during operating modes when the vehicle is plugged in but not charging and when not plugged in. Deemed savings are calculated according to the following algorithms.

Savings Algorithms and Input Variables

$$ENERGY\ STAR\ Idle\ Consumption\ [kWh] = \frac{\left(hrs_{plug} \times W_{plug} + hrs_{unplug\_C} \times W_{unplug}\right) \times days_C + hrs_{unplug\_NC} \times W_{unplug} \times days_{NC}}{1000}$$

Equation 168

$$Baseline\ Idle\ Consumption\ [kWh] = \frac{ENERGY\ STAR\ Idle\ Consumption}{0.6}$$

Equation 169

$$Annual\ Energy\ Savings\ [kWh] = Baseline\ Idle\ Consumption - ENERGY\ STAR\ Idle\ Consumption$$

Equation 170

$$Demand\ Savings\ [kW] = Annual\ Energy\ Savings\ \times PLS$$

Equation 171

Where:

hrs_{plug} = *Hours per day the vehicle is plugged into the EVSE and not charging, 9.3 hrs.*[402]

W_{plug} = *Wattage of the EVSE when the vehicle is plugged into the EVSE but not charging, 7.0 W.*[403]

hrs_{unplug_C} = *Hours per day the vehicle is not plugged into the EVSE on a charging day, 12.3 hrs.*[404]

hrs_{unplug_NC} = *Hours per day the vehicle is not plugged into the EVSE on a non-charge day, 24 hrs.*

W_{unplug} = *Wattage of the EVSE when the vehicle is not plugged into the EVSE, 2.9 W.*[405]

$days_C$ = *Number of charging days per year, 321.*[406]

$days_{NC}$ = *Number of non-charging days per year, 44.*

1000 = *conversion from Wh to kWh*

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[402] Idaho National Lab (INL) EV Project, June 2015, "Characterize the Demand and Energy Characteristics of Residential Electric Vehicle Supply Equipment," page 5. A vehicle plugged in for 11.7 hours and charging for 2.4 hours leaves 9.3 hours when it is plugged in and not charging.

[403] Average Idle Mode Input Power from ENERGY STAR certified EVSE product list as of August 27, 2019.

[404] INL; 24 hours per day minus 11.7 hours plugged in leaves 12.3 hours unplugged.

[405] Average No Vehicle Mode Input Power from ENERGY STAR certified EVSE product list.

[406] INL, page 6, 88% of PEV owners charge every day. 365 x .88 = 321.2.

0.6	=	*Efficiency adjustment factor*[407]
PLS	=	*Probability-weighted peak load share, Table 378*

Table 378: EVSE Peak Load Share[408]

	Summer PLS	Winter PLS
Climate Zone 1	0.00012	0.00016
Climate Zone 2	0.00011	0.00014
Climate Zone 3	0.00012	0.00011
Climate Zone 4	0.00011	0.00016
Climate Zone 5	0.00009	0.00023

Deemed Energy Savings Tables

Table 379 presents the deemed annual energy savings per EVSE.

Table 379: EVSE Annual Energy Savings

Annual Energy Savings (kWh)
23.6

Deemed Summer and Winter Demand Savings Tables

Table 380 presents the deemed summer and winter peak kW savings per EVSE.

Table 380: EVSE Peak Demand Savings

	Summer Peak kW	Winter Peak kW
Zone 1	0.00284	0.00374
Zone 2	0.00261	0.00341
Zone 3	0.00280	0.00263
Zone 4	0.00270	0.00384
Zone 5	0.00211	0.00548

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

[407] ENERGY STAR EVSE overview: "ENERGY STAR certified EV charger… on average use 40% less energy than a standard EV charger when the charger is in standby mode (i.e., not actively charging a vehicle)." https://www.energystar.gov/products/other/evse. Accessed August 2019.

[408] Probability weighted peak load factors are calculated according to the method in Section 4 of the Texas TRM Vol 1 using data from 3 studies: CCET Wind Integration in ERCOT, Avista Utilities Semi-Annual Report on Electric Vehicle Supply, and Xcel CO EVCS Pilot.

Measure Life and Lifetime Savings

The estimated useful life (EUL) for an EVSE is assumed to be 10 years.[409]

Program Tracking Data and Evaluation Requirements

It is required that the following list of primary inputs and contextual data be specified and tracked by the program database to inform the evaluation and apply the savings properly:

- Climate zone
- EVSE make and model number
- Vehicle year, make, and model
- Estimated number of miles driven per day

References and Efficiency Standards

Petitions and Rulings

- This section not applicable.

Relevant Standards and Reference Sources

- The applicable version of the ENERGY STAR® specifications and requirements for electric vehicle supply equipment.

Document Revision History

Table 381: Residential ENERGY STAR® Electric Vehicle Supply Equipment Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

409 U.S. Department of Energy Vehicle Technologies Office, November 2015, "Costs Associated with Non-Residential Electric Vehicle Supply Equipment" p. 21. https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf, Accessed October 2019.

2.5.11 Solar Attic Fans Measure Overview

TRM Measure ID: R-BE-SF

Market Sector: Residential

Measure Category: Building Envelope

Applicable Building Types: Residential

Fuels Affected: Electricity

Decision/Action Type: Retrofit

Program Delivery Type: Prescriptive

Deemed Savings Type: Deemed savings calculations

Savings Methodology: Engineering calculations and estimates

Measure Description

Solar attic fans increase the extraction rate of accumulated hot air in attics during the cooling season. Solar attic fans introduce no new electrical load to the home since they are powered by an attached photovoltaic panel. They save energy by reducing the load on air conditioning equipment, cooling the conditioned space directly underlying the attic, and by reducing heat exchange with supply ducts located in the attic when present.

Deemed savings are provided for reduced air conditioning load.

Note: This is a new measure with limited savings information for Texas; therefore, solar attic fans should be implemented with the expectation of a savings methodology update in future TRMs as Texas-specific field information becomes available.

Eligibility Criteria

The measure applies to existing homes with central or mini-split electric refrigerated air conditioning. Ineligible applications include new homes, homes with tile roofs, homes with metal roofs, and evaporatively-cooled homes. Customers participating in HTR or LI programs are also eligible to claim cooling savings for homes cooled by one or more room air conditioners by applying an adjustment factor to the provided deemed savings. Solar fans must have an automatic low-temperature shut-off to ensure cold outside air is not drawn into the attic during the heating season.

Baseline Condition

The baseline condition is an existing home with refrigerated air and a vented attic.

High-efficiency Condition

The high-efficiency condition is the installation of sufficient solar attic fans to remove 400 cfm for every thousand square feet of attic floorspace. A solar attic fan consists of an electric fan powered by an integrated photovoltaic panel installed for the exclusive purpose of powering the fan.

Energy and Demand Savings Methodology

Savings have been estimated by performing energy balances on the roof surface and on the attic airspace on an hourly time step. The energy balances account for heat flux from the roof into the attic and between the attic and the underlying conditioned space. Solar attic fans are assumed to operate in the cooling season in the hours of the day when there is incident solar irradiation on the panel. Deemed savings are based on replacing hot attic air with outside air using solar attic fans with a capacity of 400 cfm per thousand square feet of attic floor. Estimated savings are a function of the difference in heat transfer to conditioned space with and without solar attic fans, considering that the heat transferred to conditioned space must be removed by the air conditioning system. For homes with ducts in the attic, additional savings are estimated considering heat transfer to supply ducts.

Hourly data for the ambient conditions is from TMY3 files for the Texas TRM climate zones.

Savings Algorithms and Input Variables

Attic temperature for each hour is estimated according to the following equation for both the baseline and high-efficiency conditions.[410]

$$T_a = \frac{A_r * U_r * \frac{\alpha * I_s + h_o * T_o}{h_o + U_r} + Q * \rho * c_p * T_o + (A_c * U_c + A_d * U_d) * T_i}{\frac{A_r * U_r * h_o}{h_o + U_r} + Q * \rho * c_p + (A_c * U_c + A_d * U_d)}$$

Equation 172

Where:

A_r	=	*roof surface area (ft²)*
U_r	=	*U-factor of the roof between the unconditioned attic and the exterior (Btu/ft²-hr-°F)*
α	=	*absorption coefficient of the roof (dimensionless)*
I_s	=	*solar irradiance (Btu/ft²-hr)*
h_o	=	*convective heat transfer coefficient for air (Btu/ft²-hr-°F)*
T_o	=	*exterior temperature (°F)*

410 This equation results from solving the energy balance on the roof for Tr and inserting this value into the energy balance for the attic airspace, while solving for Ta. The equations are drawn from ASHRAE Fundamentals, Chapter 17, Residential Heat Load Guidebook. Approach originally derived by TetraTech, Inc. (see references section).

T_r = *temperature of the roof (°F)*

T_a = *temperature of the attic (°F)*

Q = *ventilation airflow rate (CFM)*

ρ = *density of air (lb/ft³)*

c_p = *specific heat of air (Btu/lb-°F)*

A_c = *ceiling surface area (ft²)*

U_c = *U-factor of the ceiling between the conditioned space and the unconditioned attic (Btu/ft²-hr-°F)*

A_d = *surface area of supply ducts in the attic (ft²); set to zero if there are no supply ducts in the attic*

U_d = *U-factor of the insulation on the ducts, (Btu/ft²-hr-°F)*

T_i = *temperature of the conditioned space (°F)*

Once hourly attic temperatures are estimated for the baseline and high-efficiency conditions, hourly energy savings are estimated as follows:

$$Hourly\ Energy\ Savings\ (kWh) = \frac{(\mathrm{A}_c * \mathrm{U}_c + \mathrm{A}_d * \mathrm{U}_d)}{1000 * \mathrm{EER}} * \left(T_{a,b} - T_{a,he}\right) * 1\ hr$$

Equation 173

Where:

A_c = *ceiling surface area (ft²)*

U_c = *U-factor of the ceiling between the conditioned space and the unconditioned attic (Btu/ft²-hr-°F)*

A_d = *surface area of supply ducts in the attic (ft²); set to zero if there are no supply ducts in the attic*

U_d = *U-factor of the insulation on the ducts (Btu/ft²-hr-°F)*

EER = *efficiency of the air conditioner (Btu/W-h)*

$T_{a,b}$ = *temperature of the baseline attic, without solar powered attic fan (°F)*

$T_{a,he}$ = *temperature of the attic in the high-efficiency condition, with solar powered attic fan (°F)*

Deemed Energy and Demand Savings Tables

Energy and demand savings are estimated for homes with ducts in the attic and for homes with no ductwork in their attics.

Table 382: Solar Attic Fans Deemed Annual Energy Savings (kWh)

Climate Zone	No Ducts in Attic	Ducts in Attic
Climate Zone 1: Amarillo	147	245
Climate Zone 2: Dallas	212	350
Climate Zone 3: Houston	236	391
Climate Zone 4: Corpus Christi	260	431
Climate Zone 5: El Paso	252	420

Annual energy savings are simply the sum of the hourly energy savings:

$$Annual\ Energy\ Savings\ (kWh) = \sum_{hr=1}^{8760} Hourly\ Energy\ Savings \times CAF$$

Equation 174

Where:

The *Hourly Energy Savings* is the appropriate value from Table 2, and

CAF = *Cooling savings adjustment factor: set to 1.0 for homes with central refrigerated air; for homes with one or more room air conditioners set to 0.6.*

Table 383: Solar Attic Fans Deemed Summer Peak Demand Savings (kW)

Climate Zone	No Ducts in Attic	Ducts in Attic
Climate Zone 1: Amarillo	0.16	0.26
Climate Zone 2: Dallas	0.12	0.2
Climate Zone 3: Houston	0.1	0.15
Climate Zone 4: Corpus Christi	0.15	0.24
Climate Zone 5: El Paso	0.17	0.28

The cooling adjustment factor is also applied to the demand savings:

$$Peak\ Demand\ Savings\ (kW) = Summer\ Peak\ Demand\ Savings \times CAF$$

Equation 175

Where:

The *Summer Peak Demand Savings* are the appropriate value from Table 383, and

CAF	=	*Cooling savings adjustment factor: set to 1.0 for homes with central refrigerated air; for homes with with one or more room air conditioners set to 0.6.*

Winter peak demand savings are not estimated. Solar attic fans that operate in the winter would likely require more space heating and produce negative savings by increasing the temperature gradient between conditioned space and the cooler attic air (while potentially creating condensation issues).

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Measure Life and Lifetime Savings

Effective Useful Life (EUL)

The EUL of a solar attic fan is closely related to its motor. The US DOE Advanced Manufacturing Office's Motor Systems Tip Sheet #3 suggests motors should last approximately 35,000 hours. The average annual hours of operation for solar attic fans across the Texas TRM zones is about 2,300 hours. Accordingly, the EUL for solar attic fans in Texas is estimated to be 15 years.

Program Tracking Data and Evaluation Requirements

The below list of primary inputs and contextual data is recommended to be specified and tracked by the program database to inform the evaluation and apply the savings properly.

- Climate zone
- Attic floor area (ft2)
- Installed capacity of installed solar attic fans (CFM)
- Absence/presence of ducts in attic space
- Absence/presence of A/C equipment in attic space
- Length and insulation R-value of ducts in the attic if applicable
- Attic insulation R-value
- Exterior roof type (e.g., black asphalt shingles, metal seam)
- Air Conditioning type, age, and estimated EER
- Azimuth of fan solar panel

- Temperature measurements (for PY2020, 5 of initial 10 projects in Texas and 10% of the subsequent 200 projects in Texas, not to exceed 25 installations); future program years' (PYs) measurement requirements will be determined on an annual basis.
    - Pre-install spot measurements (1. near insulation level and 2. underside of roof)
    - Post-install two-week logging, minimum on reading per hour (1. near insulation level and 2. underside of roof)

References and Efficiency Standards

Petitions and Rulings

- TBD

Relevant Standards and Reference Sources

- 2017 ASHRAE Handbook-Fundamentals; Chapter 17, Residential Cooling and Heating Load Calculations.
- Tetra Tech Memorandum to the Independent Electricity System Operator (IESO) of Ontario, Canada. Attic Fan Measure Characterization. Authors Mark Bergum and Marc Collins. August 20, 2018.
- US Department of Energy, EERE Advanced Manufacturing Office. Motor Systems Tip Sheet #3. Online. Available: https://www.osti.gov/servlets/purl/15020347

Document Revision History

Table 384: Residential Solar Attic Fans Revision History

TRM Version	Date	Description of Change
v7.0	10/2019	TRM v7.0 origin.

2.6 RESIDENTIAL: APPLIANCE RECYCLING

2.6.1 Refrigerator/Freezer Recycling Measure Overview

TRM Measure ID: R-AP-RR

Market Sector: Residential

Measure Category: Appliance Recycling

Applicable Building Types: Single-family, duplex, and triplex; multifamily; manufactured

Fuels Affected: Electricity

Decision/Action Type(s): Early retirement

Program Delivery Type(s): Prescriptive

Deemed Savings Type: Deemed savings calculation

Savings Methodology: Engineering algorithms and estimates

Measure Description

This measure involves early retirement and recycling of an existing, full-size (7.75 ft^3 or greater) refrigerator/freezer in a residential application. Savings represent the entire estimated energy consumption of the existing unit and are applicable over the estimated remaining life of the existing unit.

Eligibility Criteria

This measure applies to operable primary and secondary retired refrigerators/freezers. Recycling savings for this measure are limited to the removal of a working refrigerator/freezer from the electrical grid and differ from the savings specified in the ENERGY STAR® Refrigerator replacement measure. The latter, which pertain to the direct replacement of a refrigerator and reflect the difference in energy consumption between new ENERGY STAR® qualifying and standard efficiency models, may be claimed for the recycling of primary refrigerators/freezers that have been replaced if savings for that replacement were not already claimed in another energy efficiency program. To qualify, the customer must release the existing unit to the utility or utility representative to ensure proper disposal in accordance with applicable federal, state, and local regulations.

Baseline Condition

Without program intervention, the recycled refrigerator or freezer would have remained operable on the electrical grid. As a result, the baseline condition for early retirement programs is the status quo (continued operation) and the basis for estimating energy savings is the annual energy consumption of the refrigerator or freezer being retired (as specified in the "Energy and Demand Savings Methodology" section).

High-efficiency Condition

There is no efficiency standard for a recycling measure because the energy efficient action is the removal of an operable appliance, not—as with most demand-side management programs—the installation of a higher efficiency model.

Energy and Demand Savings Methodology

Savings Algorithms and Input Variables

Energy Savings

Energy savings are calculated as follows:

$$\begin{aligned}&\boldsymbol{kWh_{savings} = kWh_{existing} \times ISAF \times PUF}\\&\boldsymbol{= 1,308 \times 0.942 \times 0.915}\\&\boldsymbol{= 1,128\ kWh}\end{aligned}$$

Equation 176

Where:

$kWh_{existing}$ = *Average annual energy consumption*[411] *= 1,308 kWh*

$ISAF$ = *In Situ Adjustment Factor*[412] *= 0.942*

PUF = *Part Use Factor*[413] *= 0.915*

Demand Savings

Summer peak demand savings are calculated as follows:

$$kW_{savings=}\frac{kWh_{savings}}{AOH} \times LSAF$$

Equation 177

411 The Cadmus Group, Inc. "Residential Retrofit High Impact Measure Evaluation Report". Prepared for California Public Utilities Commission Energy Division. February 8, 2010. Average of DOE-Based Full-Year Unit Energy Consumption (weighted by representative utility survey participation).

412 Ibid. Factor to account for variation between site conditions and controlled DOE testing conditions (90 °F test chamber, empty refrigerator and freezer cabinets, and no door openings). Appliances in warmer climate zones use more energy than those in cooler climate zones; utilized SCE data (highest percentage of warm climate projects) to best approximate Texas climate, p. 139-140.

413 Ibid. Factor to account for the number of refrigerators that were running, running part time, or not running at the time of recycling, p. 142-143 (weighted by representative utility survey participation, p. 117).

Where:

AOH	=	*Annual operating hours = 8,760 hours*
$LSAF$	=	*Load shape adjustment factor (Table 385)*

Table 385: Load Shape Adjustment Factors[414]

Season	Climate Zone 1: Amarillo	Climate Zone 2: Dallas	Climate Zone 3: Houston	Climate Zone 4: Corpus Christi	Climate Zone 5: El Paso
Summer	1.112	1.099	1.108	1.100	1.081
Winter	0.929	0.966	0.924	0.941	0.966

Deemed Energy Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Summer Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Deemed Winter Demand Savings Tables

There are no lookup tables available for this measure. See engineering algorithms in the previous section for calculating energy and demand savings.

Claimed Peak Demand Savings

Refer to Volume 1, Appendix B: Peak Demand Reduction Documentation for further details on peak demand savings and methodology.

Additional Calculators and Tools

This section is not applicable.

Measure Life and Lifetime Savings

Based on the KEMA Residential Refrigerator Recycling Ninth Year Retention Study,[415] the Estimated Useful Life of Refrigerator Recycling is 8 years, representing the assumed remaining useful life of the retired unit.

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[414] See Volume 1, Appendix B.

[415] KEMA, Inc. "Residential Refrigerator Recycling Ninth Year Retention Study." Prepared for Southern California Edison Company. July 22, 2004.

Program Tracking Data and Evaluation Requirements

Primary inputs and contextual data that should be specified and tracked by the program database to inform the evaluation and apply the savings properly are:

- Climate zone
- Number of refrigerators/freezers replaced
- Age of removed unit
- Size (in cubic feet)
- Configuration (top freezer, bottom freezer, side-by-side, or single-door)

References and Efficiency Standards

Petitions and Rulings

- Docket No. 42212. Petition of El Paso Electric Company to Approve Revisions to the Deemed Savings for the Appliance Recycling Market Transformation program. Public Utility Commission of Texas.

Relevant Standards and Reference Sources

Not applicable.

Document Revision History

Table 386: Residential Refrigerator/Freezer Recycling Revision History

TRM Version	Date	Description of Change
v2.1	1/30/2015	TRM v2.1 origin.
v3.0	4/10/2015	TRM v3.0 update. LSAF updated to align with new peak demand methodology.
v3.1	11/05/2015	TRM v3.1 update. No revision.
v3.1	3/28/2016	TRM v3.1 March revision. Updated summer and winter coincidence factors.
v4.0	10/10/2016	TRM v4.0 update. No revision.
v5.0	10/2017	TRM v5.0 update. No revision.
v6.0	11/2018	TRM v6.0 update. No revision.
v7.0	10/2019	TRM v7.0 update. No revision.

3 APPENDIX A: CENTRAL AIR CONDITIONER AND HEAT PUMPS DEEMED SAVINGS TABLES

Deemed Energy Savings Tables[416]

Cooling, New Construction

Table 387 through Table 391 presents the energy savings (kWh) for cooling load types associated with a central system being installed during new construction for all five Texas climate zones.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 387: Energy Savings (Cooling kWh) for 14.0 SEER New Construction Baseline—Zone 1

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9	18.0–20.9	21.0-23.9	24.0+
< 15,000	43	83	154	264	307	411	490
15,000-20,999	65	124	231	396	461	617	735
21,000-26,999	86	166	307	529	615	822	980
27,000-32,999	108	207	384	661	769	1,028	1,225
33,000-38,999	129	248	461	793	922	1,234	1,470
39,000-44,999	151	290	538	925	1,076	1,439	1,715
45,000-53,999	172	331	615	1,057	1,230	1,645	1,960
54,000-64,999	215	414	769	1,322	1,537	2,056	2,450

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 388: Energy Savings (Cooling kWh) for 14.0 SEER New Construction Baseline—Zone 2

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9	18.0–20.9	21.0-23.9	24.0+
< 15,000	70	134	249	433	502	672	800
15,000-20,999	105	201	374	649	753	1,008	1,200
21,000-26,999	140	268	498	865	1,004	1,343	1,601
27,000-32,999	174	335	623	1,082	1,256	1,679	2,001
33,000-38,999	209	403	748	1,298	1,507	2,015	2,401
39,000-44,999	244	470	872	1,514	1,758	2,351	2,801
45,000-53,999	279	537	997	1,731	2,009	2,687	3,201
54,000-64,999	349	671	1,246	2,163	2,511	3,359	4,001

[416] Rated capacity ranges are specified based on normal rounding convention between capacity categories (values at and above the midpoint round up, while values below the midpoint round down).

Climate Zone 3: South Region, Houston Weather Data

Table 389: Energy Savings (Cooling kWh) for 14.0 SEER New Construction Baseline—Zone 3

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9	18.0–20.9	21.0-23.9	24.0+
< 15,000	82	157	292	504	586	783	933
15,000-20,999	123	236	438	756	879	1,175	1,400
21,000-26,999	163	314	584	1,008	1,172	1,566	1,866
27,000-32,999	204	393	729	1,260	1,465	1,958	2,333
33,000-38,999	245	471	875	1,512	1,757	2,350	2,799
39,000-44,999	286	550	1,021	1,764	2,050	2,741	3,266
45,000-53,999	327	628	1,167	2,017	2,343	3,133	3,732
54,000-64,999	409	786	1,459	2,521	2,929	3,916	4,665

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 390: Energy Savings (Cooling kWh) for 14.0 SEER New Construction Baseline—Zone 4

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9	18.0–20.9	21.0-23.9	24.0+
< 15,000	91	174	324	572	661	882	1,050
15,000-20,999	136	261	485	857	992	1,323	1,574
21,000-26,999	181	348	647	1,143	1,322	1,764	2,099
27,000-32,999	226	436	809	1,429	1,653	2,206	2,624
33,000-38,999	272	523	971	1,715	1,983	2,647	3,149
39,000-44,999	317	610	1,132	2,000	2,314	3,088	3,673
45,000-53,999	362	697	1,294	2,286	2,644	3,529	4,198
54,000-64,999	453	871	1,618	2,858	3,306	4,411	5,248

Climate Zone 5: West Region El Paso Weather Data

Table 391: Energy Savings (Cooling kWh) for 14.0 SEER New Construction Baseline—Zone 5

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9	18.0–20.9	21.0-23.9	24.0+
< 15,000	60	115	213	378	437	582	692
15,000-20,999	90	172	320	566	655	873	1,038
21,000-26,999	119	230	427	755	873	1,164	1,384
27,000-32,999	149	287	533	944	1,092	1,455	1,730
33,000-38,999	179	345	640	1,133	1,310	1,746	2,076
39,000-44,999	209	402	746	1,322	1,528	2,037	2,422
45,000-53,999	239	459	853	1,511	1,747	2,328	2,768
54,000-64,999	299	574	1,066	1,888	2,183	2,910	3,460

Cooling, Replace-on-burnout

Table 392 through Table 396 present the energy savings (kWh) for cooling load types associated with a central system replacing on burnout an HVAC system for all five Texas climate zones. In each table, the capacity of the efficient unit is represented in the columns and the capacity of the existing unit is represented in the rows. The savings are in the intersection of the appropriate efficient and existing capacities. Replacements where there has been to change in capacity are highlighted in light blue.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 392: Energy Savings (Cooling kWh) for 13.08 SEER Replace-on-burnout Baseline—Zone 1

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	119							
15,000-20,999	695	178						
21,000-26,999	1,271	754	237					
27,000-32,999	1,847	1,330	813	297				
33,000-38,999	2,423	1,906	1,389	873	356			
39,000-44,999	2,998	2,482	1,965	1,449	932	416		
45,000-53,999	3,574	3,058	2,541	2,025	1,508	992	475	
54,000-64,999	4,726	4,210	3,693	3,177	2,660	2,143	1,627	594

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	158							
15,000-20,999	734	238						
21,000-26,999	1,310	814	317					
27,000-32,999	1,886	1,390	893	396				
33,000-38,999	2,462	1,966	1,469	972	475			
39,000-44,999	3,038	2,541	2,045	1,548	1,051	555		
45,000-53,999	3,614	3,117	2,621	2,124	1,627	1,131	634	
54,000-64,999	4,766	4,269	3,773	3,276	2,779	2,283	1,786	792

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	229							
15,000-20,999	805	344						
21,000-26,999	1,381	920	459					
27,000-32,999	1,957	1,496	1,035	574				
33,000-38,999	2,533	2,072	1,611	1,150	688			
39,000-44,999	3,109	2,648	2,187	1,725	1,264	803		
45,000-53,999	3,685	3,224	2,763	2,301	1,840	1,379	918	
54,000-64,999	4,837	4,376	3,915	3,453	2,992	2,531	2,070	1,147

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	340							
15,000-20,999	916	510						
21,000-26,999	1,492	1,086	680					
27,000-32,999	2,068	1,662	1,256	850				
33,000-38,999	2,644	2,238	1,832	1,426	1,020			
39,000-44,999	3,220	2,814	2,408	2,002	1,596	1,190		
45,000-53,999	3,796	3,390	2,984	2,578	2,172	1,766	1,360	
54,000-64,999	4,948	4,542	4,136	3,730	3,324	2,918	2,512	1,700

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	383							
15,000-20,999	959	575						
21,000-26,999	1,535	1,151	766					
27,000-32,999	2,111	1,727	1,342	958				
33,000-38,999	2,687	2,303	1,918	1,534	1,149			
39,000-44,999	3,263	2,879	2,494	2,110	1,725	1,341		
45,000-53,999	3,839	3,454	3,070	2,686	2,301	1,917	1,533	
54,000-64,999	4,991	4,606	4,222	3,838	3,453	3,069	2,684	1,916
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	487							
15,000-20,999	1,063	730						
21,000-26,999	1,639	1,306	974					
27,000-32,999	2,215	1,882	1,550	1,217				
33,000-38,999	2,791	2,458	2,126	1,793	1,461			
39,000-44,999	3,367	3,034	2,702	2,369	2,037	1,704		
45,000-53,999	3,943	3,610	3,278	2,945	2,613	2,280	1,948	
54,000-64,999	5,094	4,762	4,430	4,097	3,765	3,432	3,100	2,435
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	566							
15,000-20,999	1,142	849						
21,000-26,999	1,718	1,425	1,132					
27,000-32,999	2,294	2,001	1,708	1,414				
33,000-38,999	2,870	2,577	2,283	1,990	1,697			
39,000-44,999	3,446	3,152	2,859	2,566	2,273	1,980		
45,000-53,999	4,021	3,728	3,435	3,142	2,849	2,556	2,263	
54,000-64,999	5,173	4,880	4,587	4,294	4,001	3,708	3,415	2,829

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 393: Energy Savings (Cooling kWh) for 13.08 SEER Replace-on-burnout Baseline—Zone 2

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	192							
15,000-20,999	1,126	289						
21,000-26,999	2,060	1,222	385					
27,000-32,999	2,993	2,156	1,318	481				
33,000-38,999	3,927	3,089	2,252	1,415	577			
39,000-44,999	4,860	4,023	3,186	2,348	1,511	674		
45,000-53,999	5,794	4,956	4,119	3,282	2,445	1,607	770	
54,000-64,999	7,661	6,824	5,986	5,149	4,312	3,474	2,637	962
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	257							
15,000-20,999	1,190	385						
21,000-26,999	2,124	1,319	514					
27,000-32,999	3,058	2,252	1,447	642				
33,000-38,999	3,991	3,186	2,381	1,576	771			
39,000-44,999	4,925	4,120	3,314	2,509	1,704	899		
45,000-53,999	5,858	5,053	4,248	3,443	2,638	1,833	1,028	
54,000-64,999	7,725	6,920	6,115	5,310	4,505	3,700	2,895	1,284

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	372							
15,000-20,999	1,305	558						
21,000-26,999	2,239	1,491	744					
27,000-32,999	3,173	2,425	1,677	930				
33,000-38,999	4,106	3,359	2,611	1,863	1,116			
39,000-44,999	5,040	4,292	3,544	2,797	2,049	1,302		
45,000-53,999	5,973	5,226	4,478	3,730	2,983	2,235	1,488	
54,000-64,999	7,840	7,093	6,345	5,598	4,850	4,102	3,355	1,859
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	555							
15,000-20,999	1,489	833						
21,000-26,999	2,422	1,767	1,111					
27,000-32,999	3,356	2,700	2,044	1,388				
33,000-38,999	4,290	3,634	2,978	2,322	1,666			
39,000-44,999	5,223	4,567	3,911	3,256	2,600	1,944		
45,000-53,999	6,157	5,501	4,845	4,189	3,533	2,877	2,221	
54,000-64,999	8,024	7,368	6,712	6,056	5,400	4,744	4,089	2,777
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	625							
15,000-20,999	1,558	937						
21,000-26,999	2,492	1,871	1,250					
27,000-32,999	3,426	2,805	2,183	1,562				
33,000-38,999	4,359	3,738	3,117	2,496	1,875			
39,000-44,999	5,293	4,672	4,051	3,429	2,808	2,187		
45,000-53,999	6,226	5,605	4,984	4,363	3,742	3,121	2,500	
54,000-64,999	8,093	7,472	6,851	6,230	5,609	4,988	4,367	3,125

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	794							
15,000-20,999	1,728	1,192						
21,000-26,999	2,662	2,125	1,589					
27,000-32,999	3,595	3,059	2,522	1,986				
33,000-38,999	4,529	3,992	3,456	2,920	2,383			
39,000-44,999	5,462	4,926	4,389	3,853	3,317	2,780		
45,000-53,999	6,396	5,859	5,323	4,787	4,250	3,714	3,178	
54,000-64,999	8,263	7,727	7,190	6,654	6,117	5,581	5,045	3,972
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	923							
15,000-20,999	1,857	1,384						
21,000-26,999	2,790	2,318	1,846					
27,000-32,999	3,724	3,252	2,779	2,307				
33,000-38,999	4,657	4,185	3,713	3,241	2,769			
39,000-44,999	5,591	5,119	4,647	4,174	3,702	3,230		
45,000-53,999	6,524	6,052	5,580	5,108	4,636	4,164	3,692	
54,000-64,999	8,391	7,919	7,447	6,975	6,503	6,031	5,559	4,615

Climate Zone 3: South Region, Houston Weather Data

Table 394: Energy Savings (Cooling kWh) for 13.08 SEER Replace-on-burnout Baseline—Zone 3

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	225							
15,000-20,999	1,318	338						
21,000-26,999	2,412	1,431	451					
27,000-32,999	3,505	2,524	1,544	563				
33,000-38,999	4,598	3,617	2,637	1,656	676			
39,000-44,999	5,691	4,710	3,730	2,750	1,769	789		
45,000-53,999	6,784	5,803	4,823	3,843	2,862	1,882	901	
54,000-64,999	8,970	7,990	7,009	6,029	5,048	4,068	3,088	1,127
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	301							
15,000-20,999	1,394	451						
21,000-26,999	2,487	1,544	602					
27,000-32,999	3,580	2,637	1,695	752				
33,000-38,999	4,673	3,730	2,788	1,845	902			
39,000-44,999	5,766	4,823	3,881	2,938	1,995	1,053		
45,000-53,999	6,859	5,917	4,974	4,031	3,089	2,146	1,203	
54,000-64,999	9,045	8,103	7,160	6,217	5,275	4,332	3,389	1,504

16.0-16.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	435							
15,000-20,999	1,529	653						
21,000-26,999	2,622	1,746	871					
27,000-32,999	3,715	2,839	1,964	1,089				
33,000-38,999	4,808	3,932	3,057	2,182	1,306			
39,000-44,999	5,901	5,026	4,150	3,275	2,399	1,524		
45,000-53,999	6,994	6,119	5,243	4,368	3,493	2,617	1,742	
54,000-64,999	9,180	8,305	7,429	6,554	5,679	4,803	3,928	2,177

17.0-17.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	648							
15,000-20,999	1,741	972						
21,000-26,999	2,834	2,065	1,296					
27,000-32,999	3,927	3,158	2,389	1,619				
33,000-38,999	5,020	4,251	3,482	2,713	1,943			
39,000-44,999	6,113	5,344	4,575	3,806	3,036	2,267		
45,000-53,999	7,206	6,437	5,668	4,899	4,130	3,360	2,591	
54,000-64,999	9,392	8,623	7,854	7,085	6,316	5,547	4,777	3,239

18.0-20.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	729							
15,000-20,999	1,823	1,094						
21,000-26,999	2,916	2,187	1,459					
27,000-32,999	4,009	3,280	2,552	1,824				
33,000-38,999	5,102	4,373	3,645	2,917	2,188			
39,000-44,999	6,195	5,467	4,738	4,010	3,282	2,553		
45,000-53,999	7,288	6,560	5,831	5,103	4,375	3,646	2,918	
54,000-64,999	9,474	8,746	8,017	7,289	6,561	5,832	5,104	3,647

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	927							
15,000-20,999	2,020	1,390						
21,000-26,999	3,113	2,483	1,854					
27,000-32,999	4,206	3,576	2,947	2,317				
33,000-38,999	5,299	4,670	4,040	3,410	2,781			
39,000-44,999	6,392	5,763	5,133	4,503	3,874	3,244		
45,000-53,999	7,485	6,856	6,226	5,596	4,967	4,337	3,707	
54,000-64,999	9,672	9,042	8,412	7,783	7,153	6,523	5,894	4,634
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,077							
15,000-20,999	2,170	1,615						
21,000-26,999	3,263	2,708	2,154					
27,000-32,999	4,356	3,801	3,247	2,692				
33,000-38,999	5,449	4,894	4,340	3,785	3,230			
39,000-44,999	6,542	5,987	5,433	4,878	4,323	3,769		
45,000-53,999	7,635	7,081	6,526	5,971	5,416	4,862	4,307	
54,000-64,999	9,821	9,267	8,712	8,157	7,603	7,048	6,493	5,384

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 395: Energy Savings (Cooling kWh) for 13.08 SEER Replace-on-burnout Baseline—Zone 4

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	250							
15,000-20,999	1,462	375						
21,000-26,999	2,674	1,587	500					
27,000-32,999	3,886	2,799	1,712	625				
33,000-38,999	5,098	4,011	2,924	1,837	750			
39,000-44,999	6,310	5,223	4,136	3,049	1,962	875		
45,000-53,999	7,523	6,435	5,348	4,261	3,174	2,087	1,000	
54,000-64,999	9,947	8,860	7,772	6,685	5,598	4,511	3,424	1,250
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	334							
15,000-20,999	1,546	500						
21,000-26,999	2,758	1,712	667					
27,000-32,999	3,970	2,924	1,879	834				
33,000-38,999	5,182	4,137	3,091	2,046	1,001			
39,000-44,999	6,394	5,349	4,303	3,258	2,213	1,167		
45,000-53,999	7,606	6,561	5,515	4,470	3,425	2,379	1,334	
54,000-64,999	10,030	8,985	7,940	6,894	5,849	4,804	3,758	1,668

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	483							
15,000-20,999	1,695	724						
21,000-26,999	2,907	1,936	966					
27,000-32,999	4,119	3,148	2,178	1,207				
33,000-38,999	5,331	4,361	3,390	2,419	1,449			
39,000-44,999	6,543	5,573	4,602	3,631	2,661	1,690		
45,000-53,999	7,755	6,785	5,814	4,843	3,873	2,902	1,931	
54,000-64,999	10,180	9,209	8,238	7,268	6,297	5,326	4,356	2,414

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	731							
15,000-20,999	1,943	1,096						
21,000-26,999	3,155	2,308	1,462					
27,000-32,999	4,367	3,520	2,674	1,827				
33,000-38,999	5,579	4,733	3,886	3,039	2,192			
39,000-44,999	6,791	5,945	5,098	4,251	3,405	2,558		
45,000-53,999	8,003	7,157	6,310	5,463	4,617	3,770	2,923	
54,000-64,999	10,428	9,581	8,734	7,888	7,041	6,194	5,347	3,654

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	820							
15,000-20,999	2,033	1,231						
21,000-26,999	3,245	2,443	1,641					
27,000-32,999	4,457	3,655	2,853	2,051				
33,000-38,999	5,669	4,867	4,065	3,263	2,461			
39,000-44,999	6,881	6,079	5,277	4,475	3,673	2,871		
45,000-53,999	8,093	7,291	6,489	5,687	4,885	4,084	3,282	
54,000-64,999	10,517	9,715	8,913	8,112	7,310	6,508	5,706	4,102

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,042							
15,000-20,999	2,254	1,562						
21,000-26,999	3,466	2,774	2,083					
27,000-32,999	4,678	3,986	3,295	2,604				
33,000-38,999	5,890	5,199	4,507	3,816	3,125			
39,000-44,999	7,102	6,411	5,719	5,028	4,337	3,645		
45,000-53,999	8,314	7,623	6,931	6,240	5,549	4,857	4,166	
54,000-64,999	10,738	10,047	9,356	8,664	7,973	7,282	6,590	5,208
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,209							
15,000-20,999	2,421	1,813						
21,000-26,999	3,633	3,025	2,418					
27,000-32,999	4,845	4,237	3,630	3,022				
33,000-38,999	6,057	5,450	4,842	4,234	3,626			
39,000-44,999	7,269	6,662	6,054	5,446	4,839	4,231		
45,000-53,999	8,481	7,874	7,266	6,658	6,051	5,443	4,835	
54,000-64,999	10,906	10,298	9,690	9,083	8,475	7,867	7,259	6,044

Climate Zone 5: West Region El Paso Weather Data

Table 396: Energy Savings (Cooling kWh) for 13.08 SEER Replace-on-burnout Baseline—Zone 5

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	165							
15,000-20,999	964	247						
21,000-26,999	1,763	1,046	329					
27,000-32,999	2,562	1,845	1,128	412				
33,000-38,999	3,361	2,644	1,927	1,211	494			
39,000-44,999	4,160	3,443	2,726	2,010	1,293	577		
45,000-53,999	4,959	4,242	3,525	2,809	2,092	1,376	659	
54,000-64,999	6,557	5,840	5,123	4,407	3,690	2,974	2,257	824
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	220							
15,000-20,999	1,019	330						
21,000-26,999	1,818	1,129	440					
27,000-32,999	2,617	1,928	1,239	550				
33,000-38,999	3,416	2,727	2,038	1,349	660			
39,000-44,999	4,215	3,526	2,837	2,148	1,459	770		
45,000-53,999	5,014	4,325	3,636	2,947	2,258	1,569	879	
54,000-64,999	6,612	5,923	5,234	4,545	3,856	3,167	2,477	1,099

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	318							
15,000-20,999	1,117	477						
21,000-26,999	1,916	1,276	637					
27,000-32,999	2,715	2,075	1,436	796				
33,000-38,999	3,514	2,874	2,235	1,595	955			
39,000-44,999	4,313	3,673	3,034	2,394	1,754	1,114		
45,000-53,999	5,112	4,472	3,833	3,193	2,553	1,913	1,273	
54,000-64,999	6,710	6,070	5,431	4,791	4,151	3,511	2,871	1,591

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	483							
15,000-20,999	1,282	724						
21,000-26,999	2,081	1,523	965					
27,000-32,999	2,880	2,322	1,764	1,207				
33,000-38,999	3,679	3,121	2,563	2,006	1,448			
39,000-44,999	4,478	3,920	3,362	2,805	2,247	1,689		
45,000-53,999	5,277	4,719	4,161	3,604	3,046	2,488	1,931	
54,000-64,999	6,875	6,317	5,759	5,202	4,644	4,086	3,529	2,413

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	542							
15,000-20,999	1,341	813						
21,000-26,999	2,140	1,612	1,083					
27,000-32,999	2,939	2,411	1,882	1,354				
33,000-38,999	3,738	3,210	2,681	2,153	1,625			
39,000-44,999	4,537	4,009	3,480	2,952	2,424	1,896		
45,000-53,999	5,336	4,808	4,279	3,751	3,223	2,695	2,167	
54,000-64,999	6,934	6,406	5,877	5,349	4,821	4,293	3,765	2,708

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	687							
15,000-20,999	1,486	1,031						
21,000-26,999	2,285	1,830	1,374					
27,000-32,999	3,084	2,629	2,173	1,718				
33,000-38,999	3,883	3,428	2,972	2,517	2,061			
39,000-44,999	4,682	4,227	3,771	3,316	2,860	2,405		
45,000-53,999	5,481	5,026	4,570	4,115	3,659	3,204	2,748	
54,000-64,999	7,079	6,624	6,168	5,713	5,257	4,802	4,346	3,435
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	797							
15,000-20,999	1,596	1,196						
21,000-26,999	2,395	1,995	1,594					
27,000-32,999	3,194	2,794	2,393	1,993				
33,000-38,999	3,993	3,593	3,192	2,792	2,391			
39,000-44,999	4,792	4,392	3,991	3,591	3,190	2,790		
45,000-53,999	5,591	5,191	4,790	4,390	3,989	3,589	3,188	
54,000-64,999	7,189	6,789	6,388	5,988	5,587	5,187	4,786	3,986

Cooling, Early Retirement

Table 397 through Table 406 present the cooling energy savings (kWh) associated with the installation of a central system following the early retirement of an HVAC system for all five Texas climate zones. These savings can be used with the replace-on-burnout energy savings in Table 392 through Table 396 to calculate annual cooling savings. In each table, the capacity of the efficient unit is represented in the columns, and the capacity of the existing unit is represented in the rows. The savings are in the intersection of the appropriate efficient and existing capacities. Replacements where there has been no change in capacity are highlighted in light blue.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 397: Energy Savings (Cooling kWh) for 12.44 SEER Early Retirement Baseline—Zone 1

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	178							
15,000-20,999	784	267						
21,000-26,999	1,389	873	356					
27,000-32,999	1,995	1,478	962	445				
33,000-38,999	2,600	2,084	1,567	1,051	534			
39,000-44,999	3,206	2,689	2,173	1,656	1,140	623		
45,000-53,999	3,811	3,295	2,778	2,262	1,745	1,229	712	
54,000-64,999	5,023	4,506	3,989	3,473	2,956	2,440	1,923	890
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	218							
15,000-20,999	823	327						
21,000-26,999	1,429	932	435					
27,000-32,999	2,034	1,538	1,041	544				
33,000-38,999	2,640	2,143	1,647	1,150	653			
39,000-44,999	3,246	2,749	2,252	1,756	1,259	762		
45,000-53,999	3,851	3,354	2,858	2,361	1,864	1,368	871	
54,000-64,999	5,062	4,566	4,069	3,572	3,076	2,579	2,082	1,089

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	289							
15,000-20,999	894	433						
21,000-26,999	1,500	1,039	577					
27,000-32,999	2,105	1,644	1,183	722				
33,000-38,999	2,711	2,250	1,789	1,327	866			
39,000-44,999	3,317	2,855	2,394	1,933	1,472	1,010		
45,000-53,999	3,922	3,461	3,000	2,538	2,077	1,616	1,155	
54,000-64,999	5,133	4,672	4,211	3,750	3,288	2,827	2,366	1,443
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	399							
15,000-20,999	1,005	599						
21,000-26,999	1,610	1,204	799					
27,000-32,999	2,216	1,810	1,404	998				
33,000-38,999	2,822	2,416	2,010	1,604	1,198			
39,000-44,999	3,427	3,021	2,615	2,209	1,803	1,397		
45,000-53,999	4,033	3,627	3,221	2,815	2,409	2,003	1,597	
54,000-64,999	5,244	4,838	4,432	4,026	3,620	3,214	2,808	1,996
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	442							
15,000-20,999	1,048	664						
21,000-26,999	1,654	1,269	885					
27,000-32,999	2,259	1,875	1,490	1,106				
33,000-38,999	2,865	2,480	2,096	1,712	1,327			
39,000-44,999	3,470	3,086	2,702	2,317	1,933	1,548		
45,000-53,999	4,076	3,691	3,307	2,923	2,538	2,154	1,770	
54,000-64,999	5,287	4,903	4,518	4,134	3,750	3,365	2,981	2,212

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	546							
15,000-20,999	1,152	819						
21,000-26,999	1,757	1,425	1,092					
27,000-32,999	2,363	2,030	1,698	1,365				
33,000-38,999	2,968	2,636	2,304	1,971	1,639			
39,000-44,999	3,574	3,242	2,909	2,577	2,244	1,912		
45,000-53,999	4,180	3,847	3,515	3,182	2,850	2,517	2,185	
54,000-64,999	5,391	5,058	4,726	4,393	4,061	3,728	3,396	2,731
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	625							
15,000-20,999	1,231	938						
21,000-26,999	1,836	1,543	1,250					
27,000-32,999	2,442	2,149	1,856	1,563				
33,000-38,999	3,047	2,754	2,461	2,168	1,875			
39,000-44,999	3,653	3,360	3,067	2,774	2,481	2,188		
45,000-53,999	4,259	3,965	3,672	3,379	3,086	2,793	2,500	
54,000-64,999	5,470	5,177	4,884	4,591	4,297	4,004	3,711	3,125

Table 398: Energy Savings (Cooling kWh) for 10.0 SEER Early Retirement Baseline—Zone 1

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	474							
15,000-20,999	1,227	710						
21,000-26,999	1,980	1,464	947					
27,000-32,999	2,734	2,217	1,700	1,184				
33,000-38,999	3,487	2,970	2,454	1,937	1,421			
39,000-44,999	4,240	3,724	3,207	2,690	2,174	1,657		
45,000-53,999	4,994	4,477	3,960	3,444	2,927	2,411	1,894	
54,000-64,999	6,500	5,984	5,467	4,950	4,434	3,917	3,401	2,368
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	513							
15,000-20,999	1,267	770						
21,000-26,999	2,020	1,523	1,027					
27,000-32,999	2,773	2,277	1,780	1,283				
33,000-38,999	3,527	3,030	2,533	2,036	1,540			
39,000-44,999	4,280	3,783	3,287	2,790	2,293	1,796		
45,000-53,999	5,033	4,537	4,040	3,543	3,046	2,550	2,053	
54,000-64,999	6,540	6,043	5,547	5,050	4,553	4,056	3,560	2,566
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	584							
15,000-20,999	1,338	876						
21,000-26,999	2,091	1,630	1,168					
27,000-32,999	2,844	2,383	1,922	1,461				
33,000-38,999	3,598	3,136	2,675	2,214	1,753			
39,000-44,999	4,351	3,890	3,428	2,967	2,506	2,045		
45,000-53,999	5,104	4,643	4,182	3,721	3,259	2,798	2,337	

54,000-64,999	6,611	6,150	5,688	5,227	4,766	4,305	3,844	2,921
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	695							
15,000-20,999	1,448	1,042						
21,000-26,999	2,201	1,796	1,390					
27,000-32,999	2,955	2,549	2,143	1,737				
33,000-38,999	3,708	3,302	2,896	2,490	2,084			
39,000-44,999	4,461	4,056	3,650	3,244	2,838	2,432		
45,000-53,999	5,215	4,809	4,403	3,997	3,591	3,185	2,779	
54,000-64,999	6,721	6,316	5,910	5,504	5,098	4,692	4,286	3,474
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	738							
15,000-20,999	1,491	1,107						
21,000-26,999	2,245	1,860	1,476					
27,000-32,999	2,998	2,614	2,229	1,845				
33,000-38,999	3,751	3,367	2,983	2,598	2,214			
39,000-44,999	4,505	4,120	3,736	3,351	2,967	2,583		
45,000-53,999	5,258	4,874	4,489	4,105	3,720	3,336	2,952	
54,000-64,999	6,765	6,380	5,996	5,612	5,227	4,843	4,458	3,690
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	842							
15,000-20,999	1,595	1,263						
21,000-26,999	2,348	2,016	1,683					
27,000-32,999	3,102	2,769	2,437	2,104				
33,000-38,999	3,855	3,523	3,190	2,858	2,525			
39,000-44,999	4,608	4,276	3,943	3,611	3,278	2,946		
45,000-53,999	5,362	5,029	4,697	4,364	4,032	3,699	3,367	

54,000-64,999	6,868	6,536	6,203	5,871	5,538	5,206	4,874	4,209
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	921							
15,000-20,999	1,674	1,381						
21,000-26,999	2,427	2,134	1,841					
27,000-32,999	3,181	2,888	2,594	2,301				
33,000-38,999	3,934	3,641	3,348	3,055	2,762			
39,000-44,999	4,687	4,394	4,101	3,808	3,515	3,222		
45,000-53,999	5,441	5,148	4,854	4,561	4,268	3,975	3,682	
54,000-64,999	6,947	6,654	6,361	6,068	5,775	5,482	5,189	4,603

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 399: Energy Savings (Cooling kWh) for 12.44 SEER Early Retirement Baseline—Zone 2

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	289							
15,000-20,999	1,270	433						
21,000-26,999	2,252	1,414	577					
27,000-32,999	3,233	2,396	1,559	721				
33,000-38,999	4,215	3,378	2,540	1,703	866			
39,000-44,999	5,196	4,359	3,522	2,684	1,847	1,010		
45,000-53,999	6,178	5,341	4,503	3,666	2,829	1,991	1,154	
54,000-64,999	8,141	7,304	6,467	5,629	4,792	3,955	3,117	1,443

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	353							
15,000-20,999	1,335	529						
21,000-26,999	2,316	1,511	706					
27,000-32,999	3,298	2,493	1,687	882				
33,000-38,999	4,279	3,474	2,669	1,864	1,059			
39,000-44,999	5,261	4,456	3,651	2,846	2,040	1,235		
45,000-53,999	6,242	5,437	4,632	3,827	3,022	2,217	1,412	
54,000-64,999	8,206	7,400	6,595	5,790	4,985	4,180	3,375	1,765
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	468							
15,000-20,999	1,450	702						
21,000-26,999	2,431	1,684	936					
27,000-32,999	3,413	2,665	1,917	1,170				
33,000-38,999	4,394	3,647	2,899	2,151	1,404			
39,000-44,999	5,376	4,628	3,881	3,133	2,385	1,638		
45,000-53,999	6,357	5,610	4,862	4,115	3,367	2,619	1,872	
54,000-64,999	8,321	7,573	6,825	6,078	5,330	4,583	3,835	2,340
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	651							
15,000-20,999	1,633	977						
21,000-26,999	2,615	1,959	1,303					
27,000-32,999	3,596	2,940	2,284	1,629				
33,000-38,999	4,578	3,922	3,266	2,610	1,954			
39,000-44,999	5,559	4,903	4,248	3,592	2,936	2,280		
45,000-53,999	6,541	5,885	5,229	4,573	3,917	3,262	2,606	
54,000-64,999	8,504	7,848	7,192	6,536	5,881	5,225	4,569	3,257

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	721							
15,000-20,999	1,703	1,081						
21,000-26,999	2,684	2,063	1,442					
27,000-32,999	3,666	3,045	2,424	1,802				
33,000-38,999	4,647	4,026	3,405	2,784	2,163			
39,000-44,999	5,629	5,008	4,387	3,766	3,145	2,523		
45,000-53,999	6,610	5,989	5,368	4,747	4,126	3,505	2,884	
54,000-64,999	8,574	7,953	7,331	6,710	6,089	5,468	4,847	3,605

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	890							
15,000-20,999	1,872	1,336						
21,000-26,999	2,854	2,317	1,781					
27,000-32,999	3,835	3,299	2,763	2,226				
33,000-38,999	4,817	4,280	3,744	3,208	2,671			
39,000-44,999	5,798	5,262	4,726	4,189	3,653	3,117		
45,000-53,999	6,780	6,244	5,707	5,171	4,635	4,098	3,562	
54,000-64,999	8,743	8,207	7,670	7,134	6,598	6,061	5,525	4,452

24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,019							
15,000-20,999	2,001	1,529						
21,000-26,999	2,982	2,510	2,038					
27,000-32,999	3,964	3,492	3,020	2,548				
33,000-38,999	4,945	4,473	4,001	3,529	3,057			
39,000-44,999	5,927	5,455	4,983	4,511	4,039	3,567		
45,000-53,999	6,909	6,436	5,964	5,492	5,020	4,548	4,076	
54,000-64,999	8,872	8,400	7,928	7,455	6,983	6,511	6,039	5,095

Table 400: Energy Savings (Cooling kWh) for 10.0 SEER Early Retirement Baseline—Zone 2

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	768							
15,000-20,999	1,989	1,151						
21,000-26,999	3,210	2,372	1,535					
27,000-32,999	4,431	3,593	2,756	1,919				
33,000-38,999	5,652	4,815	3,977	3,140	2,303			
39,000-44,999	6,873	6,036	5,198	4,361	3,524	2,686		
45,000-53,999	8,094	7,257	6,419	5,582	4,745	3,907	3,070	
54,000-64,999	10,536	9,699	8,862	8,024	7,187	6,350	5,512	3,838
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	832							
15,000-20,999	2,053	1,248						
21,000-26,999	3,274	2,469	1,664					
27,000-32,999	4,495	3,690	2,885	2,080				
33,000-38,999	5,716	4,911	4,106	3,301	2,496			
39,000-44,999	6,937	6,132	5,327	4,522	3,717	2,912		
45,000-53,999	8,158	7,353	6,548	5,743	4,938	4,133	3,328	
54,000-64,999	10,601	9,796	8,990	8,185	7,380	6,575	5,770	4,160
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	947							
15,000-20,999	2,168	1,420						
21,000-26,999	3,389	2,642	1,894					
27,000-32,999	4,610	3,863	3,115	2,367				
33,000-38,999	5,831	5,084	4,336	3,589	2,841			
39,000-44,999	7,052	6,305	5,557	4,810	4,062	3,314		
45,000-53,999	8,274	7,526	6,778	6,031	5,283	4,535	3,788	

54,000-64,999	10,716	9,968	9,220	8,473	7,725	6,978	6,230	4,735
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,130							
15,000-20,999	2,352	1,696						
21,000-26,999	3,573	2,917	2,261					
27,000-32,999	4,794	4,138	3,482	2,826				
33,000-38,999	6,015	5,359	4,703	4,047	3,391			
39,000-44,999	7,236	6,580	5,924	5,268	4,612	3,957		
45,000-53,999	8,457	7,801	7,145	6,489	5,833	5,178	4,522	
54,000-64,999	10,899	10,243	9,587	8,932	8,276	7,620	6,964	5,652
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,200							
15,000-20,999	2,421	1,800						
21,000-26,999	3,642	3,021	2,400					
27,000-32,999	4,863	4,242	3,621	3,000				
33,000-38,999	6,084	5,463	4,842	4,221	3,600			
39,000-44,999	7,305	6,684	6,063	5,442	4,821	4,200		
45,000-53,999	8,527	7,905	7,284	6,663	6,042	5,421	4,800	
54,000-64,999	10,969	10,348	9,727	9,105	8,484	7,863	7,242	6,000
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,369							
15,000-20,999	2,591	2,054						
21,000-26,999	3,812	3,275	2,739					
27,000-32,999	5,033	4,496	3,960	3,424				
33,000-38,999	6,254	5,717	5,181	4,645	4,108			
39,000-44,999	7,475	6,939	6,402	5,866	5,330	4,793		
45,000-53,999	8,696	8,160	7,623	7,087	6,551	6,014	5,478	

54,000-64,999	11,138	10,602	10,065	9,529	8,993	8,456	7,920	6,847
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,498							
15,000-20,999	2,719	2,247						
21,000-26,999	3,940	3,468	2,996					
27,000-32,999	5,161	4,689	4,217	3,745				
33,000-38,999	6,382	5,910	5,438	4,966	4,494			
39,000-44,999	7,603	7,131	6,659	6,187	5,715	5,243		
45,000-53,999	8,825	8,352	7,880	7,408	6,936	6,464	5,992	
54,000-64,999	11,267	10,795	10,323	9,851	9,378	8,906	8,434	7,490

Climate Zone 3: South Region, Houston Weather Data

Table 401: Energy Savings (Cooling kWh) for 12.44 SEER Early Retirement Baseline—Zone 3

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	338							
15,000-20,999	1,487	507						
21,000-26,999	2,636	1,656	676					
27,000-32,999	3,786	2,805	1,825	845				
33,000-38,999	4,935	3,955	2,974	1,994	1,014			
39,000-44,999	6,084	5,104	4,124	3,143	2,163	1,182		
45,000-53,999	7,234	6,253	5,273	4,293	3,312	2,332	1,351	
54,000-64,999	9,532	8,552	7,572	6,591	5,611	4,630	3,650	1,689

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	413							
15,000-20,999	1,563	620						
21,000-26,999	2,712	1,769	826					
27,000-32,999	3,861	2,919	1,976	1,033				
33,000-38,999	5,011	4,068	3,125	2,182	1,240			
39,000-44,999	6,160	5,217	4,274	3,332	2,389	1,446		
45,000-53,999	7,309	6,366	5,424	4,481	3,538	2,596	1,653	
54,000-64,999	9,608	8,665	7,722	6,780	5,837	4,894	3,952	2,066

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	548							
15,000-20,999	1,697	822						
21,000-26,999	2,847	1,971	1,096					
27,000-32,999	3,996	3,121	2,245	1,370				
33,000-38,999	5,145	4,270	3,394	2,519	1,644			
39,000-44,999	6,295	5,419	4,544	3,668	2,793	1,918		
45,000-53,999	7,444	6,568	5,693	4,818	3,942	3,067	2,192	
54,000-64,999	9,742	8,867	7,992	7,116	6,241	5,366	4,490	2,740

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	760							
15,000-20,999	1,910	1,140						
21,000-26,999	3,059	2,290	1,521					
27,000-32,999	4,208	3,439	2,670	1,901				
33,000-38,999	5,358	4,588	3,819	3,050	2,281			
39,000-44,999	6,507	5,738	4,968	4,199	3,430	2,661		
45,000-53,999	7,656	6,887	6,118	5,349	4,579	3,810	3,041	
54,000-64,999	9,955	9,186	8,416	7,647	6,878	6,109	5,340	3,801

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	842							
15,000-20,999	1,991	1,263						
21,000-26,999	3,141	2,412	1,684					
27,000-32,999	4,290	3,562	2,833	2,105				
33,000-38,999	5,439	4,711	3,983	3,254	2,526			
39,000-44,999	6,589	5,860	5,132	4,404	3,675	2,947		
45,000-53,999	7,738	7,010	6,281	5,553	4,824	4,096	3,368	
54,000-64,999	10,037	9,308	8,580	7,851	7,123	6,395	5,666	4,210
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,039							
15,000-20,999	2,189	1,559						
21,000-26,999	3,338	2,708	2,079					
27,000-32,999	4,487	3,858	3,228	2,598				
33,000-38,999	5,637	5,007	4,377	3,748	3,118			
39,000-44,999	6,786	6,156	5,527	4,897	4,267	3,638		
45,000-53,999	7,935	7,306	6,676	6,046	5,417	4,787	4,157	
54,000-64,999	10,234	9,604	8,975	8,345	7,715	7,086	6,456	5,197
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,189							
15,000-20,999	2,339	1,784						
21,000-26,999	3,488	2,933	2,378					
27,000-32,999	4,637	4,082	3,528	2,973				
33,000-38,999	5,787	5,232	4,677	4,122	3,568			
39,000-44,999	6,936	6,381	5,826	5,272	4,717	4,162		
45,000-53,999	8,085	7,530	6,976	6,421	5,866	5,312	4,757	
54,000-64,999	10,384	9,829	9,274	8,720	8,165	7,610	7,056	5,946

Table 402: Energy Savings (Cooling kWh) for 10.0 SEER Early Retirement Baseline—Zone 3

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	899							
15,000-20,999	2,328	1,348						
21,000-26,999	3,758	2,778	1,797					
27,000-32,999	5,188	4,208	3,227	2,247				
33,000-38,999	6,618	5,637	4,657	3,677	2,696			
39,000-44,999	8,047	7,067	6,087	5,106	4,126	3,145		
45,000-53,999	9,477	8,497	7,516	6,536	5,556	4,575	3,595	
54,000-64,999	12,337	11,356	10,376	9,396	8,415	7,435	6,454	4,494
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	974							
15,000-20,999	2,404	1,461						
21,000-26,999	3,834	2,891	1,948					
27,000-32,999	5,263	4,321	3,378	2,435				
33,000-38,999	6,693	5,750	4,808	3,865	2,922			
39,000-44,999	8,123	7,180	6,237	5,295	4,352	3,409		
45,000-53,999	9,553	8,610	7,667	6,725	5,782	4,839	3,896	
54,000-64,999	12,412	11,469	10,527	9,584	8,641	7,699	6,756	4,871
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,109							
15,000-20,999	2,539	1,663						
21,000-26,999	3,968	3,093	2,218					
27,000-32,999	5,398	4,523	3,647	2,772				
33,000-38,999	6,828	5,952	5,077	4,202	3,326			
39,000-44,999	8,258	7,382	6,507	5,631	4,756	3,881		
45,000-53,999	9,687	8,812	7,937	7,061	6,186	5,311	4,435	

54,000-64,999	12,547	11,671	10,796	9,921	9,045	8,170	7,295	5,544
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,321							
15,000-20,999	2,751	1,982						
21,000-26,999	4,181	3,411	2,642					
27,000-32,999	5,610	4,841	4,072	3,303				
33,000-38,999	7,040	6,271	5,502	4,733	3,963			
39,000-44,999	8,470	7,701	6,932	6,162	5,393	4,624		
45,000-53,999	9,900	9,130	8,361	7,592	6,823	6,054	5,285	
54,000-64,999	12,759	11,990	11,221	10,452	9,682	8,913	8,144	6,606
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,403							
15,000-20,999	2,833	2,104						
21,000-26,999	4,262	3,534	2,806					
27,000-32,999	5,692	4,964	4,235	3,507				
33,000-38,999	7,122	6,393	5,665	4,937	4,208			
39,000-44,999	8,552	7,823	7,095	6,367	5,638	4,910		
45,000-53,999	9,981	9,253	8,525	7,796	7,068	6,340	5,611	
54,000-64,999	12,841	12,112	11,384	10,656	9,927	9,199	8,471	7,014
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,600							
15,000-20,999	3,030	2,400						
21,000-26,999	4,460	3,830	3,200					
27,000-32,999	5,889	5,260	4,630	4,001				
33,000-38,999	7,319	6,690	6,060	5,430	4,801			
39,000-44,999	8,749	8,119	7,490	6,860	6,230	5,601		
45,000-53,999	10,179	9,549	8,919	8,290	7,660	7,030	6,401	

54,000-64,999	13,038	12,409	11,779	11,149	10,520	9,890	9,260	8,001
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,750							
15,000-20,999	3,180	2,625						
21,000-26,999	4,610	4,055	3,500					
27,000-32,999	6,039	5,485	4,930	4,375				
33,000-38,999	7,469	6,914	6,360	5,805	5,250			
39,000-44,999	8,899	8,344	7,789	7,235	6,680	6,125		
45,000-53,999	10,329	9,774	9,219	8,664	8,110	7,555	7,000	
54,000-64,999	13,188	12,633	12,079	11,524	10,969	10,415	9,860	8,750

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 403: Energy Savings (Cooling kWh) for 12.44 SEER Early Retirement Baseline—Zone 4

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	375							
15,000-20,999	1,649	562						
21,000-26,999	2,924	1,836	749					
27,000-32,999	4,198	3,111	2,024	937				
33,000-38,999	5,472	4,385	3,298	2,211	1,124			
39,000-44,999	6,747	5,660	4,573	3,485	2,398	1,311		
45,000-53,999	8,021	6,934	5,847	4,760	3,673	2,586	1,498	
54,000-64,999	10,570	9,483	8,396	7,309	6,222	5,135	4,047	1,873

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	458							
15,000-20,999	1,733	687						
21,000-26,999	3,007	1,962	916					
27,000-32,999	4,282	3,236	2,191	1,146				
33,000-38,999	5,556	4,511	3,465	2,420	1,375			
39,000-44,999	6,831	5,785	4,740	3,695	2,649	1,604		
45,000-53,999	8,105	7,060	6,014	4,969	3,924	2,878	1,833	
54,000-64,999	10,654	9,609	8,563	7,518	6,473	5,427	4,382	2,291

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	608							
15,000-20,999	1,882	911						
21,000-26,999	3,156	2,186	1,215					
27,000-32,999	4,431	3,460	2,490	1,519				
33,000-38,999	5,705	4,735	3,764	2,793	1,823			
39,000-44,999	6,980	6,009	5,039	4,068	3,097	2,127		
45,000-53,999	8,254	7,284	6,313	5,342	4,372	3,401	2,430	
54,000-64,999	10,803	9,833	8,862	7,891	6,921	5,950	4,979	3,038

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	856							
15,000-20,999	2,130	1,283						
21,000-26,999	3,404	2,558	1,711					
27,000-32,999	4,679	3,832	2,986	2,139				
33,000-38,999	5,953	5,107	4,260	3,413	2,567			
39,000-44,999	7,228	6,381	5,534	4,688	3,841	2,994		
45,000-53,999	8,502	7,656	6,809	5,962	5,116	4,269	3,422	
54,000-64,999	11,051	10,205	9,358	8,511	7,664	6,818	5,971	4,278

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	945							
15,000-20,999	2,220	1,418						
21,000-26,999	3,494	2,692	1,890					
27,000-32,999	4,769	3,967	3,165	2,363				
33,000-38,999	6,043	5,241	4,439	3,637	2,835			
39,000-44,999	7,317	6,516	5,714	4,912	4,110	3,308		
45,000-53,999	8,592	7,790	6,988	6,186	5,384	4,582	3,781	
54,000-64,999	11,141	10,339	9,537	8,735	7,933	7,131	6,329	4,726

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,166							
15,000-20,999	2,441	1,749						
21,000-26,999	3,715	3,024	2,332					
27,000-32,999	4,990	4,298	3,607	2,916				
33,000-38,999	6,264	5,573	4,881	4,190	3,499			
39,000-44,999	7,539	6,847	6,156	5,464	4,773	4,082		
45,000-53,999	8,813	8,122	7,430	6,739	6,048	5,356	4,665	
54,000-64,999	11,362	10,671	9,979	9,288	8,597	7,905	7,214	5,831

24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,334							
15,000-20,999	2,608	2,000						
21,000-26,999	3,882	3,275	2,667					
27,000-32,999	5,157	4,549	3,942	3,334				
33,000-38,999	6,431	5,824	5,216	4,608	4,001			
39,000-44,999	7,706	7,098	6,490	5,883	5,275	4,667		
45,000-53,999	8,980	8,373	7,765	7,157	6,550	5,942	5,334	
54,000-64,999	11,529	10,922	10,314	9,706	9,098	8,491	7,883	6,668

Table 404: Energy Savings (Cooling kWh) for 10.0 SEER Early Retirement Baseline—Zone 4

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	997							
15,000-20,999	2,582	1,495						
21,000-26,999	4,167	3,080	1,993					
27,000-32,999	5,753	4,666	3,579	2,491				
33,000-38,999	7,338	6,251	5,164	4,077	2,990			
39,000-44,999	8,924	7,837	6,749	5,662	4,575	3,488		
45,000-53,999	10,509	9,422	8,335	7,248	6,161	5,073	3,986	
54,000-64,999	13,680	12,593	11,506	10,419	9,331	8,244	7,157	4,983
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,080							
15,000-20,999	2,666	1,620						
21,000-26,999	4,251	3,206	2,160					
27,000-32,999	5,836	4,791	3,746	2,700				
33,000-38,999	7,422	6,377	5,331	4,286	3,241			
39,000-44,999	9,007	7,962	6,917	5,871	4,826	3,781		
45,000-53,999	10,593	9,547	8,502	7,457	6,411	5,366	4,321	
54,000-64,999	13,764	12,718	11,673	10,628	9,582	8,537	7,492	5,401
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,230							
15,000-20,999	2,815	1,844						
21,000-26,999	4,400	3,430	2,459					
27,000-32,999	5,986	5,015	4,044	3,074				
33,000-38,999	7,571	6,601	5,630	4,659	3,689			
39,000-44,999	9,157	8,186	7,215	6,245	5,274	4,303		
45,000-53,999	10,742	9,771	8,801	7,830	6,859	5,889	4,918	

54,000-64,999	13,913	12,942	11,972	11,001	10,030	9,060	8,089	6,148
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,477							
15,000-20,999	3,063	2,216						
21,000-26,999	4,648	3,802	2,955					
27,000-32,999	6,234	5,387	4,540	3,694				
33,000-38,999	7,819	6,972	6,126	5,279	4,432			
39,000-44,999	9,405	8,558	7,711	6,865	6,018	5,171		
45,000-53,999	10,990	10,143	9,297	8,450	7,603	6,757	5,910	
54,000-64,999	14,161	13,314	12,468	11,621	10,774	9,927	9,081	7,387
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,567							
15,000-20,999	3,153	2,351						
21,000-26,999	4,738	3,936	3,134					
27,000-32,999	6,323	5,521	4,720	3,918				
33,000-38,999	7,909	7,107	6,305	5,503	4,701			
39,000-44,999	9,494	8,692	7,890	7,089	6,287	5,485		
45,000-53,999	11,080	10,278	9,476	8,674	7,872	7,070	6,268	
54,000-64,999	14,250	13,449	12,647	11,845	11,043	10,241	9,439	7,835
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,788							
15,000-20,999	3,374	2,682						
21,000-26,999	4,959	4,268	3,576					
27,000-32,999	6,544	5,853	5,162	4,470				
33,000-38,999	8,130	7,439	6,747	6,056	5,364			
39,000-44,999	9,715	9,024	8,333	7,641	6,950	6,259		
45,000-53,999	11,301	10,609	9,918	9,227	8,535	7,844	7,153	

54,000-64,999	14,472	13,780	13,089	12,398	11,706	11,015	10,324	8,941
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,955							
15,000-20,999	3,541	2,933						
21,000-26,999	5,126	4,519	3,911					
27,000-32,999	6,712	6,104	5,496	4,889				
33,000-38,999	8,297	7,689	7,082	6,474	5,866			
39,000-44,999	9,883	9,275	8,667	8,060	7,452	6,844		
45,000-53,999	11,468	10,860	10,253	9,645	9,037	8,430	7,822	
54,000-64,999	14,639	14,031	13,424	12,816	12,208	11,600	10,993	9,777

Climate Zone 5: West Region El Paso Weather Data

Table 405: Energy Savings (Cooling kWh) for 12.44 SEER Early Retirement Baseline—Zone 5

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	247							
15,000-20,999	1,087	370						
21,000-26,999	1,927	1,211	494					
27,000-32,999	2,767	2,051	1,334	617				
33,000-38,999	3,607	2,891	2,174	1,457	741			
39,000-44,999	4,448	3,731	3,014	2,298	1,581	864		
45,000-53,999	5,288	4,571	3,854	3,138	2,421	1,704	988	
54,000-64,999	6,968	6,251	5,535	4,818	4,101	3,385	2,668	1,235

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	302							
15,000-20,999	1,142	453						
21,000-26,999	1,982	1,293	604					
27,000-32,999	2,822	2,133	1,444	755				
33,000-38,999	3,663	2,973	2,284	1,595	906			
39,000-44,999	4,503	3,814	3,124	2,435	1,746	1,057		
45,000-53,999	5,343	4,654	3,965	3,276	2,586	1,897	1,208	
54,000-64,999	7,023	6,334	5,645	4,956	4,267	3,578	2,889	1,510
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	401							
15,000-20,999	1,241	601						
21,000-26,999	2,081	1,441	801					
27,000-32,999	2,921	2,281	1,641	1,001				
33,000-38,999	3,761	3,121	2,481	1,841	1,202			
39,000-44,999	4,601	3,961	3,321	2,681	2,042	1,402		
45,000-53,999	5,441	4,801	4,161	3,522	2,882	2,242	1,602	
54,000-64,999	7,121	6,482	5,842	5,202	4,562	3,922	3,282	2,003
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	565							
15,000-20,999	1,405	847						
21,000-26,999	2,245	1,687	1,130					
27,000-32,999	3,085	2,528	1,970	1,412				
33,000-38,999	3,925	3,368	2,810	2,252	1,695			
39,000-44,999	4,765	4,208	3,650	3,092	2,535	1,977		
45,000-53,999	5,606	5,048	4,490	3,933	3,375	2,817	2,259	
54,000-64,999	7,286	6,728	6,170	5,613	5,055	4,497	3,940	2,824

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	624							
15,000-20,999	1,464	936						
21,000-26,999	2,304	1,776	1,248					
27,000-32,999	3,144	2,616	2,088	1,560				
33,000-38,999	3,984	3,456	2,928	2,400	1,872			
39,000-44,999	4,824	4,296	3,768	3,240	2,712	2,184		
45,000-53,999	5,665	5,136	4,608	4,080	3,552	3,024	2,496	
54,000-64,999	7,345	6,817	6,288	5,760	5,232	4,704	4,176	3,120
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	769							
15,000-20,999	1,609	1,154						
21,000-26,999	2,450	1,994	1,539					
27,000-32,999	3,290	2,834	2,379	1,923				
33,000-38,999	4,130	3,674	3,219	2,763	2,308			
39,000-44,999	4,970	4,514	4,059	3,603	3,148	2,693		
45,000-53,999	5,810	5,354	4,899	4,444	3,988	3,533	3,077	
54,000-64,999	7,490	7,035	6,579	6,124	5,668	5,213	4,757	3,846
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	879							
15,000-20,999	1,719	1,319						
21,000-26,999	2,560	2,159	1,759					
27,000-32,999	3,400	2,999	2,599	2,198				
33,000-38,999	4,240	3,839	3,439	3,038	2,638			
39,000-44,999	5,080	4,679	4,279	3,879	3,478	3,078		
45,000-53,999	5,920	5,520	5,119	4,719	4,318	3,918	3,517	
54,000-64,999	7,600	7,200	6,799	6,399	5,998	5,598	5,198	4,397

Table 406: Energy Savings (Cooling kWh) for 10.0 SEER Early Retirement Baseline—Zone 5

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	657							
15,000-20,999	1,702	985						
21,000-26,999	2,747	2,030	1,314					
27,000-32,999	3,792	3,076	2,359	1,642				
33,000-38,999	4,837	4,121	3,404	2,687	1,971			
39,000-44,999	5,882	5,166	4,449	3,732	3,016	2,299		
45,000-53,999	6,928	6,211	5,494	4,778	4,061	3,344	2,628	
54,000-64,999	9,018	8,301	7,584	6,868	6,151	5,435	4,718	3,285
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	712							
15,000-20,999	1,757	1,068						
21,000-26,999	2,802	2,113	1,424					
27,000-32,999	3,847	3,158	2,469	1,780				
33,000-38,999	4,892	4,203	3,514	2,825	2,136			
39,000-44,999	5,938	5,248	4,559	3,870	3,181	2,492		
45,000-53,999	6,983	6,294	5,604	4,915	4,226	3,537	2,848	
54,000-64,999	9,073	8,384	7,695	7,006	6,317	5,627	4,938	3,560
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	810							
15,000-20,999	1,856	1,216						
21,000-26,999	2,901	2,261	1,621					
27,000-32,999	3,946	3,306	2,666	2,026				
33,000-38,999	4,991	4,351	3,711	3,071	2,431			
39,000-44,999	6,036	5,396	4,756	4,116	3,477	2,837		
45,000-53,999	7,081	6,441	5,801	5,162	4,522	3,882	3,242	

54,000-64,999	9,171	8,531	7,892	7,252	6,612	5,972	5,332	4,052
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	975							
15,000-20,999	2,020	1,462						
21,000-26,999	3,065	2,507	1,950					
27,000-32,999	4,110	3,552	2,995	2,437				
33,000-38,999	5,155	4,598	4,040	3,482	2,925			
39,000-44,999	6,200	5,643	5,085	4,527	3,970	3,412		
45,000-53,999	7,245	6,688	6,130	5,572	5,015	4,457	3,899	
54,000-64,999	9,336	8,778	8,220	7,663	7,105	6,547	5,990	4,874
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,034							
15,000-20,999	2,079	1,551						
21,000-26,999	3,124	2,596	2,068					
27,000-32,999	4,169	3,641	3,113	2,585				
33,000-38,999	5,214	4,686	4,158	3,630	3,102			
39,000-44,999	6,259	5,731	5,203	4,675	4,147	3,619		
45,000-53,999	7,304	6,776	6,248	5,720	5,192	4,664	4,136	
54,000-64,999	9,395	8,867	8,338	7,810	7,282	6,754	6,226	5,169
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,179							
15,000-20,999	2,224	1,769						
21,000-26,999	3,269	2,814	2,359					
27,000-32,999	4,315	3,859	3,404	2,948				
33,000-38,999	5,360	4,904	4,449	3,993	3,538			
39,000-44,999	6,405	5,949	5,494	5,038	4,583	4,127		
45,000-53,999	7,450	6,994	6,539	6,083	5,628	5,173	4,717	

54,000-64,999	9,540	9,085	8,629	8,174	7,718	7,263	6,807	5,896

24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,289							
15,000-20,999	2,334	1,934						
21,000-26,999	3,379	2,979	2,579					
27,000-32,999	4,425	4,024	3,624	3,223				
33,000-38,999	5,470	5,069	4,669	4,268	3,868			
39,000-44,999	6,515	6,114	5,714	5,313	4,913	4,513		
45,000-53,999	7,560	7,159	6,759	6,359	5,958	5,558	5,157	
54,000-64,999	9,650	9,250	8,849	8,449	8,048	7,648	7,247	6,446

Heating, New Construction or Replace-on-burnout of a Heat Pump

Table 407 through Table 411 present the energy savings (kWh) for heating load types associated with a central heat pump being installed during new construction or replacing a burned-out central heat pump for all five Texas climate zones.

The rightsizing savings specified in the tables below are only applicable to Replace-on-burnout projects. New construction projects are not eligible to receive deemed savings for system rightsizing.[417]

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 407: Central Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	139							
15,000-20,999	1,177	208						
21,000-26,999	2,216	1,247	278					
27,000-32,999	3,254	2,285	1,316	347				
33,000-38,999	4,293	3,324	2,355	1,386	417			
39,000-44,999	5,331	4,362	3,393	2,424	1,455	486		
45,000-53,999	6,370	5,401	4,432	3,463	2,493	1,524	555	
54,000-64,999	8,447	7,478	6,509	5,539	4,570	3,601	2,632	694

[417] For projects using a custom baseline see TRMv6.0 Volume 4.

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	297							
15,000-20,999	1,335	445						
21,000-26,999	2,373	1,483	593					
27,000-32,999	3,412	2,522	1,632	741				
33,000-38,999	4,450	3,560	2,670	1,780	890			
39,000-44,999	5,489	4,599	3,708	2,818	1,928	1,038		
45,000-53,999	6,527	5,637	4,747	3,857	2,967	2,076	1,186	
54,000-64,999	8,604	7,714	6,824	5,934	5,043	4,153	3,263	1,483
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	378							
15,000-20,999	1,417	568						
21,000-26,999	2,455	1,606	757					
27,000-32,999	3,494	2,645	1,795	946				
33,000-38,999	4,532	3,683	2,834	1,984	1,135			
39,000-44,999	5,571	4,721	3,872	3,023	2,174	1,324		
45,000-53,999	6,609	5,760	4,911	4,061	3,212	2,363	1,514	
54,000-64,999	8,686	7,837	6,988	6,138	5,289	4,440	3,591	1,892
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	409							
15,000-20,999	1,448	614						
21,000-26,999	2,486	1,652	818					
27,000-32,999	3,525	2,691	1,857	1,023				
33,000-38,999	4,563	3,729	2,895	2,061	1,228			
39,000-44,999	5,602	4,768	3,934	3,100	2,266	1,432		
45,000-53,999	6,640	5,806	4,972	4,138	3,304	2,471	1,637	
54,000-64,999	8,717	7,883	7,049	6,215	5,381	4,548	3,714	2,046

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	439							
15,000-20,999	1,477	658						
21,000-26,999	2,516	1,697	878					
27,000-32,999	3,554	2,735	1,916	1,097				
33,000-38,999	4,593	3,774	2,955	2,136	1,316			
39,000-44,999	5,631	4,812	3,993	3,174	2,355	1,536		
45,000-53,999	6,670	5,851	5,032	4,212	3,393	2,574	1,755	
54,000-64,999	8,747	7,928	7,108	6,289	5,470	4,651	3,832	2,194

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	467							
15,000-20,999	1,506	701						
21,000-26,999	2,544	1,740	935					
27,000-32,999	3,583	2,778	1,973	1,168				
33,000-38,999	4,621	3,816	3,012	2,207	1,402			
39,000-44,999	5,660	4,855	4,050	3,245	2,441	1,636		
45,000-53,999	6,698	5,893	5,089	4,284	3,479	2,674	1,870	
54,000-64,999	8,775	7,970	7,166	6,361	5,556	4,751	3,946	2,337

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	495							
15,000-20,999	1,533	742						
21,000-26,999	2,572	1,781	990					
27,000-32,999	3,610	2,819	2,028	1,237				
33,000-38,999	4,649	3,858	3,067	2,276	1,485			
39,000-44,999	5,687	4,896	4,105	3,314	2,523	1,732		
45,000-53,999	6,726	5,935	5,144	4,353	3,562	2,771	1,980	
54,000-64,999	8,803	8,012	7,221	6,430	5,639	4,848	4,057	2,475

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	511							
15,000-20,999	1,549	766						
21,000-26,999	2,588	1,805	1,022					
27,000-32,999	3,626	2,843	2,060	1,277				
33,000-38,999	4,665	3,882	3,099	2,316	1,533			
39,000-44,999	5,703	4,920	4,137	3,354	2,571	1,788		
45,000-53,999	6,742	5,959	5,176	4,393	3,610	2,827	2,044	
54,000-64,999	8,819	8,036	7,253	6,470	5,687	4,904	4,121	2,555

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 408: Central Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	78							
15,000-20,999	649	118						
21,000-26,999	1,220	688	157					
27,000-32,999	1,790	1,259	728	196				
33,000-38,999	2,361	1,830	1,298	767	235			
39,000-44,999	2,932	2,400	1,869	1,337	806	275		
45,000-53,999	3,502	2,971	2,440	1,908	1,377	845	314	
54,000-64,999	4,644	4,112	3,581	3,049	2,518	1,987	1,455	392

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	168							
15,000-20,999	738	251						
21,000-26,999	1,309	822	335					
27,000-32,999	1,880	1,393	906	419				
33,000-38,999	2,450	1,963	1,476	990	503			
39,000-44,999	3,021	2,534	2,047	1,560	1,073	586		
45,000-53,999	3,592	3,105	2,618	2,131	1,644	1,157	670	
54,000-64,999	4,733	4,246	3,759	3,272	2,785	2,298	1,812	838
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	214							
15,000-20,999	784	321						
21,000-26,999	1,355	891	428					
27,000-32,999	1,926	1,462	998	535				
33,000-38,999	2,496	2,033	1,569	1,105	641			
39,000-44,999	3,067	2,603	2,140	1,676	1,212	748		
45,000-53,999	3,638	3,174	2,710	2,247	1,783	1,319	855	
54,000-64,999	4,779	4,315	3,852	3,388	2,924	2,460	1,997	1,069
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	231							
15,000-20,999	802	347						
21,000-26,999	1,373	917	462					
27,000-32,999	1,943	1,488	1,033	578				
33,000-38,999	2,514	2,059	1,604	1,149	694			
39,000-44,999	3,085	2,629	2,174	1,719	1,264	809		
45,000-53,999	3,655	3,200	2,745	2,290	1,835	1,380	925	
54,000-64,999	4,797	4,341	3,886	3,431	2,976	2,521	2,066	1,156

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	248							
15,000-20,999	819	372						
21,000-26,999	1,389	943	496					
27,000-32,999	1,960	1,513	1,067	620				
33,000-38,999	2,531	2,084	1,637	1,191	744			
39,000-44,999	3,101	2,655	2,208	1,761	1,315	868		
45,000-53,999	3,672	3,225	2,779	2,332	1,885	1,438	992	
54,000-64,999	4,813	4,367	3,920	3,473	3,027	2,580	2,133	1,240
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	264							
15,000-20,999	835	396						
21,000-26,999	1,405	967	528					
27,000-32,999	1,976	1,537	1,099	660				
33,000-38,999	2,547	2,108	1,670	1,231	792			
39,000-44,999	3,117	2,679	2,240	1,802	1,363	924		
45,000-53,999	3,688	3,249	2,811	2,372	1,934	1,495	1,056	
54,000-64,999	4,829	4,391	3,952	3,514	3,075	2,636	2,198	1,320
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	280							
15,000-20,999	850	419						
21,000-26,999	1,421	990	559					
27,000-32,999	1,992	1,561	1,130	699				
33,000-38,999	2,562	2,131	1,701	1,270	839			
39,000-44,999	3,133	2,702	2,271	1,840	1,410	979		
45,000-53,999	3,704	3,273	2,842	2,411	1,980	1,549	1,119	
54,000-64,999	4,845	4,414	3,983	3,552	3,122	2,691	2,260	1,398

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	289							
15,000-20,999	859	433						
21,000-26,999	1,430	1,004	577					
27,000-32,999	2,001	1,574	1,148	722				
33,000-38,999	2,571	2,145	1,719	1,292	866			
39,000-44,999	3,142	2,716	2,289	1,863	1,437	1,010		
45,000-53,999	3,713	3,286	2,860	2,434	2,007	1,581	1,155	
54,000-64,999	4,854	4,428	4,001	3,575	3,149	2,722	2,296	1,444

Climate Zone 3: South Region, Houston Weather Data

Table 409: Central Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	51							
15,000-20,999	420	77						
21,000-26,999	789	446	102					
27,000-32,999	1,158	815	471	128				
33,000-38,999	1,527	1,184	840	497	154			
39,000-44,999	1,896	1,552	1,209	866	523	179		
45,000-53,999	2,265	1,921	1,578	1,235	892	548	205	
54,000-64,999	3,003	2,659	2,316	1,973	1,629	1,286	943	256

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	109							
15,000-20,999	478	164						
21,000-26,999	847	533	219					
27,000-32,999	1,216	902	588	274				
33,000-38,999	1,585	1,271	957	642	328			
39,000-44,999	1,954	1,640	1,326	1,011	697	383		
45,000-53,999	2,323	2,009	1,694	1,380	1,066	752	438	
54,000-64,999	3,061	2,747	2,432	2,118	1,804	1,490	1,176	547
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	140							
15,000-20,999	509	209						
21,000-26,999	877	578	279					
27,000-32,999	1,246	947	648	349				
33,000-38,999	1,615	1,316	1,017	718	419			
39,000-44,999	1,984	1,685	1,386	1,087	788	489		
45,000-53,999	2,353	2,054	1,755	1,456	1,157	858	559	
54,000-64,999	3,091	2,792	2,493	2,194	1,895	1,595	1,296	698
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	151							
15,000-20,999	520	226						
21,000-26,999	889	595	302					
27,000-32,999	1,258	964	671	377				
33,000-38,999	1,627	1,333	1,040	746	453			
39,000-44,999	1,996	1,702	1,409	1,115	822	528		
45,000-53,999	2,364	2,071	1,778	1,484	1,191	897	604	
54,000-64,999	3,102	2,809	2,515	2,222	1,929	1,635	1,342	755

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	162							
15,000-20,999	531	243						
21,000-26,999	900	612	324					
27,000-32,999	1,269	981	693	405				
33,000-38,999	1,638	1,350	1,062	774	486			
39,000-44,999	2,006	1,719	1,431	1,143	855	567		
45,000-53,999	2,375	2,087	1,800	1,512	1,224	936	648	
54,000-64,999	3,113	2,825	2,537	2,249	1,961	1,674	1,386	810
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	172							
15,000-20,999	541	259						
21,000-26,999	910	628	345					
27,000-32,999	1,279	997	714	431				
33,000-38,999	1,648	1,365	1,083	800	517			
39,000-44,999	2,017	1,734	1,452	1,169	886	604		
45,000-53,999	2,386	2,103	1,821	1,538	1,255	973	690	
54,000-64,999	3,124	2,841	2,558	2,276	1,993	1,710	1,428	862
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	183							
15,000-20,999	552	274						
21,000-26,999	920	643	365					
27,000-32,999	1,289	1,012	734	457				
33,000-38,999	1,658	1,381	1,103	825	548			
39,000-44,999	2,027	1,750	1,472	1,194	917	639		
45,000-53,999	2,396	2,119	1,841	1,563	1,286	1,008	731	
54,000-64,999	3,134	2,856	2,579	2,301	2,024	1,746	1,468	913

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	189							
15,000-20,999	557	283						
21,000-26,999	926	652	377					
27,000-32,999	1,295	1,021	746	471				
33,000-38,999	1,664	1,390	1,115	840	566			
39,000-44,999	2,033	1,758	1,484	1,209	935	660		
45,000-53,999	2,402	2,127	1,853	1,578	1,303	1,029	754	
54,000-64,999	3,140	2,865	2,591	2,316	2,041	1,767	1,492	943

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 410: Central Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	34							
15,000-20,999	282	52						
21,000-26,999	529	299	69					
27,000-32,999	776	546	316	86				
33,000-38,999	1,024	794	563	333	103			
39,000-44,999	1,271	1,041	811	581	350	120		
45,000-53,999	1,518	1,288	1,058	828	598	368	137	
54,000-64,999	2,013	1,783	1,553	1,323	1,092	862	632	172

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	73							
15,000-20,999	321	110						
21,000-26,999	568	357	147					
27,000-32,999	815	605	394	183				
33,000-38,999	1,063	852	641	431	220			
39,000-44,999	1,310	1,099	889	678	467	257		
45,000-53,999	1,557	1,347	1,136	925	715	504	293	
54,000-64,999	2,052	1,841	1,631	1,420	1,209	999	788	367

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	94							
15,000-20,999	341	140						
21,000-26,999	588	388	187					
27,000-32,999	836	635	435	234				
33,000-38,999	1,083	882	682	481	281			
39,000-44,999	1,330	1,130	929	729	528	328		
45,000-53,999	1,578	1,377	1,177	976	776	575	374	
54,000-64,999	2,072	1,872	1,671	1,471	1,270	1,070	869	468

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	101							
15,000-20,999	349	152						
21,000-26,999	596	399	202					
27,000-32,999	843	647	450	253				
33,000-38,999	1,091	894	697	500	304			
39,000-44,999	1,338	1,141	944	748	551	354		
45,000-53,999	1,585	1,389	1,192	995	798	602	405	
54,000-64,999	2,080	1,883	1,686	1,490	1,293	1,096	900	506

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	109							
15,000-20,999	356	163						
21,000-26,999	603	410	217					
27,000-32,999	851	658	464	271				
33,000-38,999	1,098	905	712	519	326			
39,000-44,999	1,345	1,152	959	766	573	380		
45,000-53,999	1,593	1,400	1,206	1,013	820	627	434	
54,000-64,999	2,087	1,894	1,701	1,508	1,315	1,122	929	543
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	116							
15,000-20,999	363	173						
21,000-26,999	610	421	231					
27,000-32,999	858	668	479	289				
33,000-38,999	1,105	915	726	536	347			
39,000-44,999	1,352	1,163	973	784	594	405		
45,000-53,999	1,600	1,410	1,221	1,031	842	652	463	
54,000-64,999	2,094	1,905	1,715	1,526	1,336	1,147	957	578
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	122							
15,000-20,999	370	184						
21,000-26,999	617	431	245					
27,000-32,999	864	678	492	306				
33,000-38,999	1,112	926	740	553	367			
39,000-44,999	1,359	1,173	987	801	615	429		
45,000-53,999	1,606	1,420	1,234	1,048	862	676	490	
54,000-64,999	2,101	1,915	1,729	1,543	1,357	1,171	984	612

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	126							
15,000-20,999	374	190						
21,000-26,999	621	437	253					
27,000-32,999	868	684	500	316				
33,000-38,999	1,116	932	747	563	379			
39,000-44,999	1,363	1,179	995	811	627	442		
45,000-53,999	1,610	1,426	1,242	1,058	874	690	506	
54,000-64,999	2,105	1,921	1,737	1,553	1,369	1,184	1,000	632

Climate Zone 5: West Region El Paso Weather Data

Table 411: Central Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	81							
15,000-20,999	667	122						
21,000-26,999	1,253	708	163					
27,000-32,999	1,839	1,294	749	203				
33,000-38,999	2,425	1,880	1,334	789	244			
39,000-44,999	3,011	2,465	1,920	1,375	830	285		
45,000-53,999	3,596	3,051	2,506	1,961	1,416	871	325	
54,000-64,999	4,768	4,223	3,678	3,133	2,587	2,042	1,497	407

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	174							
15,000-20,999	760	261						
21,000-26,999	1,345	846	348					
27,000-32,999	1,931	1,432	933	434				
33,000-38,999	2,517	2,018	1,519	1,020	521			
39,000-44,999	3,103	2,604	2,105	1,606	1,107	608		
45,000-53,999	3,689	3,190	2,691	2,192	1,693	1,194	695	
54,000-64,999	4,861	4,362	3,863	3,364	2,865	2,366	1,867	869

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	222							
15,000-20,999	808	333						
21,000-26,999	1,393	918	443					
27,000-32,999	1,979	1,504	1,029	554				
33,000-38,999	2,565	2,090	1,615	1,140	665			
39,000-44,999	3,151	2,676	2,201	1,726	1,251	776		
45,000-53,999	3,737	3,262	2,787	2,312	1,837	1,362	887	
54,000-64,999	4,908	4,434	3,959	3,484	3,009	2,534	2,059	1,109

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	240							
15,000-20,999	826	360						
21,000-26,999	1,411	946	480					
27,000-32,999	1,997	1,531	1,065	599				
33,000-38,999	2,583	2,117	1,651	1,185	719			
39,000-44,999	3,169	2,703	2,237	1,771	1,305	839		
45,000-53,999	3,755	3,289	2,823	2,357	1,891	1,425	959	
54,000-64,999	4,927	4,461	3,995	3,529	3,063	2,597	2,131	1,199

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	257							
15,000-20,999	843	386						
21,000-26,999	1,429	972	514					
27,000-32,999	2,015	1,557	1,100	643				
33,000-38,999	2,601	2,143	1,686	1,229	771			
39,000-44,999	3,186	2,729	2,272	1,815	1,357	900		
45,000-53,999	3,772	3,315	2,858	2,400	1,943	1,486	1,029	
54,000-64,999	4,944	4,487	4,029	3,572	3,115	2,658	2,200	1,286
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	274							
15,000-20,999	860	411						
21,000-26,999	1,446	997	548					
27,000-32,999	2,031	1,583	1,134	685				
33,000-38,999	2,617	2,168	1,719	1,271	822			
39,000-44,999	3,203	2,754	2,305	1,856	1,408	959		
45,000-53,999	3,789	3,340	2,891	2,442	1,993	1,544	1,096	
54,000-64,999	4,961	4,512	4,063	3,614	3,165	2,716	2,267	1,369
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	290							
15,000-20,999	876	435						
21,000-26,999	1,462	1,021	580					
27,000-32,999	2,048	1,607	1,166	725				
33,000-38,999	2,633	2,193	1,752	1,311	870			
39,000-44,999	3,219	2,778	2,338	1,897	1,456	1,015		
45,000-53,999	3,805	3,364	2,923	2,483	2,042	1,601	1,160	
54,000-64,999	4,977	4,536	4,095	3,654	3,213	2,773	2,332	1,450

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	299							
15,000-20,999	885	449						
21,000-26,999	1,471	1,035	599					
27,000-32,999	2,057	1,621	1,185	749				
33,000-38,999	2,643	2,207	1,771	1,334	898			
39,000-44,999	3,229	2,793	2,356	1,920	1,484	1,048		
45,000-53,999	3,814	3,378	2,942	2,506	2,070	1,634	1,198	
54,000-64,999	4,986	4,550	4,114	3,678	3,242	2,806	2,369	1,497

Heating, Replace-on-burnout—Replacement of an Electric Resistance Furnace

Table 412 through Table 416 present the energy savings (kWh) per heating load type associated with a central heat pump replacing on burnout an electric resistance furnace for all five Texas climate zones. In each table, the capacity of the efficient unit is represented in the columns and the capacity of the existing unit is represented in the rows. The savings are in the intersection of the appropriate efficient and existing capacities. Replacements where there has been no change in capacity are highlighted in light blue.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 412: Central Energy Savings (Heating kWh) for 3.41 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,313							
15,000-20,999	7,438	6,469						
21,000-26,999	10,564	9,595	8,626					
27,000-32,999	13,689	12,720	11,751	10,782				
33,000-38,999	16,815	15,846	14,876	13,907	12,938			
39,000-44,999	19,940	18,971	18,002	17,033	16,064	15,095		
45,000-53,999	23,065	22,096	21,127	20,158	19,189	18,220	17,251	
54,000-64,999	29,316	28,347	27,378	26,409	25,440	24,471	23,502	21,564

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,470							
15,000-20,999	7,596	6,706						
21,000-26,999	10,721	9,831	8,941					
27,000-32,999	13,847	12,957	12,066	11,176				
33,000-38,999	16,972	16,082	15,192	14,302	13,411			
39,000-44,999	20,098	19,207	18,317	17,427	16,537	15,647		
45,000-53,999	23,223	22,333	21,443	20,552	19,662	18,772	17,882	
54,000-64,999	29,474	28,584	27,694	26,803	25,913	25,023	24,133	22,352
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,552							
15,000-20,999	7,678	6,828						
21,000-26,999	10,803	9,954	9,105					
27,000-32,999	13,929	13,079	12,230	11,381				
33,000-38,999	17,054	16,205	15,356	14,506	13,657			
39,000-44,999	20,180	19,330	18,481	17,632	16,782	15,933		
45,000-53,999	23,305	22,456	21,606	20,757	19,908	19,059	18,209	
54,000-64,999	29,556	28,707	27,857	27,008	26,159	25,310	24,460	22,762
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,583							
15,000-20,999	7,709	6,875						
21,000-26,999	10,834	10,000	9,166					
27,000-32,999	13,959	13,126	12,292	11,458				
33,000-38,999	17,085	16,251	15,417	14,583	13,749			
39,000-44,999	20,210	19,376	18,543	17,709	16,875	16,041		
45,000-53,999	23,336	22,502	21,668	20,834	20,000	19,166	18,332	
54,000-64,999	29,587	28,753	27,919	27,085	26,251	25,417	24,583	22,916

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,613							
15,000-20,999	7,738	6,919						
21,000-26,999	10,864	10,045	9,226					
27,000-32,999	13,989	13,170	12,351	11,532				
33,000-38,999	17,115	16,295	15,476	14,657	13,838			
39,000-44,999	20,240	19,421	18,602	17,783	16,964	16,145		
45,000-53,999	23,365	22,546	21,727	20,908	20,089	19,270	18,451	
54,000-64,999	29,616	28,797	27,978	27,159	26,340	25,521	24,702	23,064
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,641							
15,000-20,999	7,767	6,962						
21,000-26,999	10,892	10,087	9,283					
27,000-32,999	14,018	13,213	12,408	11,603				
33,000-38,999	17,143	16,338	15,534	14,729	13,924			
39,000-44,999	20,269	19,464	18,659	17,854	17,049	16,245		
45,000-53,999	23,394	22,589	21,784	20,980	20,175	19,370	18,565	
54,000-64,999	29,645	28,840	28,035	27,231	26,426	25,621	24,816	23,207
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,669							
15,000-20,999	7,794	7,003						
21,000-26,999	10,920	10,129	9,338					
27,000-32,999	14,045	13,254	12,463	11,672				
33,000-38,999	17,171	16,380	15,589	14,798	14,007			
39,000-44,999	20,296	19,505	18,714	17,923	17,132	16,341		
45,000-53,999	23,422	22,631	21,839	21,048	20,257	19,466	18,675	
54,000-64,999	29,672	28,881	28,090	27,299	26,508	25,717	24,926	23,344

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,685							
15,000-20,999	7,810	7,027						
21,000-26,999	10,936	10,153	9,370					
27,000-32,999	14,061	13,278	12,495	11,712				
33,000-38,999	17,187	16,404	15,621	14,838	14,055			
39,000-44,999	20,312	19,529	18,746	17,963	17,180	16,397		
45,000-53,999	23,438	22,655	21,872	21,089	20,306	19,523	18,740	
54,000-64,999	29,688	28,905	28,122	27,339	26,556	25,773	24,990	23,424

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 413: Central Energy Savings (Heating kWh) for 3.41HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,461							
15,000-20,999	4,224	3,692						
21,000-26,999	5,986	5,454	4,923					
27,000-32,999	7,748	7,217	6,685	6,154				
33,000-38,999	9,510	8,979	8,447	7,916	7,384			
39,000-44,999	11,272	10,741	10,209	9,678	9,147	8,615		
45,000-53,999	13,035	12,503	11,972	11,440	10,909	10,377	9,846	
54,000-64,999	16,559	16,027	15,496	14,965	14,433	13,902	13,370	12,307

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,551							
15,000-20,999	4,313	3,826						
21,000-26,999	6,075	5,588	5,101					
27,000-32,999	7,837	7,350	6,863	6,376				
33,000-38,999	9,599	9,112	8,625	8,139	7,652			
39,000-44,999	11,361	10,875	10,388	9,901	9,414	8,927		
45,000-53,999	13,124	12,637	12,150	11,663	11,176	10,689	10,202	
54,000-64,999	16,648	16,161	15,674	15,187	14,700	14,213	13,727	12,753

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,597							
15,000-20,999	4,359	3,895						
21,000-26,999	6,121	5,657	5,194					
27,000-32,999	7,883	7,420	6,956	6,492				
33,000-38,999	9,646	9,182	8,718	8,254	7,790			
39,000-44,999	11,408	10,944	10,480	10,016	9,553	9,089		
45,000-53,999	13,170	12,706	12,242	11,779	11,315	10,851	10,387	
54,000-64,999	16,694	16,230	15,767	15,303	14,839	14,375	13,912	12,984

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,614							
15,000-20,999	4,376	3,921						
21,000-26,999	6,139	5,684	5,228					
27,000-32,999	7,901	7,446	6,991	6,536				
33,000-38,999	9,663	9,208	8,753	8,298	7,843			
39,000-44,999	11,425	10,970	10,515	10,060	9,605	9,150		
45,000-53,999	13,187	12,732	12,277	11,822	11,367	10,912	10,457	
54,000-64,999	16,712	16,257	15,801	15,346	14,891	14,436	13,981	13,071

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,631							
15,000-20,999	4,393	3,946						
21,000-26,999	6,155	5,709	5,262					
27,000-32,999	7,917	7,471	7,024	6,577				
33,000-38,999	9,680	9,233	8,786	8,340	7,893			
39,000-44,999	11,442	10,995	10,548	10,102	9,655	9,208		
45,000-53,999	13,204	12,757	12,311	11,864	11,417	10,971	10,524	
54,000-64,999	16,728	16,282	15,835	15,388	14,942	14,495	14,048	13,155

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,647							
15,000-20,999	4,409	3,971						
21,000-26,999	6,171	5,733	5,294					
27,000-32,999	7,934	7,495	7,056	6,618				
33,000-38,999	9,696	9,257	8,819	8,380	7,941			
39,000-44,999	11,458	11,019	10,581	10,142	9,703	9,265		
45,000-53,999	13,220	12,782	12,343	11,904	11,466	11,027	10,588	
54,000-64,999	16,745	16,306	15,867	15,429	14,990	14,551	14,113	13,235

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,663							
15,000-20,999	4,425	3,994						
21,000-26,999	6,187	5,756	5,325					
27,000-32,999	7,949	7,518	7,087	6,657				
33,000-38,999	9,711	9,281	8,850	8,419	7,988			
39,000-44,999	11,474	11,043	10,612	10,181	9,750	9,319		
45,000-53,999	13,236	12,805	12,374	11,943	11,512	11,081	10,651	
54,000-64,999	16,760	16,329	15,898	15,468	15,037	14,606	14,175	13,313

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,672							
15,000-20,999	4,434	4,008						
21,000-26,999	6,196	5,770	5,343					
27,000-32,999	7,958	7,532	7,106	6,679				
33,000-38,999	9,720	9,294	8,868	8,441	8,015			
39,000-44,999	11,483	11,056	10,630	10,204	9,777	9,351		
45,000-53,999	13,245	12,818	12,392	11,966	11,540	11,113	10,687	
54,000-64,999	16,769	16,343	15,917	15,490	15,064	14,638	14,211	13,359

Climate Zone 3: South Region, Houston Weather Data

Table 414: Central Energy Savings (Heating kWh) for 3.41 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,613							
15,000-20,999	2,764	2,420						
21,000-26,999	3,914	3,570	3,227					
27,000-32,999	5,064	4,720	4,377	4,034				
33,000-38,999	6,214	5,870	5,527	5,184	4,840			
39,000-44,999	7,364	7,020	6,677	6,334	5,991	5,647		
45,000-53,999	8,514	8,170	7,827	7,484	7,141	6,797	6,454	
54,000-64,999	10,814	10,470	10,127	9,784	9,441	9,097	8,754	8,067

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,672							
15,000-20,999	2,822	2,508						
21,000-26,999	3,972	3,658	3,343					
27,000-32,999	5,122	4,808	4,493	4,179				
33,000-38,999	6,272	5,958	5,643	5,329	5,015			
39,000-44,999	7,422	7,108	6,793	6,479	6,165	5,851		
45,000-53,999	8,572	8,258	7,944	7,629	7,315	7,001	6,687	
54,000-64,999	10,872	10,558	10,244	9,929	9,615	9,301	8,987	8,358

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,702							
15,000-20,999	2,852	2,553						
21,000-26,999	4,002	3,703	3,404					
27,000-32,999	5,152	4,853	4,554	4,255				
33,000-38,999	6,302	6,003	5,704	5,405	5,106			
39,000-44,999	7,452	7,153	6,854	6,555	6,256	5,957		
45,000-53,999	8,602	8,303	8,004	7,705	7,406	7,107	6,808	
54,000-64,999	10,902	10,603	10,304	10,005	9,706	9,407	9,108	8,509

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,713							
15,000-20,999	2,863	2,570						
21,000-26,999	4,013	3,720	3,427					
27,000-32,999	5,163	4,870	4,577	4,283				
33,000-38,999	6,313	6,020	5,727	5,433	5,140			
39,000-44,999	7,463	7,170	6,877	6,583	6,290	5,996		
45,000-53,999	8,613	8,320	8,027	7,733	7,440	7,146	6,853	
54,000-64,999	10,914	10,620	10,327	10,033	9,740	9,446	9,153	8,566

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,724							
15,000-20,999	2,874	2,586						
21,000-26,999	4,024	3,736	3,448					
27,000-32,999	5,174	4,886	4,598	4,310				
33,000-38,999	6,324	6,036	5,748	5,461	5,173			
39,000-44,999	7,474	7,186	6,898	6,611	6,323	6,035		
45,000-53,999	8,624	8,336	8,049	7,761	7,473	7,185	6,897	
54,000-64,999	10,924	10,637	10,349	10,061	9,773	9,485	9,197	8,621

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,735							
15,000-20,999	2,885	2,602						
21,000-26,999	4,035	3,752	3,469					
27,000-32,999	5,185	4,902	4,619	4,337				
33,000-38,999	6,335	6,052	5,770	5,487	5,204			
39,000-44,999	7,485	7,202	6,920	6,637	6,354	6,072		
45,000-53,999	8,635	8,352	8,070	7,787	7,504	7,222	6,939	
54,000-64,999	10,935	10,652	10,370	10,087	9,804	9,522	9,239	8,674

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,745							
15,000-20,999	2,895	2,617						
21,000-26,999	4,045	3,767	3,490					
27,000-32,999	5,195	4,917	4,640	4,362				
33,000-38,999	6,345	6,067	5,790	5,512	5,235			
39,000-44,999	7,495	7,217	6,940	6,662	6,385	6,107		
45,000-53,999	8,645	8,368	8,090	7,812	7,535	7,257	6,980	
54,000-64,999	10,945	10,668	10,390	10,112	9,835	9,557	9,280	8,724

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,751							
15,000-20,999	2,901	2,626						
21,000-26,999	4,051	3,776	3,502					
27,000-32,999	5,201	4,926	4,652	4,377				
33,000-38,999	6,351	6,076	5,802	5,527	5,252			
39,000-44,999	7,501	7,226	6,952	6,677	6,402	6,128		
45,000-53,999	8,651	8,376	8,102	7,827	7,552	7,278	7,003	
54,000-64,999	10,951	10,676	10,402	10,127	9,853	9,578	9,303	8,754

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 415: Central Energy Savings (Heating kWh) for 3.41 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,083							
15,000-20,999	1,855	1,625						
21,000-26,999	2,627	2,397	2,167					
27,000-32,999	3,399	3,169	2,939	2,709				
33,000-38,999	4,171	3,941	3,711	3,481	3,250			
39,000-44,999	4,943	4,713	4,483	4,253	4,022	3,792		
45,000-53,999	5,715	5,485	5,255	5,024	4,794	4,564	4,334	
54,000-64,999	7,259	7,029	6,798	6,568	6,338	6,108	5,878	5,417

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,123							
15,000-20,999	1,894	1,684						
21,000-26,999	2,666	2,456	2,245					
27,000-32,999	3,438	3,228	3,017	2,806				
33,000-38,999	4,210	3,999	3,789	3,578	3,368			
39,000-44,999	4,982	4,771	4,561	4,350	4,139	3,929		
45,000-53,999	5,754	5,543	5,333	5,122	4,911	4,701	4,490	
54,000-64,999	7,298	7,087	6,876	6,666	6,455	6,244	6,034	5,613

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,143							
15,000-20,999	1,915	1,714						
21,000-26,999	2,687	2,486	2,286					
27,000-32,999	3,458	3,258	3,057	2,857				
33,000-38,999	4,230	4,030	3,829	3,629	3,428			
39,000-44,999	5,002	4,802	4,601	4,401	4,200	4,000		
45,000-53,999	5,774	5,574	5,373	5,173	4,972	4,772	4,571	
54,000-64,999	7,318	7,117	6,917	6,716	6,516	6,315	6,115	5,714

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,150							
15,000-20,999	1,922	1,726						
21,000-26,999	2,694	2,497	2,301					
27,000-32,999	3,466	3,269	3,073	2,876				
33,000-38,999	4,238	4,041	3,845	3,648	3,451			
39,000-44,999	5,010	4,813	4,616	4,420	4,223	4,026		
45,000-53,999	5,782	5,585	5,388	5,192	4,995	4,798	4,602	
54,000-64,999	7,326	7,129	6,932	6,735	6,539	6,342	6,145	5,752

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,158							
15,000-20,999	1,930	1,737						
21,000-26,999	2,702	2,508	2,315					
27,000-32,999	3,473	3,280	3,087	2,894				
33,000-38,999	4,245	4,052	3,859	3,666	3,473			
39,000-44,999	5,017	4,824	4,631	4,438	4,245	4,052		
45,000-53,999	5,789	5,596	5,403	5,210	5,017	4,824	4,631	
54,000-64,999	7,333	7,140	6,947	6,754	6,561	6,368	6,175	5,789

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,165							
15,000-20,999	1,937	1,747						
21,000-26,999	2,709	2,519	2,330					
27,000-32,999	3,480	3,291	3,101	2,912				
33,000-38,999	4,252	4,063	3,873	3,684	3,494			
39,000-44,999	5,024	4,835	4,645	4,456	4,266	4,077		
45,000-53,999	5,796	5,607	5,417	5,228	5,038	4,849	4,659	
54,000-64,999	7,340	7,150	6,961	6,771	6,582	6,392	6,203	5,824

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,172							
15,000-20,999	1,943	1,757						
21,000-26,999	2,715	2,529	2,343					
27,000-32,999	3,487	3,301	3,115	2,929				
33,000-38,999	4,259	4,073	3,887	3,701	3,515			
39,000-44,999	5,031	4,845	4,659	4,473	4,287	4,101		
45,000-53,999	5,803	5,617	5,431	5,245	5,059	4,872	4,686	
54,000-64,999	7,347	7,161	6,975	6,788	6,602	6,416	6,230	5,858

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,176							
15,000-20,999	1,947	1,763						
21,000-26,999	2,719	2,535	2,351					
27,000-32,999	3,491	3,307	3,123	2,939				
33,000-38,999	4,263	4,079	3,895	3,711	3,527			
39,000-44,999	5,035	4,851	4,667	4,483	4,299	4,114		
45,000-53,999	5,807	5,623	5,439	5,255	5,070	4,886	4,702	
54,000-64,999	7,351	7,167	6,983	6,798	6,614	6,430	6,246	5,878

Climate Zone 5: West Region El Paso Weather Data

Table 416: Central Energy Savings (Heating kWh) for 3.41 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,563							
15,000-20,999	4,390	3,844						
21,000-26,999	6,216	5,671	5,126					
27,000-32,999	8,043	7,498	6,953	6,407				
33,000-38,999	9,870	9,324	8,779	8,234	7,689			
39,000-44,999	11,696	11,151	10,606	10,061	9,516	8,970		
45,000-53,999	13,523	12,978	12,432	11,887	11,342	10,797	10,252	
54,000-64,999	17,176	16,631	16,086	15,541	14,995	14,450	13,905	12,815

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,655							
15,000-20,999	4,482	3,983						
21,000-26,999	6,309	5,810	5,311					
27,000-32,999	8,135	7,636	7,137	6,638				
33,000-38,999	9,962	9,463	8,964	8,465	7,966			
39,000-44,999	11,789	11,290	10,791	10,292	9,793	9,294		
45,000-53,999	13,615	13,116	12,617	12,118	11,619	11,120	10,621	
54,000-64,999	17,268	16,770	16,271	15,772	15,273	14,774	14,275	13,277

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,703							
15,000-20,999	4,530	4,055						
21,000-26,999	6,357	5,882	5,407					
27,000-32,999	8,183	7,708	7,233	6,758				
33,000-38,999	10,010	9,535	9,060	8,585	8,110			
39,000-44,999	11,837	11,362	10,887	10,412	9,937	9,462		
45,000-53,999	13,663	13,188	12,713	12,238	11,763	11,288	10,813	
54,000-64,999	17,316	16,841	16,367	15,892	15,417	14,942	14,467	13,517

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,721							
15,000-20,999	4,548	4,082						
21,000-26,999	6,375	5,909	5,443					
27,000-32,999	8,201	7,735	7,269	6,803				
33,000-38,999	10,028	9,562	9,096	8,630	8,164			
39,000-44,999	11,855	11,389	10,923	10,457	9,991	9,525		
45,000-53,999	13,681	13,215	12,749	12,283	11,817	11,351	10,886	
54,000-64,999	17,334	16,869	16,403	15,937	15,471	15,005	14,539	13,607

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,739							
15,000-20,999	4,565	4,108						
21,000-26,999	6,392	5,935	5,478					
27,000-32,999	8,219	7,761	7,304	6,847				
33,000-38,999	10,045	9,588	9,131	8,674	8,216			
39,000-44,999	11,872	11,415	10,957	10,500	10,043	9,586		
45,000-53,999	13,699	13,241	12,784	12,327	11,870	11,412	10,955	
54,000-64,999	17,352	16,895	16,437	15,980	15,523	15,066	14,608	13,694

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,755							
15,000-20,999	4,582	4,133						
21,000-26,999	6,409	5,960	5,511					
27,000-32,999	8,235	7,787	7,338	6,889				
33,000-38,999	10,062	9,613	9,164	8,715	8,266			
39,000-44,999	11,889	11,440	10,991	10,542	10,093	9,644		
45,000-53,999	13,715	13,266	12,818	12,369	11,920	11,471	11,022	
54,000-64,999	17,369	16,920	16,471	16,022	15,573	15,124	14,675	13,777

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,772							
15,000-20,999	4,598	4,157						
21,000-26,999	6,425	5,984	5,543					
27,000-32,999	8,252	7,811	7,370	6,929				
33,000-38,999	10,078	9,637	9,197	8,756	8,315			
39,000-44,999	11,905	11,464	11,023	10,582	10,141	9,701		
45,000-53,999	13,731	13,291	12,850	12,409	11,968	11,527	11,086	
54,000-64,999	17,385	16,944	16,503	16,062	15,621	15,181	14,740	13,858

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,781							
15,000-20,999	4,608	4,172						
21,000-26,999	6,434	5,998	5,562					
27,000-32,999	8,261	7,825	7,389	6,953				
33,000-38,999	10,088	9,651	9,215	8,779	8,343			
39,000-44,999	11,914	11,478	11,042	10,606	10,170	9,734		
45,000-53,999	13,741	13,305	12,869	12,432	11,996	11,560	11,124	
54,000-64,999	17,394	16,958	16,522	16,086	15,650	15,213	14,777	13,905

Heating, Early Retirement—Replacement of a Heat Pump

See Table 417 through Table 426 for the energy savings (kWh) per heating load type associated with a central heat pump replacing another heat pump for all five Texas climate zones. In each table, the capacity of the efficient unit is represented in the columns and the capacity of the existing unit is represented in the rows. The savings are in the intersection of the appropriate efficient and existing capacities. Replacements where there has been no change in capacity are highlighted in light blue.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 417: Central Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	336							
15,000-20,999	1,472	503						
21,000-26,999	2,609	1,640	671					
27,000-32,999	3,746	2,777	1,808	839				
33,000-38,999	4,883	3,914	2,945	1,976	1,007			
39,000-44,999	6,020	5,050	4,081	3,112	2,143	1,174		
45,000-53,999	7,156	6,187	5,218	4,249	3,280	2,311	1,342	
54,000-64,999	9,430	8,461	7,492	6,523	5,554	4,585	3,616	1,678

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	493							
15,000-20,999	1,630	740						
21,000-26,999	2,767	1,877	986					
27,000-32,999	3,904	3,013	2,123	1,233				
33,000-38,999	5,040	4,150	3,260	2,370	1,480			
39,000-44,999	6,177	5,287	4,397	3,507	2,616	1,726		
45,000-53,999	7,314	6,424	5,534	4,643	3,753	2,863	1,973	
54,000-64,999	9,588	8,697	7,807	6,917	6,027	5,137	4,246	2,466

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	575							
15,000-20,999	1,712	863						
21,000-26,999	2,849	1,999	1,150					
27,000-32,999	3,985	3,136	2,287	1,438				
33,000-38,999	5,122	4,273	3,424	2,574	1,725			
39,000-44,999	6,259	5,410	4,561	3,711	2,862	2,013		
45,000-53,999	7,396	6,547	5,697	4,848	3,999	3,149	2,300	
54,000-64,999	9,669	8,820	7,971	7,122	6,272	5,423	4,574	2,875

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	606							
15,000-20,999	1,743	909						
21,000-26,999	2,879	2,046	1,212					
27,000-32,999	4,016	3,182	2,348	1,515				
33,000-38,999	5,153	4,319	3,485	2,651	1,818			
39,000-44,999	6,290	5,456	4,622	3,788	2,954	2,120		
45,000-53,999	7,427	6,593	5,759	4,925	4,091	3,257	2,423	
54,000-64,999	9,700	8,866	8,033	7,199	6,365	5,531	4,697	3,029

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	635							
15,000-20,999	1,772	953						
21,000-26,999	2,909	2,090	1,271					
27,000-32,999	4,046	3,227	2,408	1,589				
33,000-38,999	5,183	4,364	3,545	2,726	1,906			
39,000-44,999	6,320	5,500	4,681	3,862	3,043	2,224		
45,000-53,999	7,456	6,637	5,818	4,999	4,180	3,361	2,542	
54,000-64,999	9,730	8,911	8,092	7,273	6,454	5,635	4,816	3,177

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	664							
15,000-20,999	1,801	996						
21,000-26,999	2,938	2,133	1,328					
27,000-32,999	4,074	3,270	2,465	1,660				
33,000-38,999	5,211	4,406	3,602	2,797	1,992			
39,000-44,999	6,348	5,543	4,738	3,934	3,129	2,324		
45,000-53,999	7,485	6,680	5,875	5,071	4,266	3,461	2,656	
54,000-64,999	9,758	8,954	8,149	7,344	6,539	5,735	4,930	3,320

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	692							
15,000-20,999	1,828	1,037						
21,000-26,999	2,965	2,174	1,383					
27,000-32,999	4,102	3,311	2,520	1,729				
33,000-38,999	5,239	4,448	3,657	2,866	2,075			
39,000-44,999	6,376	5,585	4,794	4,003	3,211	2,420		
45,000-53,999	7,512	6,721	5,930	5,139	4,348	3,557	2,766	
54,000-64,999	9,786	8,995	8,204	7,413	6,622	5,831	5,040	3,458

12.0+ HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	708							
15,000-20,999	1,844	1,061						
21,000-26,999	2,981	2,198	1,415					
27,000-32,999	4,118	3,335	2,552	1,769				
33,000-38,999	5,255	4,472	3,689	2,906	2,123			
39,000-44,999	6,392	5,609	4,826	4,043	3,260	2,477		
45,000-53,999	7,528	6,745	5,962	5,179	4,396	3,613	2,830	
54,000-64,999	9,802	9,019	8,236	7,453	6,670	5,887	5,104	3,538

Table 418: Central Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	808							
15,000-20,999	2,181	1,212						
21,000-26,999	3,554	2,585	1,616					
27,000-32,999	4,927	3,958	2,989	2,020				
33,000-38,999	6,300	5,331	4,362	3,393	2,424			
39,000-44,999	7,673	6,704	5,735	4,766	3,797	2,828		
45,000-53,999	9,046	8,077	7,108	6,139	5,170	4,201	3,232	
54,000-64,999	11,792	10,823	9,854	8,885	7,916	6,947	5,978	4,040

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	966							
15,000-20,999	2,339	1,448						
21,000-26,999	3,712	2,821	1,931					
27,000-32,999	5,085	4,195	3,304	2,414				
33,000-38,999	6,458	5,568	4,677	3,787	2,897			
39,000-44,999	7,831	6,941	6,050	5,160	4,270	3,380		
45,000-53,999	9,204	8,314	7,423	6,533	5,643	4,753	3,863	
54,000-64,999	11,950	11,060	10,169	9,279	8,389	7,499	6,609	4,828
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,048							
15,000-20,999	2,421	1,571						
21,000-26,999	3,794	2,944	2,095					
27,000-32,999	5,167	4,317	3,468	2,619				
33,000-38,999	6,540	5,690	4,841	3,992	3,143			
39,000-44,999	7,913	7,063	6,214	5,365	4,516	3,666		
45,000-53,999	9,286	8,436	7,587	6,738	5,889	5,039	4,190	
54,000-64,999	12,032	11,182	10,333	9,484	8,635	7,785	6,936	5,238
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,078							
15,000-20,999	2,451	1,617						
21,000-26,999	3,824	2,990	2,157					
27,000-32,999	5,197	4,364	3,530	2,696				
33,000-38,999	6,570	5,737	4,903	4,069	3,235			
39,000-44,999	7,943	7,110	6,276	5,442	4,608	3,774		
45,000-53,999	9,316	8,483	7,649	6,815	5,981	5,147	4,313	
54,000-64,999	12,063	11,229	10,395	9,561	8,727	7,893	7,059	5,391

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,108							
15,000-20,999	2,481	1,662						
21,000-26,999	3,854	3,035	2,216					
27,000-32,999	5,227	4,408	3,589	2,770				
33,000-38,999	6,600	5,781	4,962	4,143	3,324			
39,000-44,999	7,973	7,154	6,335	5,516	4,697	3,878		
45,000-53,999	9,346	8,527	7,708	6,889	6,070	5,251	4,432	
54,000-64,999	12,092	11,273	10,454	9,635	8,816	7,997	7,178	5,540
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,136							
15,000-20,999	2,510	1,705						
21,000-26,999	3,883	3,078	2,273					
27,000-32,999	5,256	4,451	3,646	2,841				
33,000-38,999	6,629	5,824	5,019	4,214	3,409			
39,000-44,999	8,002	7,197	6,392	5,587	4,783	3,978		
45,000-53,999	9,375	8,570	7,765	6,960	6,156	5,351	4,546	
54,000-64,999	12,121	11,316	10,511	9,706	8,902	8,097	7,292	5,682
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,164							
15,000-20,999	2,537	1,746						
21,000-26,999	3,910	3,119	2,328					
27,000-32,999	5,283	4,492	3,701	2,910				
33,000-38,999	6,656	5,865	5,074	4,283	3,492			
39,000-44,999	8,029	7,238	6,447	5,656	4,865	4,074		
45,000-53,999	9,402	8,611	7,820	7,029	6,238	5,447	4,656	
54,000-64,999	12,148	11,357	10,566	9,775	8,984	8,193	7,402	5,820

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,180							
15,000-20,999	2,553	1,770						
21,000-26,999	3,926	3,143	2,360					
27,000-32,999	5,299	4,516	3,733	2,950				
33,000-38,999	6,672	5,889	5,106	4,323	3,540			
39,000-44,999	8,045	7,262	6,479	5,696	4,913	4,130		
45,000-53,999	9,418	8,635	7,852	7,069	6,286	5,503	4,720	
54,000-64,999	12,164	11,381	10,598	9,815	9,032	8,249	7,466	5,900

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 419: Central Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	190							
15,000-20,999	816	284						
21,000-26,999	1,442	911	379					
27,000-32,999	2,068	1,537	1,005	474				
33,000-38,999	2,694	2,163	1,632	1,100	569			
39,000-44,999	3,321	2,789	2,258	1,726	1,195	664		
45,000-53,999	3,947	3,416	2,884	2,353	1,821	1,290	758	
54,000-64,999	5,199	4,668	4,137	3,605	3,074	2,542	2,011	948

9.0-9.4 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	279							
15,000-20,999	905	418						
21,000-26,999	1,531	1,044	557					
27,000-32,999	2,157	1,670	1,184	697				
33,000-38,999	2,784	2,297	1,810	1,323	836			
39,000-44,999	3,410	2,923	2,436	1,949	1,462	975		
45,000-53,999	4,036	3,549	3,062	2,575	2,088	1,602	1,115	
54,000-64,999	5,288	4,802	4,315	3,828	3,341	2,854	2,367	1,393
9.5-9.9 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	325							
15,000-20,999	951	487						
21,000-26,999	1,577	1,114	650					
27,000-32,999	2,204	1,740	1,276	812				
33,000-38,999	2,830	2,366	1,902	1,439	975			
39,000-44,999	3,456	2,992	2,529	2,065	1,601	1,137		
45,000-53,999	4,082	3,619	3,155	2,691	2,227	1,763	1,300	
54,000-64,999	5,335	4,871	4,407	3,943	3,480	3,016	2,552	1,625
10.0-10.4 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	342							
15,000-20,999	969	513						
21,000-26,999	1,595	1,140	685					
27,000-32,999	2,221	1,766	1,311	856				
33,000-38,999	2,847	2,392	1,937	1,482	1,027			
39,000-44,999	3,473	3,018	2,563	2,108	1,653	1,198		
45,000-53,999	4,100	3,645	3,190	2,734	2,279	1,824	1,369	
54,000-64,999	5,352	4,897	4,442	3,987	3,532	3,077	2,622	1,712

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	359							
15,000-20,999	985	539						
21,000-26,999	1,612	1,165	718					
27,000-32,999	2,238	1,791	1,344	898				
33,000-38,999	2,864	2,417	1,971	1,524	1,077			
39,000-44,999	3,490	3,044	2,597	2,150	1,703	1,257		
45,000-53,999	4,116	3,670	3,223	2,776	2,330	1,883	1,436	
54,000-64,999	5,369	4,922	4,476	4,029	3,582	3,135	2,689	1,795
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	375							
15,000-20,999	1,001	563						
21,000-26,999	1,628	1,189	750					
27,000-32,999	2,254	1,815	1,377	938				
33,000-38,999	2,880	2,441	2,003	1,564	1,126			
39,000-44,999	3,506	3,068	2,629	2,190	1,752	1,313		
45,000-53,999	4,133	3,694	3,255	2,817	2,378	1,939	1,501	
54,000-64,999	5,385	4,946	4,508	4,069	3,631	3,192	2,753	1,876
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	391							
15,000-20,999	1,017	586						
21,000-26,999	1,643	1,212	782					
27,000-32,999	2,269	1,839	1,408	977				
33,000-38,999	2,896	2,465	2,034	1,603	1,172			
39,000-44,999	3,522	3,091	2,660	2,229	1,798	1,368		
45,000-53,999	4,148	3,717	3,286	2,856	2,425	1,994	1,563	
54,000-64,999	5,401	4,970	4,539	4,108	3,677	3,246	2,815	1,954

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	400							
15,000-20,999	1,026	600						
21,000-26,999	1,652	1,226	800					
27,000-32,999	2,279	1,852	1,426	1,000				
33,000-38,999	2,905	2,478	2,052	1,626	1,199			
39,000-44,999	3,531	3,105	2,678	2,252	1,826	1,399		
45,000-53,999	4,157	3,731	3,305	2,878	2,452	2,026	1,599	
54,000-64,999	5,410	4,983	4,557	4,131	3,704	3,278	2,852	1,999

Table 420: Central Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	457							
15,000-20,999	1,216	685						
21,000-26,999	1,976	1,444	913					
27,000-32,999	2,736	2,204	1,673	1,141				
33,000-38,999	3,495	2,964	2,432	1,901	1,370			
39,000-44,999	4,255	3,724	3,192	2,661	2,129	1,598		
45,000-53,999	5,015	4,483	3,952	3,420	2,889	2,358	1,826	
54,000-64,999	6,534	6,003	5,471	4,940	4,408	3,877	3,346	2,283

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	546							
15,000-20,999	1,305	818						
21,000-26,999	2,065	1,578	1,091					
27,000-32,999	2,825	2,338	1,851	1,364				
33,000-38,999	3,584	3,098	2,611	2,124	1,637			
39,000-44,999	4,344	3,857	3,370	2,883	2,397	1,910		
45,000-53,999	5,104	4,617	4,130	3,643	3,156	2,669	2,182	
54,000-64,999	6,623	6,136	5,649	5,163	4,676	4,189	3,702	2,728
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	592							
15,000-20,999	1,352	888						
21,000-26,999	2,111	1,648	1,184					
27,000-32,999	2,871	2,407	1,943	1,480				
33,000-38,999	3,631	3,167	2,703	2,239	1,776			
39,000-44,999	4,390	3,927	3,463	2,999	2,535	2,072		
45,000-53,999	5,150	4,686	4,223	3,759	3,295	2,831	2,368	
54,000-64,999	6,670	6,206	5,742	5,278	4,814	4,351	3,887	2,959
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	609							
15,000-20,999	1,369	914						
21,000-26,999	2,129	1,674	1,219					
27,000-32,999	2,888	2,433	1,978	1,523				
33,000-38,999	3,648	3,193	2,738	2,283	1,828			
39,000-44,999	4,408	3,953	3,498	3,043	2,588	2,132		
45,000-53,999	5,168	4,712	4,257	3,802	3,347	2,892	2,437	
54,000-64,999	6,687	6,232	5,777	5,322	4,867	4,412	3,956	3,046

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	626							
15,000-20,999	1,386	939						
21,000-26,999	2,145	1,699	1,252					
27,000-32,999	2,905	2,458	2,012	1,565				
33,000-38,999	3,665	3,218	2,771	2,325	1,878			
39,000-44,999	4,425	3,978	3,531	3,084	2,638	2,191		
45,000-53,999	5,184	4,738	4,291	3,844	3,397	2,951	2,504	
54,000-64,999	6,704	6,257	5,810	5,364	4,917	4,470	4,023	3,130
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	642							
15,000-20,999	1,402	963						
21,000-26,999	2,162	1,723	1,284					
27,000-32,999	2,921	2,483	2,044	1,605				
33,000-38,999	3,681	3,242	2,804	2,365	1,926			
39,000-44,999	4,441	4,002	3,563	3,125	2,686	2,248		
45,000-53,999	5,200	4,762	4,323	3,885	3,446	3,007	2,569	
54,000-64,999	6,720	6,281	5,843	5,404	4,965	4,527	4,088	3,211
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	658							
15,000-20,999	1,417	987						
21,000-26,999	2,177	1,746	1,315					
27,000-32,999	2,937	2,506	2,075	1,644				
33,000-38,999	3,697	3,266	2,835	2,404	1,973			
39,000-44,999	4,456	4,025	3,595	3,164	2,733	2,302		
45,000-53,999	5,216	4,785	4,354	3,923	3,493	3,062	2,631	
54,000-64,999	6,735	6,305	5,874	5,443	5,012	4,581	4,150	3,289

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	667							
15,000-20,999	1,426	1,000						
21,000-26,999	2,186	1,760	1,334					
27,000-32,999	2,946	2,520	2,093	1,667				
33,000-38,999	3,706	3,279	2,853	2,427	2,000			
39,000-44,999	4,465	4,039	3,613	3,186	2,760	2,334		
45,000-53,999	5,225	4,799	4,372	3,946	3,520	3,093	2,667	
54,000-64,999	6,744	6,318	5,892	5,465	5,039	4,613	4,187	3,334

Climate Zone 3: South Region, Houston Weather Data

Table 421: Central Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	124							
15,000-20,999	529	186						
21,000-26,999	934	591	248					
27,000-32,999	1,339	996	653	310				
33,000-38,999	1,745	1,401	1,058	715	371			
39,000-44,999	2,150	1,807	1,463	1,120	777	433		
45,000-53,999	2,555	2,212	1,868	1,525	1,182	839	495	
54,000-64,999	3,365	3,022	2,679	2,336	1,992	1,649	1,306	619

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	182							
15,000-20,999	587	273						
21,000-26,999	992	678	364					
27,000-32,999	1,398	1,083	769	455				
33,000-38,999	1,803	1,489	1,174	860	546			
39,000-44,999	2,208	1,894	1,580	1,265	951	637		
45,000-53,999	2,613	2,299	1,985	1,671	1,356	1,042	728	
54,000-64,999	3,424	3,109	2,795	2,481	2,167	1,853	1,538	910
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	212							
15,000-20,999	617	318						
21,000-26,999	1,023	724	424					
27,000-32,999	1,428	1,129	830	531				
33,000-38,999	1,833	1,534	1,235	936	637			
39,000-44,999	2,238	1,939	1,640	1,341	1,042	743		
45,000-53,999	2,643	2,344	2,045	1,746	1,447	1,148	849	
54,000-64,999	3,454	3,155	2,856	2,557	2,257	1,958	1,659	1,061
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	224							
15,000-20,999	629	335						
21,000-26,999	1,034	741	447					
27,000-32,999	1,439	1,146	852	559				
33,000-38,999	1,844	1,551	1,258	964	671			
39,000-44,999	2,250	1,956	1,663	1,369	1,076	782		
45,000-53,999	2,655	2,361	2,068	1,775	1,481	1,188	894	
54,000-64,999	3,465	3,172	2,878	2,585	2,291	1,998	1,705	1,118

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	235							
15,000-20,999	640	352						
21,000-26,999	1,045	757	469					
27,000-32,999	1,450	1,162	874	586				
33,000-38,999	1,855	1,567	1,279	991	704			
39,000-44,999	2,260	1,973	1,685	1,397	1,109	821		
45,000-53,999	2,666	2,378	2,090	1,802	1,514	1,226	938	
54,000-64,999	3,476	3,188	2,900	2,612	2,324	2,036	1,748	1,173
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	245							
15,000-20,999	650	368						
21,000-26,999	1,055	773	490					
27,000-32,999	1,461	1,178	895	613				
33,000-38,999	1,866	1,583	1,300	1,018	735			
39,000-44,999	2,271	1,988	1,706	1,423	1,140	858		
45,000-53,999	2,676	2,394	2,111	1,828	1,546	1,263	980	
54,000-64,999	3,487	3,204	2,921	2,639	2,356	2,073	1,791	1,225
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	255							
15,000-20,999	660	383						
21,000-26,999	1,066	788	510					
27,000-32,999	1,471	1,193	916	638				
33,000-38,999	1,876	1,598	1,321	1,043	766			
39,000-44,999	2,281	2,004	1,726	1,448	1,171	893		
45,000-53,999	2,686	2,409	2,131	1,854	1,576	1,298	1,021	
54,000-64,999	3,497	3,219	2,942	2,664	2,386	2,109	1,831	1,276

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	261							
15,000-20,999	666	392						
21,000-26,999	1,072	797	522					
27,000-32,999	1,477	1,202	927	653				
33,000-38,999	1,882	1,607	1,333	1,058	783			
39,000-44,999	2,287	2,012	1,738	1,463	1,189	914		
45,000-53,999	2,692	2,418	2,143	1,868	1,594	1,319	1,045	
54,000-64,999	3,503	3,228	2,953	2,679	2,404	2,130	1,855	1,306

Table 422: Central Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	298							
15,000-20,999	791	447						
21,000-26,999	1,283	940	596					
27,000-32,999	1,775	1,432	1,089	745				
33,000-38,999	2,268	1,924	1,581	1,238	894			
39,000-44,999	2,760	2,417	2,073	1,730	1,387	1,044		
45,000-53,999	3,252	2,909	2,566	2,223	1,879	1,536	1,193	
54,000-64,999	4,237	3,894	3,551	3,207	2,864	2,521	2,177	1,491

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	356							
15,000-20,999	849	535						
21,000-26,999	1,341	1,027	713					
27,000-32,999	1,833	1,519	1,205	891				
33,000-38,999	2,326	2,012	1,697	1,383	1,069			
39,000-44,999	2,818	2,504	2,190	1,876	1,561	1,247		
45,000-53,999	3,311	2,996	2,682	2,368	2,054	1,740	1,425	
54,000-64,999	4,295	3,981	3,667	3,353	3,039	2,724	2,410	1,782

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	387							
15,000-20,999	879	580						
21,000-26,999	1,371	1,072	773					
27,000-32,999	1,864	1,565	1,265	966				
33,000-38,999	2,356	2,057	1,758	1,459	1,160			
39,000-44,999	2,848	2,549	2,250	1,951	1,652	1,353		
45,000-53,999	3,341	3,042	2,743	2,444	2,144	1,845	1,546	
54,000-64,999	4,326	4,026	3,727	3,428	3,129	2,830	2,531	1,933

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	398							
15,000-20,999	890	597						
21,000-26,999	1,383	1,089	796					
27,000-32,999	1,875	1,582	1,288	995				
33,000-38,999	2,367	2,074	1,781	1,487	1,194			
39,000-44,999	2,860	2,566	2,273	1,980	1,686	1,393		
45,000-53,999	3,352	3,059	2,765	2,472	2,178	1,885	1,592	
54,000-64,999	4,337	4,043	3,750	3,457	3,163	2,870	2,576	1,990

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	409							
15,000-20,999	901	613						
21,000-26,999	1,394	1,106	818					
27,000-32,999	1,886	1,598	1,310	1,022				
33,000-38,999	2,378	2,090	1,802	1,515	1,227			
39,000-44,999	2,871	2,583	2,295	2,007	1,719	1,431		
45,000-53,999	3,363	3,075	2,787	2,499	2,211	1,923	1,635	
54,000-64,999	4,348	4,060	3,772	3,484	3,196	2,908	2,620	2,044

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	419							
15,000-20,999	912	629						
21,000-26,999	1,404	1,121	839					
27,000-32,999	1,897	1,614	1,331	1,048				
33,000-38,999	2,389	2,106	1,824	1,541	1,258			
39,000-44,999	2,881	2,599	2,316	2,033	1,751	1,468		
45,000-53,999	3,374	3,091	2,808	2,526	2,243	1,960	1,678	
54,000-64,999	4,358	4,076	3,793	3,510	3,228	2,945	2,662	2,097

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	430							
15,000-20,999	922	644						
21,000-26,999	1,414	1,137	859					
27,000-32,999	1,907	1,629	1,351	1,074				
33,000-38,999	2,399	2,121	1,844	1,566	1,289			
39,000-44,999	2,891	2,614	2,336	2,059	1,781	1,503		
45,000-53,999	3,384	3,106	2,829	2,551	2,273	1,996	1,718	
54,000-64,999	4,369	4,091	3,813	3,536	3,258	2,981	2,703	2,148

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	435							
15,000-20,999	928	653						
21,000-26,999	1,420	1,146	871					
27,000-32,999	1,913	1,638	1,363	1,089				
33,000-38,999	2,405	2,130	1,856	1,581	1,306			
39,000-44,999	2,897	2,623	2,348	2,073	1,799	1,524		
45,000-53,999	3,390	3,115	2,840	2,566	2,291	2,017	1,742	
54,000-64,999	4,374	4,100	3,825	3,551	3,276	3,001	2,727	2,177

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 423: Central Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	83							
15,000-20,999	355	125						
21,000-26,999	626	396	166					
27,000-32,999	898	668	438	208				
33,000-38,999	1,170	939	709	479	249			
39,000-44,999	1,441	1,211	981	751	521	291		
45,000-53,999	1,713	1,483	1,253	1,022	792	562	332	
54,000-64,999	2,256	2,026	1,796	1,566	1,336	1,106	875	415

9.0-9.4 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	122							
15,000-20,999	394	183						
21,000-26,999	665	455	244					
27,000-32,999	937	726	516	305				
33,000-38,999	1,209	998	787	577	366			
39,000-44,999	1,480	1,270	1,059	848	638	427		
45,000-53,999	1,752	1,541	1,331	1,120	909	699	488	
54,000-64,999	2,295	2,085	1,874	1,663	1,453	1,242	1,031	610
9.5-9.9 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	142							
15,000-20,999	414	213						
21,000-26,999	686	485	285					
27,000-32,999	957	757	556	356				
33,000-38,999	1,229	1,028	828	627	427			
39,000-44,999	1,501	1,300	1,100	899	698	498		
45,000-53,999	1,772	1,572	1,371	1,171	970	770	569	
54,000-64,999	2,316	2,115	1,915	1,714	1,513	1,313	1,112	711
10.0-10.4 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	150							
15,000-20,999	422	225						
21,000-26,999	693	496	300					
27,000-32,999	965	768	571	375				
33,000-38,999	1,237	1,040	843	646	450			
39,000-44,999	1,508	1,311	1,115	918	721	525		
45,000-53,999	1,780	1,583	1,386	1,190	993	796	600	
54,000-64,999	2,323	2,126	1,930	1,733	1,536	1,340	1,143	749

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	157							
15,000-20,999	429	236						
21,000-26,999	701	507	314					
27,000-32,999	972	779	586	393				
33,000-38,999	1,244	1,051	858	665	472			
39,000-44,999	1,516	1,322	1,129	936	743	550		
45,000-53,999	1,787	1,594	1,401	1,208	1,015	822	629	
54,000-64,999	2,331	2,137	1,944	1,751	1,558	1,365	1,172	786

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	164							
15,000-20,999	436	246						
21,000-26,999	708	518	329					
27,000-32,999	979	790	600	411				
33,000-38,999	1,251	1,061	872	682	493			
39,000-44,999	1,523	1,333	1,144	954	765	575		
45,000-53,999	1,794	1,605	1,415	1,226	1,036	847	657	
54,000-64,999	2,338	2,148	1,959	1,769	1,580	1,390	1,200	821

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	171							
15,000-20,999	443	257						
21,000-26,999	714	528	342					
27,000-32,999	986	800	614	428				
33,000-38,999	1,258	1,072	886	699	513			
39,000-44,999	1,529	1,343	1,157	971	785	599		
45,000-53,999	1,801	1,615	1,429	1,243	1,057	871	684	
54,000-64,999	2,344	2,158	1,972	1,786	1,600	1,414	1,228	855

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	175							
15,000-20,999	447	263						
21,000-26,999	718	534	350					
27,000-32,999	990	806	622	438				
33,000-38,999	1,262	1,078	893	709	525			
39,000-44,999	1,533	1,349	1,165	981	797	613		
45,000-53,999	1,805	1,621	1,437	1,253	1,069	884	700	
54,000-64,999	2,348	2,164	1,980	1,796	1,612	1,428	1,244	875

Table 424: Central Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	200							
15,000-20,999	530	300						
21,000-26,999	860	630	400					
27,000-32,999	1,190	960	730	500				
33,000-38,999	1,520	1,290	1,060	830	600			
39,000-44,999	1,850	1,620	1,390	1,160	930	700		
45,000-53,999	2,181	1,950	1,720	1,490	1,260	1,030	800	
54,000-64,999	2,841	2,611	2,380	2,150	1,920	1,690	1,460	999

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	239							
15,000-20,999	569	358						
21,000-26,999	899	688	478					
27,000-32,999	1,229	1,019	808	597				
33,000-38,999	1,559	1,349	1,138	927	717			
39,000-44,999	1,889	1,679	1,468	1,257	1,047	836		
45,000-53,999	2,220	2,009	1,798	1,588	1,377	1,166	956	
54,000-64,999	2,880	2,669	2,458	2,248	2,037	1,826	1,616	1,195

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	259							
15,000-20,999	589	389						
21,000-26,999	919	719	518					
27,000-32,999	1,249	1,049	848	648				
33,000-38,999	1,580	1,379	1,179	978	777			
39,000-44,999	1,910	1,709	1,509	1,308	1,108	907		
45,000-53,999	2,240	2,039	1,839	1,638	1,438	1,237	1,037	
54,000-64,999	2,900	2,699	2,499	2,298	2,098	1,897	1,697	1,296

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	267							
15,000-20,999	597	400						
21,000-26,999	927	730	534					
27,000-32,999	1,257	1,060	864	667				
33,000-38,999	1,587	1,390	1,194	997	800			
39,000-44,999	1,917	1,721	1,524	1,327	1,130	934		
45,000-53,999	2,247	2,051	1,854	1,657	1,461	1,264	1,067	
54,000-64,999	2,908	2,711	2,514	2,317	2,121	1,924	1,727	1,334

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	274							
15,000-20,999	604	411						
21,000-26,999	934	741	548					
27,000-32,999	1,264	1,071	878	685				
33,000-38,999	1,595	1,401	1,208	1,015	822			
39,000-44,999	1,925	1,732	1,539	1,345	1,152	959		
45,000-53,999	2,255	2,062	1,869	1,676	1,483	1,290	1,096	
54,000-64,999	2,915	2,722	2,529	2,336	2,143	1,950	1,757	1,371
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	281							
15,000-20,999	611	422						
21,000-26,999	941	752	562					
27,000-32,999	1,271	1,082	892	703				
33,000-38,999	1,602	1,412	1,223	1,033	844			
39,000-44,999	1,932	1,742	1,553	1,363	1,174	984		
45,000-53,999	2,262	2,072	1,883	1,693	1,504	1,314	1,125	
54,000-64,999	2,922	2,733	2,543	2,353	2,164	1,974	1,785	1,406
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	288							
15,000-20,999	618	432						
21,000-26,999	948	762	576					
27,000-32,999	1,278	1,092	906	720				
33,000-38,999	1,608	1,422	1,236	1,050	864			
39,000-44,999	1,939	1,752	1,566	1,380	1,194	1,008		
45,000-53,999	2,269	2,083	1,896	1,710	1,524	1,338	1,152	
54,000-64,999	2,929	2,743	2,557	2,370	2,184	1,998	1,812	1,440

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	292							
15,000-20,999	622	438						
21,000-26,999	952	768	584					
27,000-32,999	1,282	1,098	914	730				
33,000-38,999	1,612	1,428	1,244	1,060	876			
39,000-44,999	1,942	1,758	1,574	1,390	1,206	1,022		
45,000-53,999	2,273	2,088	1,904	1,720	1,536	1,352	1,168	
54,000-64,999	2,933	2,749	2,565	2,380	2,196	2,012	1,828	1,460

Climate Zone 5: West Region El Paso Weather Data

Table 425: Central Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	197							
15,000-20,999	840	295						
21,000-26,999	1,484	938	393					
27,000-32,999	2,127	1,582	1,037	492				
33,000-38,999	2,770	2,225	1,680	1,135	590			
39,000-44,999	3,414	2,869	2,324	1,778	1,233	688		
45,000-53,999	4,057	3,512	2,967	2,422	1,877	1,332	786	
54,000-64,999	5,344	4,799	4,254	3,709	3,164	2,619	2,073	983

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	289							
15,000-20,999	932	434						
21,000-26,999	1,576	1,077	578					
27,000-32,999	2,219	1,720	1,221	723				
33,000-38,999	2,863	2,364	1,865	1,366	867			
39,000-44,999	3,506	3,007	2,508	2,009	1,511	1,012		
45,000-53,999	4,150	3,651	3,152	2,653	2,154	1,655	1,156	
54,000-64,999	5,437	4,938	4,439	3,940	3,441	2,942	2,443	1,445
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	337							
15,000-20,999	980	505						
21,000-26,999	1,624	1,149	674					
27,000-32,999	2,267	1,792	1,317	842				
33,000-38,999	2,911	2,436	1,961	1,486	1,011			
39,000-44,999	3,554	3,079	2,604	2,129	1,654	1,179		
45,000-53,999	4,198	3,723	3,248	2,773	2,298	1,823	1,348	
54,000-64,999	5,485	5,010	4,535	4,060	3,585	3,110	2,635	1,685
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	355							
15,000-20,999	999	533						
21,000-26,999	1,642	1,176	710					
27,000-32,999	2,285	1,819	1,354	888				
33,000-38,999	2,929	2,463	1,997	1,531	1,065			
39,000-44,999	3,572	3,106	2,640	2,175	1,709	1,243		
45,000-53,999	4,216	3,750	3,284	2,818	2,352	1,886	1,420	
54,000-64,999	5,503	5,037	4,571	4,105	3,639	3,173	2,707	1,775

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	372							
15,000-20,999	1,016	559						
21,000-26,999	1,659	1,202	745					
27,000-32,999	2,303	1,846	1,388	931				
33,000-38,999	2,946	2,489	2,032	1,574	1,117			
39,000-44,999	3,590	3,132	2,675	2,218	1,761	1,303		
45,000-53,999	4,233	3,776	3,319	2,861	2,404	1,947	1,490	
54,000-64,999	5,520	5,063	4,606	4,148	3,691	3,234	2,777	1,862
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	389							
15,000-20,999	1,033	584						
21,000-26,999	1,676	1,227	778					
27,000-32,999	2,320	1,871	1,422	973				
33,000-38,999	2,963	2,514	2,065	1,616	1,167			
39,000-44,999	3,606	3,158	2,709	2,260	1,811	1,362		
45,000-53,999	4,250	3,801	3,352	2,903	2,454	2,005	1,557	
54,000-64,999	5,537	5,088	4,639	4,190	3,741	3,292	2,844	1,946
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	405							
15,000-20,999	1,049	608						
21,000-26,999	1,692	1,251	811					
27,000-32,999	2,336	1,895	1,454	1,013				
33,000-38,999	2,979	2,538	2,097	1,657	1,216			
39,000-44,999	3,623	3,182	2,741	2,300	1,859	1,418		
45,000-53,999	4,266	3,825	3,384	2,944	2,503	2,062	1,621	
54,000-64,999	5,553	5,112	4,671	4,231	3,790	3,349	2,908	2,026

12.0+ HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	415							
15,000-20,999	1,058	622						
21,000-26,999	1,702	1,265	829					
27,000-32,999	2,345	1,909	1,473	1,037				
33,000-38,999	2,989	2,552	2,116	1,680	1,244			
39,000-44,999	3,632	3,196	2,760	2,324	1,888	1,451		
45,000-53,999	4,275	3,839	3,403	2,967	2,531	2,095	1,659	
54,000-64,999	5,562	5,126	4,690	4,254	3,818	3,382	2,946	2,073

Table 426: Central Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	473							
15,000-20,999	1,255	710						
21,000-26,999	2,037	1,492	947					
27,000-32,999	2,819	2,274	1,729	1,184				
33,000-38,999	3,601	3,056	2,511	1,966	1,420			
39,000-44,999	4,383	3,838	3,293	2,748	2,202	1,657		
45,000-53,999	5,165	4,620	4,075	3,529	2,984	2,439	1,894	
54,000-64,999	6,729	6,184	5,638	5,093	4,548	4,003	3,458	2,367

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	566							
15,000-20,999	1,348	849						
21,000-26,999	2,130	1,631	1,132					
27,000-32,999	2,912	2,413	1,914	1,415				
33,000-38,999	3,693	3,195	2,696	2,197	1,698			
39,000-44,999	4,475	3,976	3,477	2,979	2,480	1,981		
45,000-53,999	5,257	4,758	4,259	3,760	3,261	2,763	2,264	
54,000-64,999	6,821	6,322	5,823	5,324	4,825	4,326	3,827	2,829
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	614							
15,000-20,999	1,396	921						
21,000-26,999	2,178	1,703	1,228					
27,000-32,999	2,960	2,485	2,010	1,535				
33,000-38,999	3,741	3,267	2,792	2,317	1,842			
39,000-44,999	4,523	4,048	3,573	3,098	2,624	2,149		
45,000-53,999	5,305	4,830	4,355	3,880	3,405	2,930	2,455	
54,000-64,999	6,869	6,394	5,919	5,444	4,969	4,494	4,019	3,069
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	632							
15,000-20,999	1,414	948						
21,000-26,999	2,196	1,730	1,264					
27,000-32,999	2,978	2,512	2,046	1,580				
33,000-38,999	3,760	3,294	2,828	2,362	1,896			
39,000-44,999	4,541	4,075	3,610	3,144	2,678	2,212		
45,000-53,999	5,323	4,857	4,391	3,925	3,460	2,994	2,528	
54,000-64,999	6,887	6,421	5,955	5,489	5,023	4,557	4,091	3,160

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	649							
15,000-20,999	1,431	974						
21,000-26,999	2,213	1,756	1,299					
27,000-32,999	2,995	2,538	2,080	1,623				
33,000-38,999	3,777	3,320	2,862	2,405	1,948			
39,000-44,999	4,559	4,102	3,644	3,187	2,730	2,272		
45,000-53,999	5,341	4,883	4,426	3,969	3,512	3,054	2,597	
54,000-64,999	6,905	6,447	5,990	5,533	5,075	4,618	4,161	3,246
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	666							
15,000-20,999	1,448	999						
21,000-26,999	2,230	1,781	1,332					
27,000-32,999	3,012	2,563	2,114	1,665				
33,000-38,999	3,794	3,345	2,896	2,447	1,998			
39,000-44,999	4,576	4,127	3,678	3,229	2,780	2,331		
45,000-53,999	5,357	4,909	4,460	4,011	3,562	3,113	2,664	
54,000-64,999	6,921	6,472	6,023	5,575	5,126	4,677	4,228	3,330
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	682							
15,000-20,999	1,464	1,023						
21,000-26,999	2,246	1,805	1,364					
27,000-32,999	3,028	2,587	2,146	1,705				
33,000-38,999	3,810	3,369	2,928	2,487	2,046			
39,000-44,999	4,592	4,151	3,710	3,269	2,828	2,388		
45,000-53,999	5,374	4,933	4,492	4,051	3,610	3,169	2,729	
54,000-64,999	6,937	6,497	6,056	5,615	5,174	4,733	4,292	3,411

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	692							
15,000-20,999	1,473	1,037						
21,000-26,999	2,255	1,819	1,383					
27,000-32,999	3,037	2,601	2,165	1,729				
33,000-38,999	3,819	3,383	2,947	2,511	2,075			
39,000-44,999	4,601	4,165	3,729	3,293	2,857	2,420		
45,000-53,999	5,383	4,947	4,511	4,075	3,638	3,202	2,766	
54,000-64,999	6,947	6,511	6,075	5,638	5,202	4,766	4,330	3,458

Heating, Early Retirement—Replacement of an Electric Resistance Furnace

See Table 412 through Table 416 for the energy savings (kWh) per heating load type associated with a central heat pump replacing an electric resistance furnace for all five Texas climate zones.

Deemed Summer Demand Savings Tables[418]

Systems rated at 17 SEER or greater are assumed to be two-stage systems, while those under 17 SEER are assumed to be single-stage systems. This results in slightly lower summer demand savings for 17.0-17.9 SEER systems as compared to 16.0-16.9 SEER systems.

New Construction

Table 427 through Table 431 present the summer demand savings (kW) associated with a central systems being installed during new construction for all 5 Texas climate zones.

[418] Rated capacity ranges are specified based on normal rounding convention between capacity categories (values at and above the midpoint round up, while values below the midpoint round down).

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 427: Summer Demand Savings for 14.0 SEER New Construction Baseline—Zone 1

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9*	18.0–20.9	21.0-23.9	24.0+
< 15,000	0.04	0.08	0.14	0.11	0.16	0.24	0.30
15,000-20,999	0.06	0.12	0.22	0.16	0.24	0.35	0.45
21,000-26,999	0.08	0.16	0.29	0.21	0.31	0.47	0.60
27,000-32,999	0.10	0.19	0.36	0.27	0.39	0.59	0.75
33,000-38,999	0.12	0.23	0.43	0.32	0.47	0.71	0.90
39,000-44,999	0.14	0.27	0.50	0.37	0.55	0.82	1.05
45,000-53,999	0.16	0.31	0.58	0.42	0.63	0.94	1.20
54,000-64,999	0.20	0.39	0.72	0.53	0.79	1.18	1.50

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 428: Summer Demand Savings for 14.0 SEER New Construction Baseline—Zone 2

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9*	18.0–20.9	21.0-23.9	24.0+
< 15,000	0.04	0.08	0.15	0.12	0.17	0.25	0.32
15,000-20,999	0.06	0.12	0.23	0.18	0.26	0.38	0.48
21,000-26,999	0.09	0.16	0.31	0.24	0.34	0.50	0.64
27,000-32,999	0.11	0.21	0.38	0.30	0.43	0.63	0.80
33,000-38,999	0.13	0.25	0.46	0.35	0.52	0.76	0.96
39,000-44,999	0.15	0.29	0.53	0.41	0.60	0.88	1.12
45,000-53,999	0.17	0.33	0.61	0.47	0.69	1.01	1.28
54,000-64,999	0.21	0.41	0.76	0.59	0.86	1.26	1.60

Climate Zone 3: South Region, Houston Weather Data

Table 429: Summer Demand Savings for 14.0 SEER New Construction Baseline—Zone 3

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9*	18.0–20.9	21.0-23.9	24.0+
< 15,000	0.04	0.08	0.15	0.10	0.16	0.23	0.29
15,000-20,999	0.06	0.12	0.22	0.15	0.23	0.35	0.44
21,000-26,999	0.08	0.16	0.30	0.21	0.31	0.46	0.59
27,000-32,999	0.10	0.20	0.37	0.26	0.39	0.58	0.74
33,000-38,999	0.12	0.24	0.45	0.31	0.47	0.69	0.88
39,000-44,999	0.15	0.28	0.52	0.36	0.55	0.81	1.03
45,000-53,999	0.17	0.32	0.59	0.41	0.62	0.92	1.18
54,000-64,999	0.21	0.40	0.74	0.51	0.78	1.16	1.47

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 430: Summer Demand Savings for 14.0 SEER New Construction Baseline—Zone 4

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9*	18.0–20.9	21.0-23.9	24.0+
< 15,000	0.03	0.06	0.12	0.15	0.19	0.27	0.33
15,000-20,999	0.05	0.09	0.17	0.22	0.28	0.40	0.49
21,000-26,999	0.06	0.12	0.23	0.30	0.37	0.53	0.66
27,000-32,999	0.08	0.16	0.29	0.37	0.46	0.66	0.82
33,000-38,999	0.10	0.19	0.35	0.45	0.56	0.80	0.98
39,000-44,999	0.11	0.22	0.41	0.52	0.65	0.93	1.15
45,000-53,999	0.13	0.25	0.46	0.60	0.74	1.06	1.31
54,000-64,999	0.16	0.31	0.58	0.75	0.93	1.33	1.64

Climate Zone 5: West Region El Paso Weather Data

Table 431: Summer Demand Savings for 14.0 SEER New Construction Baseline—Zone 5

Size (Btuh)	SEER Range						
	14.5–14.9	15.0–15.9	16.0–16.9	17.0–17.9*	18.0–20.9	21.0-23.9	24.0+
< 15,000	0.04	0.08	0.14	0.13	0.17	0.26	0.33
15,000-20,999	0.06	0.11	0.21	0.19	0.26	0.39	0.49
21,000-26,999	0.08	0.15	0.28	0.25	0.35	0.52	0.65
27,000-32,999	0.10	0.19	0.35	0.31	0.43	0.65	0.82
33,000-38,999	0.12	0.23	0.42	0.38	0.52	0.78	0.98
39,000-44,999	0.14	0.27	0.49	0.44	0.61	0.90	1.15
45,000-53,999	0.16	0.30	0.57	0.50	0.70	1.03	1.31
54,000-64,999	0.20	0.38	0.71	0.63	0.87	1.29	1.64

Replace-on-burnout

Table 432 through Table 436 present the summer demand savings (kW) associated with a central system replacing on burnout an HVAC system for all 5 Texas climate zones. In each table, the capacity of the efficient unit is represented in the columns and the capacity of the existing unit is represented in the rows. The savings are in the intersection of the appropriate efficient and existing capacities. Replacements where there has been no change in capacity are highlighted in light blue.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 432: Summer Demand Savings for 13.08 SEER Replace-on-burnout Baseline—Zone 1

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.65	0.17						
21,000-26,999	1.19	0.71	0.22					
27,000-32,999	1.73	1.25	0.76	0.28				
33,000-38,999	2.27	1.79	1.30	0.82	0.33			
39,000-44,999	2.81	2.33	1.84	1.36	0.87	0.39		
45,000-53,999	3.35	2.87	2.38	1.90	1.41	0.93	0.45	
54,000-64,999	4.43	3.94	3.46	2.98	2.49	2.01	1.52	0.56

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.69	0.22						
21,000-26,999	1.23	0.76	0.30					
27,000-32,999	1.77	1.30	0.84	0.37				
33,000-38,999	2.31	1.84	1.38	0.91	0.45			
39,000-44,999	2.85	2.38	1.92	1.45	0.99	0.52		
45,000-53,999	3.39	2.92	2.46	1.99	1.52	1.06	0.59	
54,000-64,999	4.47	4.00	3.53	3.07	2.60	2.14	1.67	0.74

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.21							
15,000-20,999	0.75	0.32						
21,000-26,999	1.29	0.86	0.43					
27,000-32,999	1.83	1.40	0.97	0.54				
33,000-38,999	2.37	1.94	1.51	1.08	0.64			
39,000-44,999	2.91	2.48	2.05	1.62	1.18	0.75		
45,000-53,999	3.45	3.02	2.59	2.16	1.72	1.29	0.86	
54,000-64,999	4.53	4.10	3.67	3.24	2.80	2.37	1.94	1.07

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.72	0.27						
21,000-26,999	1.26	0.81	0.35					
27,000-32,999	1.80	1.34	0.89	0.44				
33,000-38,999	2.34	1.88	1.43	0.98	0.53			
39,000-44,999	2.88	2.42	1.97	1.52	1.07	0.62		
45,000-53,999	3.41	2.96	2.51	2.06	1.61	1.16	0.71	
54,000-64,999	4.49	4.04	3.59	3.14	2.69	2.24	1.79	0.88

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.77	0.34						
21,000-26,999	1.31	0.88	0.46					
27,000-32,999	1.85	1.42	1.00	0.57				
33,000-38,999	2.39	1.96	1.54	1.11	0.68			
39,000-44,999	2.93	2.50	2.08	1.65	1.22	0.80		
45,000-53,999	3.47	3.04	2.61	2.19	1.76	1.34	0.91	
54,000-64,999	4.55	4.12	3.69	3.27	2.84	2.42	1.99	1.14
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.31							
15,000-20,999	0.85	0.46						
21,000-26,999	1.39	1.00	0.61					
27,000-32,999	1.92	1.54	1.15	0.76				
33,000-38,999	2.46	2.08	1.69	1.30	0.92			
39,000-44,999	3.00	2.62	2.23	1.84	1.46	1.07		
45,000-53,999	3.54	3.16	2.77	2.38	2.00	1.61	1.22	
54,000-64,999	4.62	4.24	3.85	3.46	3.08	2.69	2.30	1.53
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.37							
15,000-20,999	0.91	0.56						
21,000-26,999	1.45	1.10	0.74					
27,000-32,999	1.99	1.64	1.28	0.93				
33,000-38,999	2.53	2.18	1.82	1.47	1.11			
39,000-44,999	3.07	2.71	2.36	2.01	1.65	1.30		
45,000-53,999	3.61	3.25	2.90	2.55	2.19	1.84	1.48	
54,000-64,999	4.69	4.33	3.98	3.63	3.27	2.92	2.56	1.85

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 433: Summer Demand Savings for 13.08 SEER Replace-on-burnout Baseline—Zone 2

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.69	0.18						
21,000-26,999	1.26	0.75	0.24					
27,000-32,999	1.84	1.32	0.81	0.29				
33,000-38,999	2.41	1.89	1.38	0.87	0.35			
39,000-44,999	2.98	2.47	1.95	1.44	0.93	0.41		
45,000-53,999	3.55	3.04	2.53	2.01	1.50	0.99	0.47	
54,000-64,999	4.70	4.18	3.67	3.16	2.64	2.13	1.62	0.59
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.73	0.24						
21,000-26,999	1.30	0.81	0.31					
27,000-32,999	1.87	1.38	0.89	0.39				
33,000-38,999	2.45	1.95	1.46	0.97	0.47			
39,000-44,999	3.02	2.53	2.03	1.54	1.04	0.55		
45,000-53,999	3.59	3.10	2.60	2.11	1.62	1.12	0.63	
54,000-64,999	4.74	4.24	3.75	3.26	2.76	2.27	1.77	0.79

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.80	0.34						
21,000-26,999	1.37	0.91	0.46					
27,000-32,999	1.95	1.49	1.03	0.57				
33,000-38,999	2.52	2.06	1.60	1.14	0.68			
39,000-44,999	3.09	2.63	2.17	1.71	1.26	0.80		
45,000-53,999	3.66	3.20	2.75	2.29	1.83	1.37	0.91	
54,000-64,999	4.81	4.35	3.89	3.43	2.97	2.52	2.06	1.14

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.19							
15,000-20,999	0.77	0.29						
21,000-26,999	1.34	0.86	0.39					
27,000-32,999	1.91	1.43	0.96	0.48				
33,000-38,999	2.48	2.01	1.53	1.06	0.58			
39,000-44,999	3.05	2.58	2.10	1.63	1.15	0.68		
45,000-53,999	3.63	3.15	2.68	2.20	1.72	1.25	0.77	
54,000-64,999	4.77	4.30	3.82	3.34	2.87	2.39	1.92	0.97

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.82	0.37						
21,000-26,999	1.39	0.94	0.49					
27,000-32,999	1.96	1.52	1.07	0.62				
33,000-38,999	2.54	2.09	1.64	1.19	0.74			
39,000-44,999	3.11	2.66	2.21	1.76	1.31	0.87		
45,000-53,999	3.68	3.23	2.78	2.34	1.89	1.44	0.99	
54,000-64,999	4.83	4.38	3.93	3.48	3.03	2.58	2.13	1.24

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.33							
15,000-20,999	0.90	0.49						
21,000-26,999	1.47	1.06	0.66					
27,000-32,999	2.04	1.64	1.23	0.82				
33,000-38,999	2.62	2.21	1.80	1.39	0.98			
39,000-44,999	3.19	2.78	2.37	1.96	1.55	1.15		
45,000-53,999	3.76	3.35	2.94	2.54	2.13	1.72	1.31	
54,000-64,999	4.91	4.50	4.09	3.68	3.27	2.86	2.45	1.64
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.39							
15,000-20,999	0.97	0.59						
21,000-26,999	1.54	1.16	0.79					
27,000-32,999	2.11	1.74	1.36	0.99				
33,000-38,999	2.68	2.31	1.93	1.56	1.18			
39,000-44,999	3.26	2.88	2.51	2.13	1.76	1.38		
45,000-53,999	3.83	3.45	3.08	2.70	2.33	1.95	1.58	
54,000-64,999	4.97	4.60	4.22	3.85	3.47	3.10	2.72	1.97

Climate Zone 3: South Region, Houston Weather Data

Table 434: Summer Demand Savings for 13.08 SEER Replace-on-burnout Baseline—Zone 3

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.67	0.17						
21,000-26,999	1.23	0.73	0.23					
27,000-32,999	1.78	1.28	0.79	0.29				
33,000-38,999	2.34	1.84	1.34	0.84	0.34			
39,000-44,999	2.90	2.40	1.90	1.40	0.90	0.40		
45,000-53,999	3.45	2.95	2.45	1.96	1.46	0.96	0.46	
54,000-64,999	4.57	4.07	3.57	3.07	2.57	2.07	1.57	0.57
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.71	0.23						
21,000-26,999	1.27	0.79	0.31					
27,000-32,999	1.82	1.34	0.86	0.38				
33,000-38,999	2.38	1.90	1.42	0.94	0.46			
39,000-44,999	2.93	2.46	1.98	1.50	1.02	0.54		
45,000-53,999	3.49	3.01	2.53	2.05	1.57	1.09	0.61	
54,000-64,999	4.60	4.12	3.64	3.16	2.68	2.20	1.73	0.77

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.22							
15,000-20,999	0.78	0.33						
21,000-26,999	1.33	0.89	0.44					
27,000-32,999	1.89	1.45	1.00	0.55				
33,000-38,999	2.45	2.00	1.56	1.11	0.66			
39,000-44,999	3.00	2.56	2.11	1.67	1.22	0.78		
45,000-53,999	3.56	3.11	2.67	2.22	1.78	1.33	0.89	
54,000-64,999	4.67	4.23	3.78	3.34	2.89	2.44	2.00	1.11
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.73	0.26						
21,000-26,999	1.29	0.82	0.35					
27,000-32,999	1.84	1.38	0.91	0.44				
33,000-38,999	2.40	1.93	1.46	1.00	0.53			
39,000-44,999	2.96	2.49	2.02	1.55	1.08	0.62		
45,000-53,999	3.51	3.05	2.58	2.11	1.64	1.17	0.70	
54,000-64,999	4.63	4.16	3.69	3.22	2.75	2.28	1.82	0.88
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.79	0.34						
21,000-26,999	1.34	0.90	0.46					
27,000-32,999	1.90	1.46	1.01	0.57				
33,000-38,999	2.45	2.01	1.57	1.13	0.69			
39,000-44,999	3.01	2.57	2.13	1.69	1.24	0.80		
45,000-53,999	3.57	3.13	2.68	2.24	1.80	1.36	0.92	
54,000-64,999	4.68	4.24	3.80	3.36	2.91	2.47	2.03	1.15

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.30							
15,000-20,999	0.86	0.46						
21,000-26,999	1.42	1.01	0.61					
27,000-32,999	1.97	1.57	1.17	0.76				
33,000-38,999	2.53	2.13	1.72	1.32	0.91			
39,000-44,999	3.09	2.68	2.28	1.87	1.47	1.07		
45,000-53,999	3.64	3.24	2.83	2.43	2.03	1.62	1.22	
54,000-64,999	4.76	4.35	3.95	3.54	3.14	2.73	2.33	1.52
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.37							
15,000-20,999	0.92	0.55						
21,000-26,999	1.48	1.11	0.74					
27,000-32,999	2.04	1.66	1.29	0.92				
33,000-38,999	2.59	2.22	1.85	1.48	1.10			
39,000-44,999	3.15	2.78	2.40	2.03	1.66	1.29		
45,000-53,999	3.71	3.33	2.96	2.59	2.22	1.84	1.47	
54,000-64,999	4.82	4.45	4.07	3.70	3.33	2.96	2.58	1.84

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 435: Summer Demand Savings for 13.08 SEER Replace-on-burnout Baseline—Zone 4

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.09							
15,000-20,999	0.52	0.13						
21,000-26,999	0.96	0.57	0.18					
27,000-32,999	1.39	1.00	0.61	0.22				
33,000-38,999	1.83	1.44	1.05	0.66	0.27			
39,000-44,999	2.26	1.87	1.48	1.09	0.70	0.31		
45,000-53,999	2.70	2.31	1.92	1.53	1.14	0.75	0.36	
54,000-64,999	3.57	3.18	2.79	2.40	2.01	1.62	1.23	0.45
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.55	0.18						
21,000-26,999	0.99	0.61	0.24					
27,000-32,999	1.42	1.05	0.67	0.30				
33,000-38,999	1.86	1.48	1.11	0.73	0.36			
39,000-44,999	2.29	1.92	1.54	1.17	0.79	0.42		
45,000-53,999	2.73	2.35	1.98	1.60	1.23	0.85	0.48	
54,000-64,999	3.60	3.22	2.85	2.47	2.10	1.72	1.35	0.60

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.61	0.26						
21,000-26,999	1.04	0.69	0.35					
27,000-32,999	1.48	1.13	0.78	0.43				
33,000-38,999	1.91	1.56	1.22	0.87	0.52			
39,000-44,999	2.35	2.00	1.65	1.30	0.95	0.61		
45,000-53,999	2.78	2.43	2.09	1.74	1.39	1.04	0.69	
54,000-64,999	3.65	3.30	2.96	2.61	2.26	1.91	1.56	0.87

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.21							
15,000-20,999	0.64	0.31						
21,000-26,999	1.08	0.74	0.41					
27,000-32,999	1.51	1.18	0.85	0.52				
33,000-38,999	1.95	1.61	1.28	0.95	0.62			
39,000-44,999	2.38	2.05	1.72	1.39	1.05	0.72		
45,000-53,999	2.82	2.48	2.15	1.82	1.49	1.16	0.83	
54,000-64,999	3.68	3.35	3.02	2.69	2.36	2.03	1.70	1.03

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.68	0.36						
21,000-26,999	1.11	0.80	0.48					
27,000-32,999	1.55	1.23	0.92	0.61				
33,000-38,999	1.98	1.67	1.35	1.04	0.73			
39,000-44,999	2.42	2.10	1.79	1.48	1.16	0.85		
45,000-53,999	2.85	2.54	2.22	1.91	1.60	1.28	0.97	
54,000-64,999	3.72	3.41	3.09	2.78	2.47	2.15	1.84	1.21

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.32							
15,000-20,999	0.76	0.48						
21,000-26,999	1.19	0.92	0.65					
27,000-32,999	1.63	1.35	1.08	0.81				
33,000-38,999	2.06	1.79	1.52	1.24	0.97			
39,000-44,999	2.50	2.22	1.95	1.68	1.40	1.13		
45,000-53,999	2.93	2.66	2.38	2.11	1.84	1.56	1.29	
54,000-64,999	3.80	3.53	3.25	2.98	2.71	2.43	2.16	1.61
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.39							
15,000-20,999	0.82	0.58						
21,000-26,999	1.25	1.01	0.77					
27,000-32,999	1.69	1.45	1.21	0.96				
33,000-38,999	2.12	1.88	1.64	1.40	1.16			
39,000-44,999	2.56	2.32	2.07	1.83	1.59	1.35		
45,000-53,999	2.99	2.75	2.51	2.27	2.02	1.78	1.54	
54,000-64,999	3.86	3.62	3.38	3.14	2.89	2.65	2.41	1.93

Climate Zone 5: West Region El Paso Weather Data

Table 436: Summer Demand Savings for 13.08 SEER Replace-on-burnout Baseline—Zone 5

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.64	0.16						
21,000-26,999	1.17	0.69	0.22					
27,000-32,999	1.70	1.22	0.75	0.27				
33,000-38,999	2.23	1.75	1.28	0.80	0.33			
39,000-44,999	2.76	2.28	1.81	1.33	0.86	0.38		
45,000-53,999	3.29	2.81	2.34	1.86	1.39	0.91	0.44	
54,000-64,999	4.35	3.87	3.40	2.92	2.45	1.97	1.50	0.55
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.68	0.22						
21,000-26,999	1.20	0.75	0.29					
27,000-32,999	1.73	1.28	0.82	0.36				
33,000-38,999	2.26	1.81	1.35	0.89	0.44			
39,000-44,999	2.79	2.34	1.88	1.42	0.97	0.51		
45,000-53,999	3.32	2.87	2.41	1.95	1.50	1.04	0.58	
54,000-64,999	4.38	3.93	3.47	3.01	2.56	2.10	1.64	0.73

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.21							
15,000-20,999	0.74	0.32						
21,000-26,999	1.27	0.85	0.42					
27,000-32,999	1.80	1.38	0.95	0.53				
33,000-38,999	2.33	1.90	1.48	1.06	0.63			
39,000-44,999	2.86	2.43	2.01	1.59	1.16	0.74		
45,000-53,999	3.39	2.96	2.54	2.12	1.69	1.27	0.84	
54,000-64,999	4.45	4.02	3.60	3.17	2.75	2.33	1.90	1.05
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.72	0.29						
21,000-26,999	1.25	0.82	0.39					
27,000-32,999	1.78	1.35	0.92	0.49				
33,000-38,999	2.31	1.88	1.45	1.02	0.59			
39,000-44,999	2.84	2.41	1.98	1.55	1.12	0.68		
45,000-53,999	3.37	2.94	2.51	2.08	1.65	1.21	0.78	
54,000-64,999	4.43	4.00	3.57	3.14	2.70	2.27	1.84	0.98
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.77	0.37						
21,000-26,999	1.30	0.89	0.49					
27,000-32,999	1.83	1.42	1.02	0.61				
33,000-38,999	2.36	1.95	1.55	1.14	0.73			
39,000-44,999	2.89	2.48	2.08	1.67	1.26	0.85		
45,000-53,999	3.42	3.01	2.61	2.20	1.79	1.38	0.97	
54,000-64,999	4.48	4.07	3.66	3.26	2.85	2.44	2.03	1.22

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.33							
15,000-20,999	0.86	0.49						
21,000-26,999	1.39	1.02	0.66					
27,000-32,999	1.92	1.55	1.19	0.82				
33,000-38,999	2.45	2.08	1.72	1.35	0.98			
39,000-44,999	2.98	2.61	2.24	1.88	1.51	1.15		
45,000-53,999	3.51	3.14	2.77	2.41	2.04	1.68	1.31	
54,000-64,999	4.56	4.20	3.83	3.47	3.10	2.74	2.37	1.64
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.40							
15,000-20,999	0.93	0.60						
21,000-26,999	1.46	1.12	0.79					
27,000-32,999	1.99	1.65	1.32	0.99				
33,000-38,999	2.51	2.18	1.85	1.52	1.19			
39,000-44,999	3.04	2.71	2.38	2.05	1.72	1.39		
45,000-53,999	3.57	3.24	2.91	2.58	2.25	1.92	1.59	
54,000-64,999	4.63	4.30	3.97	3.64	3.31	2.98	2.65	1.98

Early Retirement

Table 437 through Table 446 present the summer demand savings (kW) associated with a central system replacing an HVAC system for all five Texas climate zones. These savings can be used with the Replace-on-burnout energy savings in Table 432 through Table 436 to calculate summer demand savings. In each table, the capacity of the efficient unit is represented in the columns and the capacity of the existing unit is represented in the rows. The savings are in the intersection of the appropriate efficient and existing capacities. Replacements where there has been no change in capacity are highlighted in light blue.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 437: Summer Demand Savings for 12.44 SEER Early Retirement Baseline—Zone 1

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.73	0.25						
21,000-26,999	1.30	0.82	0.33					
27,000-32,999	1.87	1.39	0.90	0.42				
33,000-38,999	2.44	1.95	1.47	0.98	0.50			
39,000-44,999	3.00	2.52	2.04	1.55	1.07	0.58		
45,000-53,999	3.57	3.09	2.60	2.12	1.64	1.15	0.67	
54,000-64,999	4.71	4.22	3.74	3.25	2.77	2.29	1.80	0.83
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.77	0.31						
21,000-26,999	1.34	0.87	0.41					
27,000-32,999	1.91	1.44	0.98	0.51				
33,000-38,999	2.47	2.01	1.54	1.08	0.61			
39,000-44,999	3.04	2.58	2.11	1.64	1.18	0.71		
45,000-53,999	3.61	3.14	2.68	2.21	1.75	1.28	0.82	
54,000-64,999	4.74	4.28	3.81	3.35	2.88	2.42	1.95	1.02

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.27							
15,000-20,999	0.84	0.41						
21,000-26,999	1.41	0.97	0.54					
27,000-32,999	1.97	1.54	1.11	0.68				
33,000-38,999	2.54	2.11	1.68	1.24	0.81			
39,000-44,999	3.11	2.68	2.24	1.81	1.38	0.95		
45,000-53,999	3.68	3.24	2.81	2.38	1.95	1.51	1.08	
54,000-64,999	4.81	4.38	3.95	3.51	3.08	2.65	2.22	1.35

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.80	0.35						
21,000-26,999	1.37	0.92	0.46					
27,000-32,999	1.93	1.48	1.03	0.58				
33,000-38,999	2.50	2.05	1.60	1.15	0.70			
39,000-44,999	3.07	2.62	2.17	1.72	1.26	0.81		
45,000-53,999	3.64	3.19	2.73	2.28	1.83	1.38	0.93	
54,000-64,999	4.77	4.32	3.87	3.42	2.97	2.52	2.06	1.16

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.28							
15,000-20,999	0.85	0.43						
21,000-26,999	1.42	0.99	0.57					
27,000-32,999	1.99	1.56	1.13	0.71				
33,000-38,999	2.55	2.13	1.70	1.28	0.85			
39,000-44,999	3.12	2.70	2.27	1.84	1.42	0.99		
45,000-53,999	3.69	3.26	2.84	2.41	1.99	1.56	1.13	
54,000-64,999	4.82	4.40	3.97	3.55	3.12	2.69	2.27	1.42

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.36							
15,000-20,999	0.93	0.54						
21,000-26,999	1.50	1.11	0.72					
27,000-32,999	2.06	1.68	1.29	0.90				
33,000-38,999	2.63	2.24	1.86	1.47	1.08			
39,000-44,999	3.20	2.81	2.43	2.04	1.65	1.27		
45,000-53,999	3.77	3.38	2.99	2.61	2.22	1.83	1.45	
54,000-64,999	4.90	4.51	4.13	3.74	3.35	2.97	2.58	1.81
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.43							
15,000-20,999	0.99	0.64						
21,000-26,999	1.56	1.21	0.85					
27,000-32,999	2.13	1.77	1.42	1.07				
33,000-38,999	2.70	2.34	1.99	1.63	1.28			
39,000-44,999	3.26	2.91	2.55	2.20	1.85	1.49		
45,000-53,999	3.83	3.48	3.12	2.77	2.41	2.06	1.71	
54,000-64,999	4.97	4.61	4.26	3.90	3.55	3.19	2.84	2.13

Table 438: Summer Demand Savings for 10.0 SEER Early Retirement Baseline—Zone 1

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.44							
15,000-20,999	1.15	0.67						
21,000-26,999	1.86	1.37	0.89					
27,000-32,999	2.56	2.08	1.59	1.11				
33,000-38,999	3.27	2.78	2.30	1.82	1.33			
39,000-44,999	3.97	3.49	3.00	2.52	2.04	1.55		
45,000-53,999	4.68	4.19	3.71	3.23	2.74	2.26	1.77	
54,000-64,999	6.09	5.61	5.12	4.64	4.15	3.67	3.19	2.22
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.48							
15,000-20,999	1.19	0.72						
21,000-26,999	1.89	1.43	0.96					
27,000-32,999	2.60	2.13	1.67	1.20				
33,000-38,999	3.30	2.84	2.37	1.91	1.44			
39,000-44,999	4.01	3.54	3.08	2.61	2.15	1.68		
45,000-53,999	4.72	4.25	3.79	3.32	2.85	2.39	1.92	
54,000-64,999	6.13	5.66	5.20	4.73	4.27	3.80	3.34	2.40
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.55							
15,000-20,999	1.25	0.82						
21,000-26,999	1.96	1.53	1.09					
27,000-32,999	2.67	2.23	1.80	1.37				
33,000-38,999	3.37	2.94	2.51	2.07	1.64			
39,000-44,999	4.08	3.64	3.21	2.78	2.35	1.92		
45,000-53,999	4.78	4.35	3.92	3.49	3.05	2.62	2.19	

54,000-64,999	6.19	5.76	5.33	4.90	4.47	4.03	3.60	2.74
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.51							
15,000-20,999	1.22	0.76						
21,000-26,999	1.92	1.47	1.02					
27,000-32,999	2.63	2.18	1.72	1.27				
33,000-38,999	3.33	2.88	2.43	1.98	1.53			
39,000-44,999	4.04	3.59	3.14	2.69	2.23	1.78		
45,000-53,999	4.74	4.29	3.84	3.39	2.94	2.49	2.04	
54,000-64,999	6.16	5.71	5.25	4.80	4.35	3.90	3.45	2.55
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.56							
15,000-20,999	1.27	0.84						
21,000-26,999	1.97	1.55	1.12					
27,000-32,999	2.68	2.25	1.83	1.40				
33,000-38,999	3.38	2.96	2.53	2.11	1.68			
39,000-44,999	4.09	3.66	3.24	2.81	2.39	1.96		
45,000-53,999	4.80	4.37	3.94	3.52	3.09	2.67	2.24	
54,000-64,999	6.21	5.78	5.36	4.93	4.50	4.08	3.65	2.80
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.64							
15,000-20,999	1.34	0.96						
21,000-26,999	2.05	1.66	1.28					
27,000-32,999	2.76	2.37	1.98	1.60				
33,000-38,999	3.46	3.08	2.69	2.30	1.92			
39,000-44,999	4.17	3.78	3.39	3.01	2.62	2.23		
45,000-53,999	4.87	4.49	4.10	3.71	3.33	2.94	2.55	

54,000-64,999	6.29	5.90	5.51	5.13	4.74	4.35	3.97	3.19
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.70							
15,000-20,999	1.41	1.05						
21,000-26,999	2.11	1.76	1.41					
27,000-32,999	2.82	2.47	2.11	1.76				
33,000-38,999	3.53	3.17	2.82	2.46	2.11			
39,000-44,999	4.23	3.88	3.52	3.17	2.82	2.46		
45,000-53,999	4.94	4.58	4.23	3.88	3.52	3.17	2.81	
54,000-64,999	6.35	6.00	5.64	5.29	4.93	4.58	4.22	3.52

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 439: Summer Demand Savings for 12.44 SEER Early Retirement Baseline—Zone 2

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.78	0.27						
21,000-26,999	1.38	0.87	0.35					
27,000-32,999	1.98	1.47	0.96	0.44				
33,000-38,999	2.58	2.07	1.56	1.04	0.53			
39,000-44,999	3.19	2.67	2.16	1.65	1.13	0.62		
45,000-53,999	3.79	3.27	2.76	2.25	1.73	1.22	0.71	
54,000-64,999	4.99	4.48	3.96	3.45	2.94	2.42	1.91	0.88

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.22							
15,000-20,999	0.82	0.32						
21,000-26,999	1.42	0.93	0.43					
27,000-32,999	2.02	1.53	1.03	0.54				
33,000-38,999	2.62	2.13	1.64	1.14	0.65			
39,000-44,999	3.23	2.73	2.24	1.74	1.25	0.76		
45,000-53,999	3.83	3.33	2.84	2.35	1.85	1.36	0.87	
54,000-64,999	5.03	4.54	4.04	3.55	3.06	2.56	2.07	1.08
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.89	0.43						
21,000-26,999	1.49	1.03	0.57					
27,000-32,999	2.09	1.63	1.18	0.72				
33,000-38,999	2.69	2.24	1.78	1.32	0.86			
39,000-44,999	3.30	2.84	2.38	1.92	1.46	1.00		
45,000-53,999	3.90	3.44	2.98	2.52	2.06	1.61	1.15	
54,000-64,999	5.10	4.64	4.18	3.73	3.27	2.81	2.35	1.43
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.85	0.38						
21,000-26,999	1.46	0.98	0.50					
27,000-32,999	2.06	1.58	1.11	0.63				
33,000-38,999	2.66	2.18	1.71	1.23	0.76			
39,000-44,999	3.26	2.79	2.31	1.83	1.36	0.88		
45,000-53,999	3.86	3.39	2.91	2.44	1.96	1.48	1.01	
54,000-64,999	5.07	4.59	4.11	3.64	3.16	2.69	2.21	1.26

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.31							
15,000-20,999	0.91	0.46						
21,000-26,999	1.51	1.06	0.61					
27,000-32,999	2.11	1.66	1.21	0.77				
33,000-38,999	2.71	2.26	1.82	1.37	0.92			
39,000-44,999	3.32	2.87	2.42	1.97	1.52	1.07		
45,000-53,999	3.92	3.47	3.02	2.57	2.12	1.67	1.22	
54,000-64,999	5.12	4.67	4.22	3.77	3.33	2.88	2.43	1.53

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.39							
15,000-20,999	0.99	0.58						
21,000-26,999	1.59	1.18	0.77					
27,000-32,999	2.19	1.78	1.37	0.97				
33,000-38,999	2.79	2.38	1.98	1.57	1.16			
39,000-44,999	3.40	2.99	2.58	2.17	1.76	1.35		
45,000-53,999	4.00	3.59	3.18	2.77	2.36	1.95	1.55	
54,000-64,999	5.20	4.79	4.38	3.97	3.57	3.16	2.75	1.93

24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.45							
15,000-20,999	1.06	0.68						
21,000-26,999	1.66	1.28	0.91					
27,000-32,999	2.26	1.88	1.51	1.13				
33,000-38,999	2.86	2.49	2.11	1.74	1.36			
39,000-44,999	3.46	3.09	2.71	2.34	1.96	1.59		
45,000-53,999	4.06	3.69	3.31	2.94	2.56	2.19	1.81	
54,000-64,999	5.27	4.89	4.52	4.14	3.77	3.39	3.02	2.27

Table 440: Summer Demand Savings for 10.0 SEER Early Retirement Baseline—Zone 2

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.47							
15,000-20,999	1.22	0.71						
21,000-26,999	1.97	1.45	0.94					
27,000-32,999	2.72	2.20	1.69	1.18				
33,000-38,999	3.47	2.95	2.44	1.93	1.41			
39,000-44,999	4.21	3.70	3.19	2.67	2.16	1.65		
45,000-53,999	4.96	4.45	3.94	3.42	2.91	2.40	1.88	
54,000-64,999	6.46	5.95	5.43	4.92	4.41	3.89	3.38	2.35
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.51							
15,000-20,999	1.26	0.77						
21,000-26,999	2.01	1.51	1.02					
27,000-32,999	2.76	2.26	1.77	1.28				
33,000-38,999	3.50	3.01	2.52	2.02	1.53			
39,000-44,999	4.25	3.76	3.27	2.77	2.28	1.79		
45,000-53,999	5.00	4.51	4.01	3.52	3.03	2.53	2.04	
54,000-64,999	6.50	6.01	5.51	5.02	4.52	4.03	3.54	2.55
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.58							
15,000-20,999	1.33	0.87						
21,000-26,999	2.08	1.62	1.16					
27,000-32,999	2.83	2.37	1.91	1.45				
33,000-38,999	3.58	3.12	2.66	2.20	1.74			
39,000-44,999	4.32	3.87	3.41	2.95	2.49	2.03		
45,000-53,999	5.07	4.61	4.16	3.70	3.24	2.78	2.32	

54,000-64,999	6.57	6.11	5.65	5.19	4.74	4.28	3.82	2.90
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.55							
15,000-20,999	1.29	0.82						
21,000-26,999	2.04	1.57	1.09					
27,000-32,999	2.79	2.32	1.84	1.36				
33,000-38,999	3.54	3.06	2.59	2.11	1.64			
39,000-44,999	4.29	3.81	3.34	2.86	2.39	1.91		
45,000-53,999	5.04	4.56	4.09	3.61	3.13	2.66	2.18	
54,000-64,999	6.53	6.06	5.58	5.11	4.63	4.16	3.68	2.73
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.60							
15,000-20,999	1.35	0.90						
21,000-26,999	2.10	1.65	1.20					
27,000-32,999	2.85	2.40	1.95	1.50				
33,000-38,999	3.59	3.15	2.70	2.25	1.80			
39,000-44,999	4.34	3.89	3.45	3.00	2.55	2.10		
45,000-53,999	5.09	4.64	4.19	3.75	3.30	2.85	2.40	
54,000-64,999	6.59	6.14	5.69	5.24	4.79	4.35	3.90	3.00
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.68							
15,000-20,999	1.43	1.02						
21,000-26,999	2.18	1.77	1.36					
27,000-32,999	2.93	2.52	2.11	1.70				
33,000-38,999	3.67	3.27	2.86	2.45	2.04			
39,000-44,999	4.42	4.01	3.61	3.20	2.79	2.38		
45,000-53,999	5.17	4.76	4.35	3.95	3.54	3.13	2.72	

54,000-64,999	6.67	6.26	5.85	5.44	5.03	4.63	4.22	3.40
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.75							
15,000-20,999	1.50	1.12						
21,000-26,999	2.24	1.87	1.49					
27,000-32,999	2.99	2.62	2.24	1.87				
33,000-38,999	3.74	3.37	2.99	2.62	2.24			
39,000-44,999	4.49	4.12	3.74	3.37	2.99	2.61		
45,000-53,999	5.24	4.86	4.49	4.11	3.74	3.36	2.99	
54,000-64,999	6.74	6.36	5.99	5.61	5.24	4.86	4.49	3.74

Climate Zone 3: South Region, Houston Weather Data

Table 441: Summer Demand Savings for 12.44 SEER Early Retirement Baseline—Zone 3

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.76	0.26						
21,000-26,999	1.34	0.84	0.34					
27,000-32,999	1.93	1.43	0.93	0.43				
33,000-38,999	2.51	2.01	1.51	1.01	0.52			
39,000-44,999	3.10	2.60	2.10	1.60	1.10	0.60		
45,000-53,999	3.68	3.18	2.68	2.18	1.69	1.19	0.69	
54,000-64,999	4.85	4.35	3.85	3.35	2.86	2.36	1.86	0.86

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.21							
15,000-20,999	0.80	0.32						
21,000-26,999	1.38	0.90	0.42					
27,000-32,999	1.97	1.49	1.01	0.53				
33,000-38,999	2.55	2.07	1.59	1.11	0.63			
39,000-44,999	3.14	2.66	2.18	1.70	1.22	0.74		
45,000-53,999	3.72	3.24	2.76	2.28	1.80	1.32	0.84	
54,000-64,999	4.89	4.41	3.93	3.45	2.97	2.49	2.01	1.05
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.28							
15,000-20,999	0.86	0.42						
21,000-26,999	1.45	1.00	0.56					
27,000-32,999	2.03	1.59	1.14	0.70				
33,000-38,999	2.62	2.17	1.73	1.28	0.84			
39,000-44,999	3.20	2.76	2.31	1.87	1.42	0.98		
45,000-53,999	3.79	3.34	2.90	2.45	2.01	1.56	1.12	
54,000-64,999	4.96	4.51	4.07	3.62	3.18	2.73	2.29	1.39
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.82	0.35						
21,000-26,999	1.40	0.93	0.47					
27,000-32,999	1.99	1.52	1.05	0.58				
33,000-38,999	2.57	2.10	1.64	1.17	0.70			
39,000-44,999	3.16	2.69	2.22	1.75	1.28	0.82		
45,000-53,999	3.74	3.27	2.81	2.34	1.87	1.40	0.93	
54,000-64,999	4.91	4.44	3.98	3.51	3.04	2.57	2.10	1.17

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.87	0.43						
21,000-26,999	1.46	1.01	0.57					
27,000-32,999	2.04	1.60	1.16	0.72				
33,000-38,999	2.63	2.18	1.74	1.30	0.86			
39,000-44,999	3.21	2.77	2.33	1.89	1.44	1.00		
45,000-53,999	3.80	3.35	2.91	2.47	2.03	1.59	1.15	
54,000-64,999	4.97	4.52	4.08	3.64	3.20	2.76	2.32	1.43
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.36							
15,000-20,999	0.95	0.54						
21,000-26,999	1.53	1.13	0.72					
27,000-32,999	2.12	1.71	1.31	0.90				
33,000-38,999	2.70	2.30	1.89	1.49	1.08			
39,000-44,999	3.29	2.88	2.48	2.07	1.67	1.27		
45,000-53,999	3.87	3.47	3.06	2.66	2.25	1.85	1.45	
54,000-64,999	5.04	4.64	4.23	3.83	3.42	3.02	2.62	1.81
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.42							
15,000-20,999	1.01	0.64						
21,000-26,999	1.59	1.22	0.85					
27,000-32,999	2.18	1.81	1.43	1.06				
33,000-38,999	2.76	2.39	2.02	1.65	1.27			
39,000-44,999	3.35	2.98	2.60	2.23	1.86	1.49		
45,000-53,999	3.93	3.56	3.19	2.82	2.44	2.07	1.70	
54,000-64,999	5.10	4.73	4.36	3.99	3.61	3.24	2.87	2.12

Table 442: Summer Demand Savings for 10.0 SEER Early Retirement Baseline—Zone 3

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.46							
15,000-20,999	1.19	0.69						
21,000-26,999	1.91	1.41	0.91					
27,000-32,999	2.64	2.14	1.64	1.14				
33,000-38,999	3.37	2.87	2.37	1.87	1.37			
39,000-44,999	4.10	3.60	3.10	2.60	2.10	1.60		
45,000-53,999	4.82	4.32	3.83	3.33	2.83	2.33	1.83	
54,000-64,999	6.28	5.78	5.28	4.78	4.28	3.78	3.29	2.29
15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.50							
15,000-20,999	1.22	0.74						
21,000-26,999	1.95	1.47	0.99					
27,000-32,999	2.68	2.20	1.72	1.24				
33,000-38,999	3.41	2.93	2.45	1.97	1.49			
39,000-44,999	4.13	3.65	3.17	2.69	2.22	1.74		
45,000-53,999	4.86	4.38	3.90	3.42	2.94	2.46	1.98	
54,000-64,999	6.32	5.84	5.36	4.88	4.40	3.92	3.44	2.48
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.56							
15,000-20,999	1.29	0.85						
21,000-26,999	2.02	1.57	1.13					
27,000-32,999	2.75	2.30	1.86	1.41				
33,000-38,999	3.48	3.03	2.58	2.14	1.69			
39,000-44,999	4.20	3.76	3.31	2.87	2.42	1.98		
45,000-53,999	4.93	4.49	4.04	3.59	3.15	2.70	2.26	

54,000-64,999	6.39	5.94	5.50	5.05	4.60	4.16	3.71	2.82
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.52							
15,000-20,999	1.25	0.78						
21,000-26,999	1.97	1.51	1.04					
27,000-32,999	2.70	2.23	1.76	1.30				
33,000-38,999	3.43	2.96	2.49	2.02	1.56			
39,000-44,999	4.16	3.69	3.22	2.75	2.28	1.81		
45,000-53,999	4.88	4.42	3.95	3.48	3.01	2.54	2.07	
54,000-64,999	6.34	5.87	5.40	4.93	4.47	4.00	3.53	2.59
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.57							
15,000-20,999	1.30	0.86						
21,000-26,999	2.03	1.59	1.14					
27,000-32,999	2.76	2.31	1.87	1.43				
33,000-38,999	3.48	3.04	2.60	2.16	1.72			
39,000-44,999	4.21	3.77	3.33	2.89	2.44	2.00		
45,000-53,999	4.94	4.50	4.05	3.61	3.17	2.73	2.29	
54,000-64,999	6.39	5.95	5.51	5.07	4.63	4.19	3.74	2.86
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.65							
15,000-20,999	1.37	0.97						
21,000-26,999	2.10	1.70	1.29					
27,000-32,999	2.83	2.43	2.02	1.62				
33,000-38,999	3.56	3.15	2.75	2.35	1.94			
39,000-44,999	4.29	3.88	3.48	3.07	2.67	2.26		
45,000-53,999	5.01	4.61	4.21	3.80	3.40	2.99	2.59	

54,000-64,999	6.47	6.06	5.66	5.26	4.85	4.45	4.04	3.24
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.71							
15,000-20,999	1.44	1.07						
21,000-26,999	2.17	1.79	1.42					
27,000-32,999	2.89	2.52	2.15	1.78				
33,000-38,999	3.62	3.25	2.88	2.50	2.13			
39,000-44,999	4.35	3.98	3.60	3.23	2.86	2.49		
45,000-53,999	5.08	4.70	4.33	3.96	3.59	3.21	2.84	
54,000-64,999	6.53	6.16	5.79	5.41	5.04	4.67	4.30	3.55

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 443: Summer Demand Savings for 12.44 SEER Early Retirement Baseline—Zone 4

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.59	0.20						
21,000-26,999	1.05	0.66	0.27					
27,000-32,999	1.51	1.12	0.73	0.34				
33,000-38,999	1.96	1.57	1.18	0.79	0.40			
39,000-44,999	2.42	2.03	1.64	1.25	0.86	0.47		
45,000-53,999	2.88	2.49	2.10	1.71	1.32	0.93	0.54	
54,000-64,999	3.79	3.40	3.01	2.62	2.23	1.84	1.45	0.67

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.62	0.25						
21,000-26,999	1.08	0.70	0.33					
27,000-32,999	1.54	1.16	0.79	0.41				
33,000-38,999	1.99	1.62	1.24	0.87	0.49			
39,000-44,999	2.45	2.08	1.70	1.33	0.95	0.58		
45,000-53,999	2.91	2.53	2.16	1.78	1.41	1.03	0.66	
54,000-64,999	3.82	3.45	3.07	2.70	2.32	1.95	1.57	0.82
16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.22							
15,000-20,999	0.68	0.33						
21,000-26,999	1.13	0.78	0.44					
27,000-32,999	1.59	1.24	0.89	0.54				
33,000-38,999	2.05	1.70	1.35	1.00	0.65			
39,000-44,999	2.50	2.16	1.81	1.46	1.11	0.76		
45,000-53,999	2.96	2.61	2.26	1.92	1.57	1.22	0.87	
54,000-64,999	3.88	3.53	3.18	2.83	2.48	2.13	1.79	1.09
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.71	0.38						
21,000-26,999	1.17	0.83	0.50					
27,000-32,999	1.62	1.29	0.96	0.63				
33,000-38,999	2.08	1.75	1.42	1.09	0.75			
39,000-44,999	2.54	2.21	1.87	1.54	1.21	0.88		
45,000-53,999	2.99	2.66	2.33	2.00	1.67	1.34	1.01	
54,000-64,999	3.91	3.58	3.25	2.91	2.58	2.25	1.92	1.26

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.74	0.43						
21,000-26,999	1.20	0.89	0.57					
27,000-32,999	1.66	1.34	1.03	0.72				
33,000-38,999	2.12	1.80	1.49	1.17	0.86			
39,000-44,999	2.57	2.26	1.95	1.63	1.32	1.00		
45,000-53,999	3.03	2.72	2.40	2.09	1.78	1.46	1.15	
54,000-64,999	3.94	3.63	3.32	3.00	2.69	2.38	2.06	1.44

21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.37							
15,000-20,999	0.82	0.55						
21,000-26,999	1.28	1.01	0.74					
27,000-32,999	1.74	1.47	1.19	0.92				
33,000-38,999	2.20	1.92	1.65	1.38	1.10			
39,000-44,999	2.65	2.38	2.11	1.83	1.56	1.29		
45,000-53,999	3.11	2.84	2.56	2.29	2.02	1.74	1.47	
54,000-64,999	4.02	3.75	3.48	3.20	2.93	2.66	2.38	1.84

24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.43							
15,000-20,999	0.89	0.64						
21,000-26,999	1.34	1.10	0.86					
27,000-32,999	1.80	1.56	1.32	1.07				
33,000-38,999	2.26	2.02	1.77	1.53	1.29			
39,000-44,999	2.72	2.47	2.23	1.99	1.75	1.50		
45,000-53,999	3.17	2.93	2.69	2.45	2.20	1.96	1.72	
54,000-64,999	4.09	3.84	3.60	3.36	3.12	2.88	2.63	2.15

Table 444: Summer Demand Savings for 10.0 SEER Early Retirement Baseline—Zone 4

14.5-14.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.36							
15,000-20,999	0.93	0.54						
21,000-26,999	1.49	1.10	0.71					
27,000-32,999	2.06	1.67	1.28	0.89				
33,000-38,999	2.63	2.24	1.85	1.46	1.07			
39,000-44,999	3.20	2.81	2.42	2.03	1.64	1.25		
45,000-53,999	3.77	3.38	2.99	2.60	2.21	1.82	1.43	
54,000-64,999	4.91	4.52	4.13	3.74	3.35	2.96	2.57	1.79
15.0-15.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.39							
15,000-20,999	0.96	0.58						
21,000-26,999	1.52	1.15	0.77					
27,000-32,999	2.09	1.72	1.34	0.97				
33,000-38,999	2.66	2.29	1.91	1.54	1.16			
39,000-44,999	3.23	2.86	2.48	2.11	1.73	1.36		
45,000-53,999	3.80	3.42	3.05	2.67	2.30	1.92	1.55	
54,000-64,999	4.94	4.56	4.19	3.81	3.44	3.06	2.69	1.94
16.0-16.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.44							
15,000-20,999	1.01	0.66						
21,000-26,999	1.58	1.23	0.88					
27,000-32,999	2.15	1.80	1.45	1.10				
33,000-38,999	2.72	2.37	2.02	1.67	1.32			
39,000-44,999	3.28	2.94	2.59	2.24	1.89	1.54		
45,000-53,999	3.85	3.50	3.16	2.81	2.46	2.11	1.76	

54,000-64,999	4.99	4.64	4.29	3.95	3.60	3.25	2.90	2.21
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.47							
15,000-20,999	1.04	0.71						
21,000-26,999	1.61	1.28	0.95					
27,000-32,999	2.18	1.85	1.52	1.19				
33,000-38,999	2.75	2.42	2.09	1.75	1.42			
39,000-44,999	3.32	2.99	2.66	2.32	1.99	1.66		
45,000-53,999	3.89	3.56	3.22	2.89	2.56	2.23	1.90	
54,000-64,999	5.02	4.69	4.36	4.03	3.70	3.37	3.04	2.37
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.51							
15,000-20,999	1.08	0.77						
21,000-26,999	1.65	1.33	1.02					
27,000-32,999	2.22	1.90	1.59	1.28				
33,000-38,999	2.78	2.47	2.16	1.84	1.53			
39,000-44,999	3.35	3.04	2.73	2.41	2.10	1.79		
45,000-53,999	3.92	3.61	3.29	2.98	2.67	2.35	2.04	
54,000-64,999	5.06	4.75	4.43	4.12	3.81	3.49	3.18	2.55
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.59							
15,000-20,999	1.16	0.89						
21,000-26,999	1.73	1.45	1.18					
27,000-32,999	2.30	2.02	1.75	1.48				
33,000-38,999	2.87	2.59	2.32	2.05	1.77			
39,000-44,999	3.43	3.16	2.89	2.61	2.34	2.07		
45,000-53,999	4.00	3.73	3.46	3.18	2.91	2.64	2.36	

54,000-64,999	5.14	4.87	4.59	4.32	4.05	3.77	3.50	2.95
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.65							
15,000-20,999	1.22	0.98						
21,000-26,999	1.79	1.55	1.31					
27,000-32,999	2.36	2.12	1.87	1.63				
33,000-38,999	2.93	2.69	2.44	2.20	1.96			
39,000-44,999	3.50	3.25	3.01	2.77	2.53	2.29		
45,000-53,999	4.07	3.82	3.58	3.34	3.10	2.85	2.61	
54,000-64,999	5.20	4.96	4.72	4.48	4.23	3.99	3.75	3.26

Climate Zone 5: West Region El Paso Weather Data

Table 445: Summer Demand Savings for 12.44 SEER Early Retirement Baseline—Zone 5

14.5-14.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.72	0.25						
21,000-26,999	1.28	0.80	0.33					
27,000-32,999	1.83	1.36	0.88	0.41				
33,000-38,999	2.39	1.92	1.44	0.97	0.49			
39,000-44,999	2.95	2.47	2.00	1.52	1.05	0.57		
45,000-53,999	3.50	3.03	2.55	2.08	1.60	1.13	0.65	
54,000-64,999	4.62	4.14	3.67	3.19	2.72	2.24	1.77	0.82

15.0-15.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.76	0.30						
21,000-26,999	1.31	0.86	0.40					
27,000-32,999	1.87	1.41	0.96	0.50				
33,000-38,999	2.43	1.97	1.51	1.06	0.60			
39,000-44,999	2.98	2.53	2.07	1.61	1.16	0.70		
45,000-53,999	3.54	3.08	2.63	2.17	1.71	1.26	0.80	
54,000-64,999	4.65	4.20	3.74	3.28	2.83	2.37	1.91	1.00

16.0-16.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.27							
15,000-20,999	0.82	0.40						
21,000-26,999	1.38	0.95	0.53					
27,000-32,999	1.94	1.51	1.09	0.66				
33,000-38,999	2.49	2.07	1.64	1.22	0.80			
39,000-44,999	3.05	2.63	2.20	1.78	1.35	0.93		
45,000-53,999	3.61	3.18	2.76	2.33	1.91	1.49	1.06	
54,000-64,999	4.72	4.30	3.87	3.45	3.02	2.60	2.18	1.33

17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.81	0.37						
21,000-26,999	1.36	0.93	0.50					
27,000-32,999	1.92	1.49	1.06	0.62				
33,000-38,999	2.48	2.05	1.61	1.18	0.75			
39,000-44,999	3.03	2.60	2.17	1.74	1.31	0.87		
45,000-53,999	3.59	3.16	2.73	2.30	1.86	1.43	1.00	
54,000-64,999	4.70	4.27	3.84	3.41	2.98	2.55	2.11	1.25

18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.30							
15,000-20,999	0.85	0.45						
21,000-26,999	1.41	1.00	0.60					
27,000-32,999	1.97	1.56	1.15	0.75				
33,000-38,999	2.53	2.12	1.71	1.30	0.89			
39,000-44,999	3.08	2.67	2.27	1.86	1.45	1.04		
45,000-53,999	3.64	3.23	2.82	2.42	2.01	1.60	1.19	
54,000-64,999	4.75	4.34	3.94	3.53	3.12	2.71	2.31	1.49
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.38							
15,000-20,999	0.94	0.57						
21,000-26,999	1.50	1.13	0.77					
27,000-32,999	2.05	1.69	1.32	0.96				
33,000-38,999	2.61	2.24	1.88	1.51	1.15			
39,000-44,999	3.17	2.80	2.44	2.07	1.70	1.34		
45,000-53,999	3.72	3.36	2.99	2.63	2.26	1.90	1.53	
54,000-64,999	4.84	4.47	4.11	3.74	3.37	3.01	2.64	1.91
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.45							
15,000-20,999	1.01	0.68						
21,000-26,999	1.56	1.23	0.90					
27,000-32,999	2.12	1.79	1.46	1.13				
33,000-38,999	2.68	2.35	2.02	1.69	1.35			
39,000-44,999	3.24	2.90	2.57	2.24	1.91	1.58		
45,000-53,999	3.79	3.46	3.13	2.80	2.47	2.14	1.81	
54,000-64,999	4.91	4.57	4.24	3.91	3.58	3.25	2.92	2.26

Table 446: Summer Demand Savings for 10.0 SEER Early Retirement Baseline—Zone 5

14.5-14.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.44							
15,000-20,999	1.13	0.65						
21,000-26,999	1.82	1.35	0.87					
27,000-32,999	2.51	2.04	1.56	1.09				
33,000-38,999	3.21	2.73	2.26	1.78	1.31			
39,000-44,999	3.90	3.42	2.95	2.47	2.00	1.52		
45,000-53,999	4.59	4.12	3.64	3.17	2.69	2.22	1.74	
54,000-64,999	5.98	5.50	5.03	4.55	4.08	3.60	3.13	2.18
15.0-15.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.47							
15,000-20,999	1.16	0.71						
21,000-26,999	1.86	1.40	0.94					
27,000-32,999	2.55	2.09	1.64	1.18				
33,000-38,999	3.24	2.79	2.33	1.87	1.42			
39,000-44,999	3.93	3.48	3.02	2.56	2.11	1.65		
45,000-53,999	4.63	4.17	3.71	3.26	2.80	2.34	1.89	
54,000-64,999	6.01	5.56	5.10	4.64	4.19	3.73	3.27	2.36
16.0-16.9 SEER								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.54							
15,000-20,999	1.23	0.81						
21,000-26,999	1.92	1.50	1.07					
27,000-32,999	2.61	2.19	1.77	1.34				
33,000-38,999	3.31	2.88	2.46	2.04	1.61			
39,000-44,999	4.00	3.58	3.15	2.73	2.30	1.88		
45,000-53,999	4.69	4.27	3.84	3.42	3.00	2.57	2.15	

54,000-64,999	6.08	5.65	5.23	4.81	4.38	3.96	3.53	2.69
17.0-17.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.52							
15,000-20,999	1.21	0.78						
21,000-26,999	1.91	1.48	1.04					
27,000-32,999	2.60	2.17	1.74	1.30				
33,000-38,999	3.29	2.86	2.43	2.00	1.56			
39,000-44,999	3.98	3.55	3.12	2.69	2.26	1.83		
45,000-53,999	4.68	4.25	3.81	3.38	2.95	2.52	2.09	
54,000-64,999	6.06	5.63	5.20	4.77	4.34	3.90	3.47	2.61
18.0-20.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.57							
15,000-20,999	1.26	0.85						
21,000-26,999	1.95	1.55	1.14					
27,000-32,999	2.65	2.24	1.83	1.42				
33,000-38,999	3.34	2.93	2.52	2.12	1.71			
39,000-44,999	4.03	3.62	3.22	2.81	2.40	1.99		
45,000-53,999	4.73	4.32	3.91	3.50	3.09	2.69	2.28	
54,000-64,999	6.11	5.70	5.30	4.89	4.48	4.07	3.66	2.85
21.0-23.9 SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.65							
15,000-20,999	1.35	0.98						
21,000-26,999	2.04	1.67	1.31					
27,000-32,999	2.73	2.37	2.00	1.64				
33,000-38,999	3.42	3.06	2.69	2.33	1.96			
39,000-44,999	4.12	3.75	3.39	3.02	2.66	2.29		
45,000-53,999	4.81	4.44	4.08	3.71	3.35	2.98	2.62	

54,000-64,999	6.20	5.83	5.46	5.10	4.73	4.37	4.00	3.27
24.0+ SEER								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.72							
15,000-20,999	1.42	1.08						
21,000-26,999	2.11	1.78	1.45					
27,000-32,999	2.80	2.47	2.14	1.81				
33,000-38,999	3.49	3.16	2.83	2.50	2.17			
39,000-44,999	4.19	3.85	3.52	3.19	2.86	2.53		
45,000-53,999	4.88	4.55	4.22	3.89	3.55	3.22	2.89	
54,000-64,999	6.26	5.93	5.60	5.27	4.94	4.61	4.28	3.62

Deemed Winter Demand Savings Tables[419]

New Construction or Replace-on-burnout of a Heat Pump

Table 447 through Table 451 present the winter demand savings (kW) associated with a central heat pump being installed during new construction or replacing a burned-out central heat pump.

The rightsizing savings specified in the tables below are only applicable to Replace-on-burnout projects. New construction projects are not eligible to receive deemed savings for system rightsizing.[420]

419 Rated capacity ranges are specified with a 5 percent tolerance in accordance with AHRI Standard 210/240 to account for systems that are rated slightly below the applicable nominal capacity. AHRI Standard 210/240. Table J1. http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_210-240_2017.pdf.

420 For projects using a custom baseline see TRMv6.0 Volume 4.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 447: Central Winter Demand Savings for 8.2 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.06							
15,000-20,999	0.72	0.08						
21,000-26,999	1.39	0.75	0.11					
27,000-32,999	2.06	1.42	0.78	0.14				
33,000-38,999	2.72	2.08	1.44	0.80	0.17			
39,000-44,999	3.39	2.75	2.11	1.47	0.83	0.19		
45,000-53,999	4.06	3.42	2.78	2.14	1.50	0.86	0.22	
54,000-64,999	5.39	4.75	4.11	3.47	2.83	2.19	1.55	0.28
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.78	0.18						
21,000-26,999	1.45	0.84	0.24					
27,000-32,999	2.12	1.51	0.90	0.29				
33,000-38,999	2.79	2.18	1.57	0.96	0.35			
39,000-44,999	3.45	2.85	2.24	1.63	1.02	0.41		
45,000-53,999	4.12	3.51	2.90	2.30	1.69	1.08	0.47	
54,000-64,999	5.46	4.85	4.24	3.63	3.02	2.41	1.81	0.59

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.82	0.23						
21,000-26,999	1.48	0.89	0.30					
27,000-32,999	2.15	1.56	0.97	0.38				
33,000-38,999	2.82	2.23	1.63	1.04	0.45			
39,000-44,999	3.49	2.89	2.30	1.71	1.12	0.53		
45,000-53,999	4.15	3.56	2.97	2.38	1.79	1.19	0.60	
54,000-64,999	5.49	4.90	4.30	3.71	3.12	2.53	1.94	0.75
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.83	0.24						
21,000-26,999	1.50	0.91	0.32					
27,000-32,999	2.16	1.58	0.99	0.41				
33,000-38,999	2.83	2.25	1.66	1.07	0.49			
39,000-44,999	3.50	2.91	2.33	1.74	1.15	0.57		
45,000-53,999	4.17	3.58	2.99	2.41	1.82	1.24	0.65	
54,000-64,999	5.50	4.91	4.33	3.74	3.16	2.57	1.98	0.81
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.84	0.26						
21,000-26,999	1.51	0.93	0.35					
27,000-32,999	2.18	1.60	1.02	0.44				
33,000-38,999	2.84	2.26	1.68	1.10	0.52			
39,000-44,999	3.51	2.93	2.35	1.77	1.19	0.61		
45,000-53,999	4.18	3.60	3.02	2.44	1.86	1.28	0.70	
54,000-64,999	5.51	4.93	4.35	3.77	3.19	2.61	2.03	0.87

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.19							
15,000-20,999	0.85	0.28						
21,000-26,999	1.52	0.95	0.37					
27,000-32,999	2.19	1.61	1.04	0.46				
33,000-38,999	2.85	2.28	1.71	1.13	0.56			
39,000-44,999	3.52	2.95	2.37	1.80	1.22	0.65		
45,000-53,999	4.19	3.61	3.04	2.47	1.89	1.32	0.74	
54,000-64,999	5.52	4.95	4.37	3.80	3.23	2.65	2.08	0.93
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.86	0.29						
21,000-26,999	1.53	0.96	0.39					
27,000-32,999	2.20	1.63	1.06	0.49				
33,000-38,999	2.87	2.30	1.73	1.16	0.59			
39,000-44,999	3.53	2.96	2.39	1.83	1.26	0.69		
45,000-53,999	4.20	3.63	3.06	2.49	1.92	1.35	0.79	
54,000-64,999	5.53	4.96	4.40	3.83	3.26	2.69	2.12	0.98
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.87	0.30						
21,000-26,999	1.54	0.97	0.41					
27,000-32,999	2.20	1.64	1.07	0.51				
33,000-38,999	2.87	2.31	1.74	1.17	0.61			
39,000-44,999	3.54	2.97	2.41	1.84	1.28	0.71		
45,000-53,999	4.21	3.64	3.07	2.51	1.94	1.38	0.81	
54,000-64,999	5.54	4.97	4.41	3.84	3.28	2.71	2.15	1.01

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 448: Central Winter Demand Savings for 8.2 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.06							
15,000-20,999	0.68	0.08						
21,000-26,999	1.30	0.70	0.11					
27,000-32,999	1.92	1.33	0.73	0.14				
33,000-38,999	2.54	1.95	1.35	0.76	0.17			
39,000-44,999	3.16	2.57	1.97	1.38	0.79	0.19		
45,000-53,999	3.78	3.19	2.60	2.00	1.41	0.82	0.22	
54,000-64,999	5.03	4.43	3.84	3.24	2.65	2.06	1.46	0.28
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.74	0.18						
21,000-26,999	1.36	0.80	0.24					
27,000-32,999	1.98	1.42	0.86	0.30				
33,000-38,999	2.60	2.04	1.48	0.92	0.35			
39,000-44,999	3.22	2.66	2.10	1.54	0.98	0.41		
45,000-53,999	3.85	3.28	2.72	2.16	1.60	1.04	0.47	
54,000-64,999	5.09	4.53	3.96	3.40	2.84	2.28	1.72	0.59

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.77	0.23						
21,000-26,999	1.39	0.85	0.30					
27,000-32,999	2.01	1.47	0.92	0.38				
33,000-38,999	2.64	2.09	1.54	1.00	0.45			
39,000-44,999	3.26	2.71	2.17	1.62	1.07	0.53		
45,000-53,999	3.88	3.33	2.79	2.24	1.70	1.15	0.60	
54,000-64,999	5.12	4.57	4.03	3.48	2.94	2.39	1.85	0.75

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.78	0.24						
21,000-26,999	1.41	0.87	0.33					
27,000-32,999	2.03	1.49	0.95	0.41				
33,000-38,999	2.65	2.11	1.57	1.03	0.49			
39,000-44,999	3.27	2.73	2.19	1.65	1.11	0.57		
45,000-53,999	3.89	3.35	2.81	2.27	1.73	1.19	0.65	
54,000-64,999	5.13	4.59	4.05	3.51	2.97	2.44	1.90	0.82

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.80	0.26						
21,000-26,999	1.42	0.88	0.35					
27,000-32,999	2.04	1.51	0.97	0.44				
33,000-38,999	2.66	2.13	1.59	1.06	0.53			
39,000-44,999	3.28	2.75	2.21	1.68	1.15	0.61		
45,000-53,999	3.90	3.37	2.84	2.30	1.77	1.23	0.70	
54,000-64,999	5.14	4.61	4.08	3.54	3.01	2.48	1.94	0.88

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.19							
15,000-20,999	0.81	0.28						
21,000-26,999	1.43	0.90	0.37					
27,000-32,999	2.05	1.52	0.99	0.47				
33,000-38,999	2.67	2.14	1.62	1.09	0.56			
39,000-44,999	3.29	2.76	2.24	1.71	1.18	0.65		
45,000-53,999	3.91	3.39	2.86	2.33	1.80	1.27	0.75	
54,000-64,999	5.16	4.63	4.10	3.57	3.04	2.52	1.99	0.93

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.82	0.30						
21,000-26,999	1.44	0.92	0.39					
27,000-32,999	2.06	1.54	1.02	0.49				
33,000-38,999	2.68	2.16	1.64	1.11	0.59			
39,000-44,999	3.30	2.78	2.26	1.74	1.21	0.69		
45,000-53,999	3.92	3.40	2.88	2.36	1.83	1.31	0.79	
54,000-64,999	5.17	4.64	4.12	3.60	3.08	2.55	2.03	0.99

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.83	0.31						
21,000-26,999	1.45	0.93	0.41					
27,000-32,999	2.07	1.55	1.03	0.51				
33,000-38,999	2.69	2.17	1.65	1.13	0.61			
39,000-44,999	3.31	2.79	2.27	1.75	1.23	0.71		
45,000-53,999	3.93	3.41	2.89	2.37	1.85	1.33	0.82	
54,000-64,999	5.17	4.65	4.14	3.62	3.10	2.58	2.06	1.02

Climate Zone 3: South Region, Houston Weather Data

Table 449: Central Winter Demand Savings for 8.2 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.05							
15,000-20,999	0.40	0.07						
21,000-26,999	0.76	0.43	0.10					
27,000-32,999	1.11	0.78	0.45	0.12				
33,000-38,999	1.47	1.14	0.81	0.48	0.15			
39,000-44,999	1.82	1.49	1.16	0.83	0.50	0.17		
45,000-53,999	2.17	1.84	1.51	1.19	0.86	0.53	0.20	
54,000-64,999	2.88	2.55	2.22	1.89	1.56	1.23	0.90	0.25
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.46	0.16						
21,000-26,999	0.81	0.51	0.21					
27,000-32,999	1.17	0.87	0.56	0.26				
33,000-38,999	1.52	1.22	0.92	0.62	0.32			
39,000-44,999	1.88	1.57	1.27	0.97	0.67	0.37		
45,000-53,999	2.23	1.93	1.63	1.32	1.02	0.72	0.42	
54,000-64,999	2.94	2.64	2.33	2.03	1.73	1.43	1.13	0.53

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.49	0.20						
21,000-26,999	0.84	0.56	0.27					
27,000-32,999	1.20	0.91	0.62	0.34				
33,000-38,999	1.55	1.26	0.98	0.69	0.40			
39,000-44,999	1.90	1.62	1.33	1.04	0.76	0.47		
45,000-53,999	2.26	1.97	1.68	1.40	1.11	0.82	0.54	
54,000-64,999	2.97	2.68	2.39	2.11	1.82	1.53	1.24	0.67
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.14							
15,000-20,999	0.50	0.22						
21,000-26,999	0.85	0.57	0.29					
27,000-32,999	1.21	0.93	0.64	0.36				
33,000-38,999	1.56	1.28	1.00	0.72	0.43			
39,000-44,999	1.92	1.63	1.35	1.07	0.79	0.51		
45,000-53,999	2.27	1.99	1.71	1.42	1.14	0.86	0.58	
54,000-64,999	2.98	2.70	2.41	2.13	1.85	1.57	1.29	0.72
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.51	0.23						
21,000-26,999	0.86	0.59	0.31					
27,000-32,999	1.22	0.94	0.66	0.39				
33,000-38,999	1.57	1.30	1.02	0.74	0.47			
39,000-44,999	1.93	1.65	1.37	1.10	0.82	0.54		
45,000-53,999	2.28	2.00	1.73	1.45	1.17	0.90	0.62	
54,000-64,999	2.99	2.71	2.44	2.16	1.88	1.61	1.33	0.78

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.52	0.25						
21,000-26,999	0.87	0.60	0.33					
27,000-32,999	1.23	0.96	0.69	0.41				
33,000-38,999	1.58	1.31	1.04	0.77	0.50			
39,000-44,999	1.94	1.66	1.39	1.12	0.85	0.58		
45,000-53,999	2.29	2.02	1.75	1.48	1.20	0.93	0.66	
54,000-64,999	3.00	2.73	2.46	2.18	1.91	1.64	1.37	0.83

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.53	0.26						
21,000-26,999	0.88	0.62	0.35					
27,000-32,999	1.24	0.97	0.70	0.44				
33,000-38,999	1.59	1.33	1.06	0.79	0.53			
39,000-44,999	1.95	1.68	1.41	1.15	0.88	0.61		
45,000-53,999	2.30	2.03	1.77	1.50	1.23	0.97	0.70	
54,000-64,999	3.01	2.74	2.47	2.21	1.94	1.68	1.41	0.88

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.53	0.27						
21,000-26,999	0.89	0.63	0.36					
27,000-32,999	1.24	0.98	0.72	0.45				
33,000-38,999	1.60	1.33	1.07	0.81	0.54			
39,000-44,999	1.95	1.69	1.42	1.16	0.90	0.63		
45,000-53,999	2.31	2.04	1.78	1.51	1.25	0.99	0.72	
54,000-64,999	3.01	2.75	2.49	2.22	1.96	1.70	1.43	0.90

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 450: Central Winter Demand Savings for 8.2 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.04							
15,000-20,999	0.30	0.06						
21,000-26,999	0.57	0.32	0.07					
27,000-32,999	0.84	0.59	0.34	0.09				
33,000-38,999	1.10	0.85	0.61	0.36	0.11			
39,000-44,999	1.37	1.12	0.87	0.62	0.38	0.13		
45,000-53,999	1.63	1.39	1.14	0.89	0.64	0.40	0.15	
54,000-64,999	2.17	1.92	1.67	1.42	1.18	0.93	0.68	0.18
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.08							
15,000-20,999	0.35	0.12						
21,000-26,999	0.61	0.38	0.16					
27,000-32,999	0.88	0.65	0.42	0.20				
33,000-38,999	1.14	0.92	0.69	0.46	0.24			
39,000-44,999	1.41	1.18	0.96	0.73	0.50	0.28		
45,000-53,999	1.68	1.45	1.22	1.00	0.77	0.54	0.32	
54,000-64,999	2.21	1.98	1.75	1.53	1.30	1.07	0.85	0.39

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.10							
15,000-20,999	0.37	0.15						
21,000-26,999	0.63	0.42	0.20					
27,000-32,999	0.90	0.68	0.47	0.25				
33,000-38,999	1.17	0.95	0.73	0.52	0.30			
39,000-44,999	1.43	1.22	1.00	0.78	0.57	0.35		
45,000-53,999	1.70	1.48	1.27	1.05	0.83	0.62	0.40	
54,000-64,999	2.23	2.01	1.80	1.58	1.37	1.15	0.94	0.50
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.38	0.16						
21,000-26,999	0.64	0.43	0.22					
27,000-32,999	0.91	0.70	0.48	0.27				
33,000-38,999	1.17	0.96	0.75	0.54	0.33			
39,000-44,999	1.44	1.23	1.02	0.80	0.59	0.38		
45,000-53,999	1.71	1.49	1.28	1.07	0.86	0.65	0.44	
54,000-64,999	2.24	2.03	1.81	1.60	1.39	1.18	0.97	0.54
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.38	0.18						
21,000-26,999	0.65	0.44	0.23					
27,000-32,999	0.92	0.71	0.50	0.29				
33,000-38,999	1.18	0.97	0.77	0.56	0.35			
39,000-44,999	1.45	1.24	1.03	0.82	0.62	0.41		
45,000-53,999	1.71	1.51	1.30	1.09	0.88	0.67	0.47	
54,000-64,999	2.25	2.04	1.83	1.62	1.41	1.21	1.00	0.58

11.0-11.4 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.39	0.19						
21,000-26,999	0.66	0.45	0.25					
27,000-32,999	0.92	0.72	0.51	0.31				
33,000-38,999	1.19	0.98	0.78	0.58	0.37			
39,000-44,999	1.45	1.25	1.05	0.84	0.64	0.44		
45,000-53,999	1.72	1.52	1.31	1.11	0.91	0.70	0.50	
54,000-64,999	2.25	2.05	1.85	1.64	1.44	1.23	1.03	0.62

11.5-11.9 HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.40	0.20						
21,000-26,999	0.66	0.46	0.26					
27,000-32,999	0.93	0.73	0.53	0.33				
33,000-38,999	1.20	1.00	0.80	0.60	0.40			
39,000-44,999	1.46	1.26	1.06	0.86	0.66	0.46		
45,000-53,999	1.73	1.53	1.33	1.13	0.93	0.73	0.53	
54,000-64,999	2.26	2.06	1.86	1.66	1.46	1.26	1.06	0.66

12.0+ HSPF								
Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.14							
15,000-20,999	0.40	0.20						
21,000-26,999	0.67	0.47	0.27					
27,000-32,999	0.93	0.74	0.54	0.34				
33,000-38,999	1.20	1.00	0.80	0.61	0.41			
39,000-44,999	1.47	1.27	1.07	0.87	0.67	0.48		
45,000-53,999	1.73	1.53	1.34	1.14	0.94	0.74	0.54	
54,000-64,999	2.26	2.07	1.87	1.67	1.47	1.27	1.08	0.68

Climate Zone 5: West Region El Paso Weather Data

Table 451: Central Winter Demand Savings for 8.2 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.03							
15,000-20,999	0.26	0.05						
21,000-26,999	0.49	0.28	0.06					
27,000-32,999	0.72	0.50	0.29	0.08				
33,000-38,999	0.95	0.73	0.52	0.31	0.10			
39,000-44,999	1.17	0.96	0.75	0.54	0.32	0.11		
45,000-53,999	1.40	1.19	0.98	0.77	0.55	0.34	0.13	
54,000-64,999	1.86	1.65	1.43	1.22	1.01	0.80	0.58	0.16
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.07							
15,000-20,999	0.30	0.10						
21,000-26,999	0.52	0.33	0.14					
27,000-32,999	0.75	0.56	0.36	0.17				
33,000-38,999	0.98	0.79	0.59	0.40	0.20			
39,000-44,999	1.21	1.02	0.82	0.63	0.43	0.24		
45,000-53,999	1.44	1.24	1.05	0.86	0.66	0.47	0.27	
54,000-64,999	1.90	1.70	1.51	1.31	1.12	0.92	0.73	0.34

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.09							
15,000-20,999	0.32	0.13						
21,000-26,999	0.54	0.36	0.17					
27,000-32,999	0.77	0.59	0.40	0.22				
33,000-38,999	1.00	0.82	0.63	0.44	0.26			
39,000-44,999	1.23	1.04	0.86	0.67	0.49	0.30		
45,000-53,999	1.46	1.27	1.09	0.90	0.72	0.53	0.35	
54,000-64,999	1.92	1.73	1.54	1.36	1.17	0.99	0.80	0.43

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.09							
15,000-20,999	0.32	0.14						
21,000-26,999	0.55	0.37	0.19					
27,000-32,999	0.78	0.60	0.42	0.23				
33,000-38,999	1.01	0.83	0.64	0.46	0.28			
39,000-44,999	1.24	1.05	0.87	0.69	0.51	0.33		
45,000-53,999	1.46	1.28	1.10	0.92	0.74	0.56	0.37	
54,000-64,999	1.92	1.74	1.56	1.38	1.19	1.01	0.83	0.47

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.10							
15,000-20,999	0.33	0.15						
21,000-26,999	0.56	0.38	0.20					
27,000-32,999	0.79	0.61	0.43	0.25				
33,000-38,999	1.01	0.84	0.66	0.48	0.30			
39,000-44,999	1.24	1.06	0.89	0.71	0.53	0.35		
45,000-53,999	1.47	1.29	1.11	0.94	0.76	0.58	0.40	
54,000-64,999	1.93	1.75	1.57	1.39	1.22	1.04	0.86	0.50

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.34	0.16						
21,000-26,999	0.56	0.39	0.21					
27,000-32,999	0.79	0.62	0.44	0.27				
33,000-38,999	1.02	0.85	0.67	0.50	0.32			
39,000-44,999	1.25	1.07	0.90	0.72	0.55	0.37		
45,000-53,999	1.48	1.30	1.13	0.95	0.78	0.60	0.43	
54,000-64,999	1.94	1.76	1.59	1.41	1.23	1.06	0.88	0.53
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.34	0.17						
21,000-26,999	0.57	0.40	0.23					
27,000-32,999	0.80	0.63	0.45	0.28				
33,000-38,999	1.03	0.86	0.68	0.51	0.34			
39,000-44,999	1.26	1.08	0.91	0.74	0.57	0.40		
45,000-53,999	1.48	1.31	1.14	0.97	0.80	0.62	0.45	
54,000-64,999	1.94	1.77	1.60	1.43	1.25	1.08	0.91	0.57
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.35	0.18						
21,000-26,999	0.57	0.40	0.23					
27,000-32,999	0.80	0.63	0.46	0.29				
33,000-38,999	1.03	0.86	0.69	0.52	0.35			
39,000-44,999	1.26	1.09	0.92	0.75	0.58	0.41		
45,000-53,999	1.49	1.32	1.15	0.98	0.81	0.64	0.47	
54,000-64,999	1.95	1.78	1.61	1.43	1.26	1.09	0.92	0.58

Replace-on-burnout—*Replacement of Electric Resistance Furnace*

Table 452 through Table 456 present the winter demand savings (kW) per heating load type associated with a central heat pump replacing an electric resistance furnace for all five climate zones. In each table, the capacity of the efficient unit is represented in the columns and the capacity of the existing unit is represented in the rows. The savings are in the intersection of the appropriate efficient and existing capacities. Replacements where there has been no change in capacity are highlighted in light blue.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 452: Central Winter Demand Savings for 3.41 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.52							
15,000-20,999	2.92	2.28						
21,000-26,999	4.32	3.68	3.04					
27,000-32,999	5.72	5.08	4.44	3.80				
33,000-38,999	7.12	6.48	5.84	5.20	4.56			
39,000-44,999	8.52	7.88	7.24	6.60	5.96	5.32		
45,000-53,999	9.91	9.27	8.63	8.00	7.36	6.72	6.08	
54,000-64,999	12.71	12.07	11.43	10.79	10.15	9.51	8.87	7.60
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.58							
15,000-20,999	2.98	2.37						
21,000-26,999	4.38	3.77	3.16					
27,000-32,999	5.78	5.17	4.56	3.95				
33,000-38,999	7.18	6.57	5.96	5.35	4.75			
39,000-44,999	8.58	7.97	7.36	6.75	6.14	5.54		
45,000-53,999	9.98	9.37	8.76	8.15	7.54	6.94	6.33	
54,000-64,999	12.78	12.17	11.56	10.95	10.34	9.73	9.13	7.91

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.61							
15,000-20,999	3.01	2.42						
21,000-26,999	4.41	3.82	3.23					
27,000-32,999	5.81	5.22	4.63	4.04				
33,000-38,999	7.21	6.62	6.03	5.43	4.84			
39,000-44,999	8.61	8.02	7.43	6.83	6.24	5.65		
45,000-53,999	10.01	9.42	8.83	8.23	7.64	7.05	6.46	
54,000-64,999	12.81	12.22	11.62	11.03	10.44	9.85	9.26	8.07
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.63							
15,000-20,999	3.03	2.44						
21,000-26,999	4.42	3.84	3.25					
27,000-32,999	5.82	5.24	4.65	4.07				
33,000-38,999	7.22	6.64	6.05	5.47	4.88			
39,000-44,999	8.62	8.04	7.45	6.86	6.28	5.69		
45,000-53,999	10.02	9.44	8.85	8.26	7.68	7.09	6.51	
54,000-64,999	12.82	12.23	11.65	11.06	10.48	9.89	9.30	8.13
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.64							
15,000-20,999	3.04	2.46						
21,000-26,999	4.44	3.86	3.28					
27,000-32,999	5.84	5.26	4.68	4.10				
33,000-38,999	7.23	6.65	6.07	5.49	4.91			
39,000-44,999	8.63	8.05	7.47	6.89	6.31	5.73		
45,000-53,999	10.03	9.45	8.87	8.29	7.71	7.13	6.55	
54,000-64,999	12.83	12.25	11.67	11.09	10.51	9.93	9.35	8.19

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.65							
15,000-20,999	3.05	2.47						
21,000-26,999	4.45	3.87	3.30					
27,000-32,999	5.85	5.27	4.70	4.12				
33,000-38,999	7.25	6.67	6.10	5.52	4.95			
39,000-44,999	8.65	8.07	7.50	6.92	6.35	5.77		
45,000-53,999	10.04	9.47	8.90	8.32	7.75	7.17	6.60	
54,000-64,999	12.84	12.27	11.69	11.12	10.55	9.97	9.40	8.25

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.66							
15,000-20,999	3.06	2.49						
21,000-26,999	4.46	3.89	3.32					
27,000-32,999	5.86	5.29	4.72	4.15				
33,000-38,999	7.26	6.69	6.12	5.55	4.98			
39,000-44,999	8.66	8.09	7.52	6.95	6.38	5.81		
45,000-53,999	10.06	9.49	8.92	8.35	7.78	7.21	6.64	
54,000-64,999	12.85	12.28	11.72	11.15	10.58	10.01	9.44	8.30

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.67							
15,000-20,999	3.07	2.50						
21,000-26,999	4.47	3.90	3.33					
27,000-32,999	5.86	5.30	4.73	4.17				
33,000-38,999	7.26	6.70	6.13	5.57	5.00			
39,000-44,999	8.66	8.10	7.53	6.97	6.40	5.83		
45,000-53,999	10.06	9.50	8.93	8.36	7.80	7.23	6.67	
54,000-64,999	12.86	12.29	11.73	11.16	10.60	10.03	9.47	8.33

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 453: Central Winter Demand Savings for 3.41 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.55							
15,000-20,999	2.92	2.33						
21,000-26,999	4.30	3.70	3.11					
27,000-32,999	5.67	5.07	4.48	3.89				
33,000-38,999	7.04	6.44	5.85	5.26	4.66			
39,000-44,999	8.41	7.81	7.22	6.63	6.03	5.44		
45,000-53,999	9.78	9.18	8.59	8.00	7.40	6.81	6.22	
54,000-64,999	12.52	11.93	11.33	10.74	10.15	9.55	8.96	7.77
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.62							
15,000-20,999	2.99	2.43						
21,000-26,999	4.36	3.80	3.23					
27,000-32,999	5.73	5.17	4.60	4.04				
33,000-38,999	7.10	6.54	5.98	5.41	4.85			
39,000-44,999	8.47	7.91	7.35	6.78	6.22	5.66		
45,000-53,999	9.84	9.28	8.72	8.15	7.59	7.03	6.47	
54,000-64,999	12.58	12.02	11.46	10.90	10.33	9.77	9.21	8.09

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.65							
15,000-20,999	3.02	2.47						
21,000-26,999	4.39	3.85	3.30					
27,000-32,999	5.76	5.22	4.67	4.12				
33,000-38,999	7.13	6.59	6.04	5.50	4.95			
39,000-44,999	8.50	7.96	7.41	6.87	6.32	5.77		
45,000-53,999	9.87	9.33	8.78	8.24	7.69	7.14	6.60	
54,000-64,999	12.61	12.07	11.52	10.98	10.43	9.89	9.34	8.25
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.66							
15,000-20,999	3.03	2.49						
21,000-26,999	4.40	3.86	3.32					
27,000-32,999	5.77	5.23	4.69	4.16				
33,000-38,999	7.14	6.60	6.07	5.53	4.99			
39,000-44,999	8.52	7.98	7.44	6.90	6.36	5.82		
45,000-53,999	9.89	9.35	8.81	8.27	7.73	7.19	6.65	
54,000-64,999	12.63	12.09	11.55	11.01	10.47	9.93	9.39	8.31
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.67							
15,000-20,999	3.04	2.51						
21,000-26,999	4.42	3.88	3.35					
27,000-32,999	5.79	5.25	4.72	4.18				
33,000-38,999	7.16	6.62	6.09	5.56	5.02			
39,000-44,999	8.53	7.99	7.46	6.93	6.39	5.86		
45,000-53,999	9.90	9.36	8.83	8.30	7.76	7.23	6.70	
54,000-64,999	12.64	12.11	11.57	11.04	10.50	9.97	9.44	8.37

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.69							
15,000-20,999	3.06	2.53						
21,000-26,999	4.43	3.90	3.37					
27,000-32,999	5.80	5.27	4.74	4.21				
33,000-38,999	7.17	6.64	6.11	5.58	5.06			
39,000-44,999	8.54	8.01	7.48	6.95	6.43	5.90		
45,000-53,999	9.91	9.38	8.85	8.33	7.80	7.27	6.74	
54,000-64,999	12.65	12.12	11.59	11.07	10.54	10.01	9.48	8.43
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.70							
15,000-20,999	3.07	2.54						
21,000-26,999	4.44	3.92	3.39					
27,000-32,999	5.81	5.29	4.76	4.24				
33,000-38,999	7.18	6.66	6.13	5.61	5.09			
39,000-44,999	8.55	8.03	7.50	6.98	6.46	5.94		
45,000-53,999	9.92	9.40	8.88	8.35	7.83	7.31	6.79	
54,000-64,999	12.66	12.14	11.62	11.09	10.57	10.05	9.53	8.48
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.70							
15,000-20,999	3.07	2.55						
21,000-26,999	4.44	3.92	3.41					
27,000-32,999	5.81	5.30	4.78	4.26				
33,000-38,999	7.19	6.67	6.15	5.63	5.11			
39,000-44,999	8.56	8.04	7.52	7.00	6.48	5.96		
45,000-53,999	9.93	9.41	8.89	8.37	7.85	7.33	6.81	
54,000-64,999	12.67	12.15	11.63	11.11	10.59	10.07	9.55	8.51

Climate Zone 3: South Region, Houston Weather Data

Table 454: Central Winter Demand Savings for 3.41 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.51							
15,000-20,999	2.60	2.27						
21,000-26,999	3.68	3.35	3.02					
27,000-32,999	4.77	4.44	4.11	3.78				
33,000-38,999	5.85	5.52	5.19	4.86	4.53			
39,000-44,999	6.94	6.61	6.28	5.95	5.62	5.29		
45,000-53,999	8.02	7.69	7.36	7.03	6.70	6.37	6.05	
54,000-64,999	10.19	9.86	9.53	9.20	8.87	8.54	8.22	7.56
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.57							
15,000-20,999	2.65	2.35						
21,000-26,999	3.74	3.44	3.13					
27,000-32,999	4.82	4.52	4.22	3.92				
33,000-38,999	5.91	5.61	5.30	5.00	4.70			
39,000-44,999	6.99	6.69	6.39	6.09	5.79	5.48		
45,000-53,999	8.08	7.78	7.47	7.17	6.87	6.57	6.27	
54,000-64,999	10.25	9.95	9.64	9.34	9.04	8.74	8.44	7.84

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.60							
15,000-20,999	2.68	2.39						
21,000-26,999	3.77	3.48	3.19					
27,000-32,999	4.85	4.56	4.28	3.99				
33,000-38,999	5.94	5.65	5.36	5.08	4.79			
39,000-44,999	7.02	6.73	6.45	6.16	5.87	5.59		
45,000-53,999	8.11	7.82	7.53	7.25	6.96	6.67	6.38	
54,000-64,999	10.28	9.99	9.70	9.42	9.13	8.84	8.55	7.98
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.61							
15,000-20,999	2.69	2.41						
21,000-26,999	3.78	3.50	3.21					
27,000-32,999	4.86	4.58	4.30	4.02				
33,000-38,999	5.95	5.67	5.38	5.10	4.82			
39,000-44,999	7.03	6.75	6.47	6.19	5.91	5.62		
45,000-53,999	8.12	7.84	7.55	7.27	6.99	6.71	6.43	
54,000-64,999	10.29	10.01	9.72	9.44	9.16	8.88	8.60	8.03
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.62							
15,000-20,999	2.70	2.43						
21,000-26,999	3.79	3.51	3.23					
27,000-32,999	4.87	4.60	4.32	4.04				
33,000-38,999	5.96	5.68	5.41	5.13	4.85			
39,000-44,999	7.04	6.77	6.49	6.21	5.94	5.66		
45,000-53,999	8.13	7.85	7.58	7.30	7.02	6.75	6.47	
54,000-64,999	10.30	10.02	9.75	9.47	9.19	8.92	8.64	8.09

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.63							
15,000-20,999	2.71	2.44						
21,000-26,999	3.80	3.53	3.26					
27,000-32,999	4.88	4.61	4.34	4.07				
33,000-38,999	5.97	5.70	5.43	5.15	4.88			
39,000-44,999	7.05	6.78	6.51	6.24	5.97	5.70		
45,000-53,999	8.14	7.87	7.60	7.32	7.05	6.78	6.51	
54,000-64,999	10.31	10.04	9.77	9.49	9.22	8.95	8.68	8.14
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.64							
15,000-20,999	2.72	2.46						
21,000-26,999	3.81	3.54	3.27					
27,000-32,999	4.89	4.63	4.36	4.09				
33,000-38,999	5.98	5.71	5.44	5.18	4.91			
39,000-44,999	7.06	6.80	6.53	6.26	6.00	5.73		
45,000-53,999	8.15	7.88	7.62	7.35	7.08	6.82	6.55	
54,000-64,999	10.32	10.05	9.79	9.52	9.25	8.99	8.72	8.19
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.64							
15,000-20,999	2.73	2.46						
21,000-26,999	3.81	3.55	3.29					
27,000-32,999	4.90	4.63	4.37	4.11				
33,000-38,999	5.98	5.72	5.46	5.19	4.93			
39,000-44,999	7.07	6.80	6.54	6.28	6.01	5.75		
45,000-53,999	8.15	7.89	7.63	7.36	7.10	6.84	6.57	
54,000-64,999	10.32	10.06	9.80	9.53	9.27	9.01	8.74	8.22

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 455: Central Winter Demand Savings for 3.41 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.16							
15,000-20,999	1.99	1.74						
21,000-26,999	2.82	2.57	2.32					
27,000-32,999	3.65	3.40	3.15	2.90				
33,000-38,999	4.47	4.23	3.98	3.73	3.48			
39,000-44,999	5.30	5.05	4.81	4.56	4.31	4.06		
45,000-53,999	6.13	5.88	5.63	5.39	5.14	4.89	4.64	
54,000-64,999	7.79	7.54	7.29	7.04	6.80	6.55	6.30	5.80
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.20							
15,000-20,999	2.03	1.80						
21,000-26,999	2.86	2.63	2.41					
27,000-32,999	3.69	3.46	3.23	3.01				
33,000-38,999	4.52	4.29	4.06	3.84	3.61			
39,000-44,999	5.34	5.12	4.89	4.66	4.44	4.21		
45,000-53,999	6.17	5.94	5.72	5.49	5.26	5.04	4.81	
54,000-64,999	7.83	7.60	7.37	7.15	6.92	6.69	6.47	6.01

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.22							
15,000-20,999	2.05	1.84						
21,000-26,999	2.88	2.67	2.45					
27,000-32,999	3.71	3.49	3.28	3.06				
33,000-38,999	4.54	4.32	4.11	3.89	3.67			
39,000-44,999	5.37	5.15	4.93	4.72	4.50	4.29		
45,000-53,999	6.19	5.98	5.76	5.55	5.33	5.11	4.90	
54,000-64,999	7.85	7.63	7.42	7.20	6.99	6.77	6.55	6.12
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.23							
15,000-20,999	2.06	1.85						
21,000-26,999	2.89	2.68	2.47					
27,000-32,999	3.72	3.51	3.29	3.08				
33,000-38,999	4.55	4.33	4.12	3.91	3.70			
39,000-44,999	5.37	5.16	4.95	4.74	4.53	4.32		
45,000-53,999	6.20	5.99	5.78	5.57	5.35	5.14	4.93	
54,000-64,999	7.86	7.65	7.43	7.22	7.01	6.80	6.59	6.16
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.24							
15,000-20,999	2.07	1.86						
21,000-26,999	2.90	2.69	2.48					
27,000-32,999	3.73	3.52	3.31	3.10				
33,000-38,999	4.55	4.35	4.14	3.93	3.72			
39,000-44,999	5.38	5.17	4.97	4.76	4.55	4.34		
45,000-53,999	6.21	6.00	5.79	5.59	5.38	5.17	4.96	
54,000-64,999	7.87	7.66	7.45	7.24	7.03	6.83	6.62	6.20

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.25							
15,000-20,999	2.08	1.87						
21,000-26,999	2.90	2.70	2.50					
27,000-32,999	3.73	3.53	3.32	3.12				
33,000-38,999	4.56	4.36	4.15	3.95	3.75			
39,000-44,999	5.39	5.18	4.98	4.78	4.57	4.37		
45,000-53,999	6.22	6.01	5.81	5.61	5.40	5.20	4.99	
54,000-64,999	7.87	7.67	7.47	7.26	7.06	6.85	6.65	6.24
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.26							
15,000-20,999	2.08	1.88						
21,000-26,999	2.91	2.71	2.51					
27,000-32,999	3.74	3.54	3.34	3.14				
33,000-38,999	4.57	4.37	4.17	3.97	3.77			
39,000-44,999	5.40	5.20	5.00	4.80	4.60	4.39		
45,000-53,999	6.22	6.02	5.82	5.62	5.42	5.22	5.02	
54,000-64,999	7.88	7.68	7.48	7.28	7.08	6.88	6.68	6.28
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.26							
15,000-20,999	2.09	1.89						
21,000-26,999	2.92	2.72	2.52					
27,000-32,999	3.74	3.55	3.35	3.15				
33,000-38,999	4.57	4.37	4.18	3.98	3.78			
39,000-44,999	5.40	5.20	5.00	4.81	4.61	4.41		
45,000-53,999	6.23	6.03	5.83	5.63	5.44	5.24	5.04	
54,000-64,999	7.88	7.69	7.49	7.29	7.09	6.89	6.70	6.30

Climate Zone 5: West Region El Paso Weather Data

Table 456: Central Winter Demand Savings for 3.41 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.00							
15,000-20,999	1.72	1.50						
21,000-26,999	2.43	2.22	2.00					
27,000-32,999	3.14	2.93	2.72	2.51				
33,000-38,999	3.86	3.65	3.43	3.22	3.01			
39,000-44,999	4.57	4.36	4.15	3.93	3.72	3.51		
45,000-53,999	5.29	5.07	4.86	4.65	4.43	4.22	4.01	
54,000-64,999	6.71	6.50	6.29	6.08	5.86	5.65	5.44	5.01
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.04							
15,000-20,999	1.75	1.56						
21,000-26,999	2.47	2.27	2.08					
27,000-32,999	3.18	2.99	2.79	2.60				
33,000-38,999	3.89	3.70	3.50	3.31	3.12			
39,000-44,999	4.61	4.41	4.22	4.02	3.83	3.63		
45,000-53,999	5.32	5.13	4.93	4.74	4.54	4.35	4.15	
54,000-64,999	6.75	6.55	6.36	6.17	5.97	5.78	5.58	5.19

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.06							
15,000-20,999	1.77	1.59						
21,000-26,999	2.48	2.30	2.11					
27,000-32,999	3.20	3.01	2.83	2.64				
33,000-38,999	3.91	3.73	3.54	3.36	3.17			
39,000-44,999	4.63	4.44	4.26	4.07	3.89	3.70		
45,000-53,999	5.34	5.16	4.97	4.78	4.60	4.41	4.23	
54,000-64,999	6.77	6.58	6.40	6.21	6.03	5.84	5.66	5.29
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.06							
15,000-20,999	1.78	1.60						
21,000-26,999	2.49	2.31	2.13					
27,000-32,999	3.21	3.02	2.84	2.66				
33,000-38,999	3.92	3.74	3.56	3.37	3.19			
39,000-44,999	4.63	4.45	4.27	4.09	3.91	3.72		
45,000-53,999	5.35	5.17	4.98	4.80	4.62	4.44	4.26	
54,000-64,999	6.78	6.59	6.41	6.23	6.05	5.87	5.68	5.32
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.07							
15,000-20,999	1.78	1.61						
21,000-26,999	2.50	2.32	2.14					
27,000-32,999	3.21	3.03	2.86	2.68				
33,000-38,999	3.93	3.75	3.57	3.39	3.21			
39,000-44,999	4.64	4.46	4.28	4.11	3.93	3.75		
45,000-53,999	5.35	5.18	5.00	4.82	4.64	4.46	4.28	
54,000-64,999	6.78	6.60	6.43	6.25	6.07	5.89	5.71	5.35

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.08							
15,000-20,999	1.79	1.62						
21,000-26,999	2.51	2.33	2.15					
27,000-32,999	3.22	3.04	2.87	2.69				
33,000-38,999	3.93	3.76	3.58	3.41	3.23			
39,000-44,999	4.65	4.47	4.30	4.12	3.95	3.77		
45,000-53,999	5.36	5.19	5.01	4.84	4.66	4.48	4.31	
54,000-64,999	6.79	6.61	6.44	6.26	6.09	5.91	5.74	5.39

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.08							
15,000-20,999	1.80	1.63						
21,000-26,999	2.51	2.34	2.17					
27,000-32,999	3.23	3.05	2.88	2.71				
33,000-38,999	3.94	3.77	3.60	3.42	3.25			
39,000-44,999	4.65	4.48	4.31	4.14	3.97	3.79		
45,000-53,999	5.37	5.19	5.02	4.85	4.68	4.51	4.34	
54,000-64,999	6.79	6.62	6.45	6.28	6.11	5.93	5.76	5.42

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.09							
15,000-20,999	1.80	1.63						
21,000-26,999	2.52	2.35	2.17					
27,000-32,999	3.23	3.06	2.89	2.72				
33,000-38,999	3.94	3.77	3.60	3.43	3.26			
39,000-44,999	4.66	4.49	4.32	4.15	3.98	3.81		
45,000-53,999	5.37	5.20	5.03	4.86	4.69	4.52	4.35	
54,000-64,999	6.80	6.63	6.46	6.29	6.12	5.95	5.78	5.44

Early Retirement—Replacement of a Heat Pump

See Table 457 through Table 466 for the winter demand savings (kW) per heating load type associated with a central heat pump replacing another heat pump for all five Texas climate zones. In each table, the capacity of the efficient unit is represented in the columns and the capacity of the existing unit is represented in the rows. The savings are in the intersection of the appropriate efficient and existing capacities. Replacements where there has been no change in capacity are highlighted in light blue.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 457: Central Winter Demand Savings for 7.7 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.84	0.20						
21,000-26,999	1.55	0.91	0.27					
27,000-32,999	2.25	1.61	0.97	0.33				
33,000-38,999	2.96	2.32	1.68	1.04	0.40			
39,000-44,999	3.66	3.02	2.39	1.75	1.11	0.47		
45,000-53,999	4.37	3.73	3.09	2.45	1.81	1.17	0.53	
54,000-64,999	5.78	5.14	4.50	3.86	3.22	2.58	1.95	0.67
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.90	0.29						
21,000-26,999	1.61	1.00	0.39					
27,000-32,999	2.31	1.71	1.10	0.49				
33,000-38,999	3.02	2.41	1.80	1.20	0.59			
39,000-44,999	3.73	3.12	2.51	1.90	1.29	0.69		
45,000-53,999	4.43	3.82	3.22	2.61	2.00	1.39	0.78	
54,000-64,999	5.85	5.24	4.63	4.02	3.41	2.80	2.20	0.98

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.93	0.34						
21,000-26,999	1.64	1.05	0.46					
27,000-32,999	2.35	1.75	1.16	0.57				
33,000-38,999	3.05	2.46	1.87	1.28	0.68			
39,000-44,999	3.76	3.17	2.58	1.98	1.39	0.80		
45,000-53,999	4.47	3.87	3.28	2.69	2.10	1.51	0.91	
54,000-64,999	5.88	5.29	4.69	4.10	3.51	2.92	2.33	1.14

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.95	0.36						
21,000-26,999	1.65	1.07	0.48					
27,000-32,999	2.36	1.77	1.19	0.60				
33,000-38,999	3.07	2.48	1.89	1.31	0.72			
39,000-44,999	3.77	3.19	2.60	2.01	1.43	0.84		
45,000-53,999	4.48	3.89	3.31	2.72	2.13	1.55	0.96	
54,000-64,999	5.89	5.30	4.72	4.13	3.55	2.96	2.37	1.20

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.96	0.38						
21,000-26,999	1.66	1.08	0.50					
27,000-32,999	2.37	1.79	1.21	0.63				
33,000-38,999	3.08	2.50	1.92	1.34	0.76			
39,000-44,999	3.78	3.20	2.62	2.04	1.46	0.88		
45,000-53,999	4.49	3.91	3.33	2.75	2.17	1.59	1.01	
54,000-64,999	5.90	5.32	4.74	4.16	3.58	3.00	2.42	1.26

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.26							
15,000-20,999	0.97	0.40						
21,000-26,999	1.68	1.10	0.53					
27,000-32,999	2.38	1.81	1.23	0.66				
33,000-38,999	3.09	2.51	1.94	1.37	0.79			
39,000-44,999	3.79	3.22	2.65	2.07	1.50	0.92		
45,000-53,999	4.50	3.93	3.35	2.78	2.20	1.63	1.05	
54,000-64,999	5.91	5.34	4.76	4.19	3.62	3.04	2.47	1.32

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.27							
15,000-20,999	0.98	0.41						
21,000-26,999	1.69	1.12	0.55					
27,000-32,999	2.39	1.82	1.26	0.69				
33,000-38,999	3.10	2.53	1.96	1.39	0.82			
39,000-44,999	3.81	3.24	2.67	2.10	1.53	0.96		
45,000-53,999	4.51	3.94	3.37	2.81	2.24	1.67	1.10	
54,000-64,999	5.92	5.36	4.79	4.22	3.65	3.08	2.51	1.37

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.28							
15,000-20,999	0.99	0.42						
21,000-26,999	1.69	1.13	0.56					
27,000-32,999	2.40	1.83	1.27	0.70				
33,000-38,999	3.11	2.54	1.97	1.41	0.84			
39,000-44,999	3.81	3.25	2.68	2.11	1.55	0.98		
45,000-53,999	4.52	3.95	3.39	2.82	2.26	1.69	1.12	
54,000-64,999	5.93	5.36	4.80	4.23	3.67	3.10	2.54	1.40

Table 458: Central Winter Demand Savings for 6.8 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.32							
15,000-20,999	1.12	0.48						
21,000-26,999	1.92	1.28	0.64					
27,000-32,999	2.72	2.08	1.44	0.80				
33,000-38,999	3.52	2.88	2.24	1.60	0.96			
39,000-44,999	4.32	3.68	3.04	2.40	1.76	1.12		
45,000-53,999	5.12	4.48	3.84	3.20	2.56	1.92	1.28	
54,000-64,999	6.72	6.08	5.44	4.80	4.16	3.52	2.88	1.60
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.38							
15,000-20,999	1.18	0.58						
21,000-26,999	1.98	1.38	0.77					
27,000-32,999	2.78	2.18	1.57	0.96				
33,000-38,999	3.58	2.98	2.37	1.76	1.15			
39,000-44,999	4.38	3.78	3.17	2.56	1.95	1.34		
45,000-53,999	5.18	4.58	3.97	3.36	2.75	2.14	1.53	
54,000-64,999	6.78	6.18	5.57	4.96	4.35	3.74	3.13	1.92
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.42							
15,000-20,999	1.22	0.62						
21,000-26,999	2.02	1.42	0.83					
27,000-32,999	2.82	2.22	1.63	1.04				
33,000-38,999	3.62	3.02	2.43	1.84	1.25			
39,000-44,999	4.42	3.82	3.23	2.64	2.05	1.46		
45,000-53,999	5.22	4.62	4.03	3.44	2.85	2.26	1.66	

54,000-64,999	6.82	6.22	5.63	5.04	4.45	3.86	3.26	2.08
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.43							
15,000-20,999	1.23	0.64						
21,000-26,999	2.03	1.44	0.86					
27,000-32,999	2.83	2.24	1.66	1.07				
33,000-38,999	3.63	3.04	2.46	1.87	1.28			
39,000-44,999	4.43	3.84	3.26	2.67	2.08	1.50		
45,000-53,999	5.23	4.64	4.06	3.47	2.88	2.30	1.71	
54,000-64,999	6.83	6.24	5.66	5.07	4.48	3.90	3.31	2.14
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.44							
15,000-20,999	1.24	0.66						
21,000-26,999	2.04	1.46	0.88					
27,000-32,999	2.84	2.26	1.68	1.10				
33,000-38,999	3.64	3.06	2.48	1.90	1.32			
39,000-44,999	4.44	3.86	3.28	2.70	2.12	1.54		
45,000-53,999	5.24	4.66	4.08	3.50	2.92	2.34	1.76	
54,000-64,999	6.84	6.26	5.68	5.10	4.52	3.94	3.36	2.20
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.45							
15,000-20,999	1.25	0.68						
21,000-26,999	2.05	1.48	0.90					
27,000-32,999	2.85	2.28	1.70	1.13				
33,000-38,999	3.65	3.08	2.50	1.93	1.35			
39,000-44,999	4.45	3.88	3.30	2.73	2.15	1.58		
45,000-53,999	5.25	4.68	4.10	3.53	2.95	2.38	1.80	

54,000-64,999	6.85	6.28	5.70	5.13	4.55	3.98	3.40	2.26
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.46							
15,000-20,999	1.26	0.69						
21,000-26,999	2.06	1.49	0.92					
27,000-32,999	2.86	2.29	1.72	1.16				
33,000-38,999	3.66	3.09	2.52	1.96	1.39			
39,000-44,999	4.46	3.89	3.32	2.76	2.19	1.62		
45,000-53,999	5.26	4.69	4.12	3.56	2.99	2.42	1.85	
54,000-64,999	6.86	6.29	5.72	5.16	4.59	4.02	3.45	2.31
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.47							
15,000-20,999	1.27	0.70						
21,000-26,999	2.07	1.50	0.94					
27,000-32,999	2.87	2.30	1.74	1.17				
33,000-38,999	3.67	3.10	2.54	1.97	1.41			
39,000-44,999	4.47	3.90	3.34	2.77	2.21	1.64		
45,000-53,999	5.27	4.70	4.14	3.57	3.01	2.44	1.87	
54,000-64,999	6.87	6.30	5.74	5.17	4.61	4.04	3.47	2.34

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 459: Central Winter Demand Savings for 7.7 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.79	0.20						
21,000-26,999	1.45	0.86	0.27					
27,000-32,999	2.12	1.52	0.93	0.33				
33,000-38,999	2.78	2.18	1.59	1.00	0.40			
39,000-44,999	3.44	2.84	2.25	1.66	1.06	0.47		
45,000-53,999	4.10	3.50	2.91	2.32	1.72	1.13	0.54	
54,000-64,999	5.42	4.82	4.23	3.64	3.04	2.45	1.86	0.67
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.86	0.30						
21,000-26,999	1.52	0.96	0.39					
27,000-32,999	2.18	1.62	1.05	0.49				
33,000-38,999	2.84	2.28	1.71	1.15	0.59			
39,000-44,999	3.50	2.94	2.37	1.81	1.25	0.69		
45,000-53,999	4.16	3.60	3.04	2.47	1.91	1.35	0.79	
54,000-64,999	5.48	4.92	4.36	3.79	3.23	2.67	2.11	0.98

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.89	0.34						
21,000-26,999	1.55	1.00	0.46					
27,000-32,999	2.21	1.67	1.12	0.57				
33,000-38,999	2.87	2.33	1.78	1.23	0.69			
39,000-44,999	3.53	2.99	2.44	1.89	1.35	0.80		
45,000-53,999	4.19	3.65	3.10	2.56	2.01	1.46	0.92	
54,000-64,999	5.51	4.97	4.42	3.88	3.33	2.78	2.24	1.15
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.90	0.36						
21,000-26,999	1.56	1.02	0.48					
27,000-32,999	2.22	1.68	1.14	0.60				
33,000-38,999	2.88	2.34	1.80	1.26	0.73			
39,000-44,999	3.54	3.00	2.46	1.93	1.39	0.85		
45,000-53,999	4.20	3.66	3.13	2.59	2.05	1.51	0.97	
54,000-64,999	5.53	4.99	4.45	3.91	3.37	2.83	2.29	1.21
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.91	0.38						
21,000-26,999	1.57	1.04	0.51					
27,000-32,999	2.23	1.70	1.17	0.63				
33,000-38,999	2.90	2.36	1.83	1.29	0.76			
39,000-44,999	3.56	3.02	2.49	1.95	1.42	0.89		
45,000-53,999	4.22	3.68	3.15	2.62	2.08	1.55	1.01	
54,000-64,999	5.54	5.00	4.47	3.94	3.40	2.87	2.34	1.27

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.26							
15,000-20,999	0.93	0.40						
21,000-26,999	1.59	1.06	0.53					
27,000-32,999	2.25	1.72	1.19	0.66				
33,000-38,999	2.91	2.38	1.85	1.32	0.79			
39,000-44,999	3.57	3.04	2.51	1.98	1.46	0.93		
45,000-53,999	4.23	3.70	3.17	2.64	2.12	1.59	1.06	
54,000-64,999	5.55	5.02	4.49	3.96	3.44	2.91	2.38	1.32
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.28							
15,000-20,999	0.94	0.41						
21,000-26,999	1.60	1.07	0.55					
27,000-32,999	2.26	1.73	1.21	0.69				
33,000-38,999	2.92	2.40	1.87	1.35	0.83			
39,000-44,999	3.58	3.06	2.53	2.01	1.49	0.97		
45,000-53,999	4.24	3.72	3.19	2.67	2.15	1.63	1.10	
54,000-64,999	5.56	5.04	4.51	3.99	3.47	2.95	2.42	1.38
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.28							
15,000-20,999	0.94	0.42						
21,000-26,999	1.60	1.08	0.56					
27,000-32,999	2.26	1.74	1.23	0.71				
33,000-38,999	2.92	2.40	1.89	1.37	0.85			
39,000-44,999	3.58	3.07	2.55	2.03	1.51	0.99		
45,000-53,999	4.25	3.73	3.21	2.69	2.17	1.65	1.13	
54,000-64,999	5.57	5.05	4.53	4.01	3.49	2.97	2.45	1.41

Table 460: Central Winter Demand Savings for 6.8 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.32							
15,000-20,999	1.08	0.48						
21,000-26,999	1.83	1.24	0.64					
27,000-32,999	2.59	1.99	1.40	0.81				
33,000-38,999	3.34	2.75	2.15	1.56	0.97			
39,000-44,999	4.10	3.50	2.91	2.32	1.72	1.13		
45,000-53,999	4.85	4.26	3.66	3.07	2.48	1.88	1.29	
54,000-64,999	6.36	5.77	5.17	4.58	3.99	3.39	2.80	1.61
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.39							
15,000-20,999	1.14	0.58						
21,000-26,999	1.89	1.33	0.77					
27,000-32,999	2.65	2.09	1.53	0.96				
33,000-38,999	3.40	2.84	2.28	1.72	1.16			
39,000-44,999	4.16	3.60	3.03	2.47	1.91	1.35		
45,000-53,999	4.91	4.35	3.79	3.23	2.67	2.10	1.54	
54,000-64,999	6.42	5.86	5.30	4.74	4.17	3.61	3.05	1.93
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.42							
15,000-20,999	1.17	0.63						
21,000-26,999	1.93	1.38	0.84					
27,000-32,999	2.68	2.14	1.59	1.04				
33,000-38,999	3.44	2.89	2.35	1.80	1.25			
39,000-44,999	4.19	3.65	3.10	2.55	2.01	1.46		
45,000-53,999	4.95	4.40	3.85	3.31	2.76	2.22	1.67	

54,000-64,999	6.46	5.91	5.36	4.82	4.27	3.73	3.18	2.09
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.43							
15,000-20,999	1.18	0.65						
21,000-26,999	1.94	1.40	0.86					
27,000-32,999	2.69	2.15	1.62	1.08				
33,000-38,999	3.45	2.91	2.37	1.83	1.29			
39,000-44,999	4.20	3.66	3.12	2.59	2.05	1.51		
45,000-53,999	4.96	4.42	3.88	3.34	2.80	2.26	1.72	
54,000-64,999	6.47	5.93	5.39	4.85	4.31	3.77	3.23	2.15
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.44							
15,000-20,999	1.20	0.66						
21,000-26,999	1.95	1.42	0.88					
27,000-32,999	2.71	2.17	1.64	1.11				
33,000-38,999	3.46	2.93	2.39	1.86	1.33			
39,000-44,999	4.22	3.68	3.15	2.61	2.08	1.55		
45,000-53,999	4.97	4.44	3.90	3.37	2.84	2.30	1.77	
54,000-64,999	6.48	5.95	5.41	4.88	4.35	3.81	3.28	2.21
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.45							
15,000-20,999	1.21	0.68						
21,000-26,999	1.96	1.43	0.91					
27,000-32,999	2.72	2.19	1.66	1.13				
33,000-38,999	3.47	2.94	2.42	1.89	1.36			
39,000-44,999	4.23	3.70	3.17	2.64	2.12	1.59		
45,000-53,999	4.98	4.45	3.93	3.40	2.87	2.34	1.81	

54,000-64,999	6.49	5.96	5.44	4.91	4.38	3.85	3.32	2.27

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.46							
15,000-20,999	1.22	0.70						
21,000-26,999	1.97	1.45	0.93					
27,000-32,999	2.73	2.21	1.68	1.16				
33,000-38,999	3.48	2.96	2.44	1.92	1.39			
39,000-44,999	4.24	3.72	3.19	2.67	2.15	1.63		
45,000-53,999	4.99	4.47	3.95	3.43	2.90	2.38	1.86	
54,000-64,999	6.50	5.98	5.46	4.93	4.41	3.89	3.37	2.32

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.47							
15,000-20,999	1.23	0.71						
21,000-26,999	1.98	1.46	0.94					
27,000-32,999	2.74	2.22	1.70	1.18				
33,000-38,999	3.49	2.97	2.45	1.93	1.41			
39,000-44,999	4.24	3.73	3.21	2.69	2.17	1.65		
45,000-53,999	5.00	4.48	3.96	3.44	2.92	2.40	1.88	
54,000-64,999	6.51	5.99	5.47	4.95	4.43	3.91	3.39	2.35

Climate Zone 3: South Region, Houston Weather Data

Table 461: Central Winter Demand Savings for 7.7 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.51	0.18						
21,000-26,999	0.90	0.57	0.24					
27,000-32,999	1.29	0.96	0.63	0.30				
33,000-38,999	1.67	1.34	1.02	0.69	0.36			
39,000-44,999	2.06	1.73	1.40	1.07	0.75	0.42		
45,000-53,999	2.45	2.12	1.79	1.46	1.13	0.80	0.48	
54,000-64,999	3.23	2.90	2.57	2.24	1.91	1.58	1.25	0.59
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.56	0.26						
21,000-26,999	0.95	0.65	0.35					
27,000-32,999	1.34	1.04	0.74	0.44				
33,000-38,999	1.73	1.43	1.13	0.83	0.52			
39,000-44,999	2.12	1.82	1.52	1.21	0.91	0.61		
45,000-53,999	2.51	2.21	1.90	1.60	1.30	1.00	0.70	
54,000-64,999	3.29	2.98	2.68	2.38	2.08	1.78	1.48	0.87

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.59	0.31						
21,000-26,999	0.98	0.69	0.41					
27,000-32,999	1.37	1.08	0.80	0.51				
33,000-38,999	1.76	1.47	1.19	0.90	0.61			
39,000-44,999	2.15	1.86	1.57	1.29	1.00	0.71		
45,000-53,999	2.54	2.25	1.96	1.68	1.39	1.10	0.81	
54,000-64,999	3.31	3.03	2.74	2.45	2.17	1.88	1.59	1.02

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.21							
15,000-20,999	0.60	0.32						
21,000-26,999	0.99	0.71	0.43					
27,000-32,999	1.38	1.10	0.82	0.54				
33,000-38,999	1.77	1.49	1.21	0.93	0.64			
39,000-44,999	2.16	1.88	1.60	1.31	1.03	0.75		
45,000-53,999	2.55	2.27	1.98	1.70	1.42	1.14	0.86	
54,000-64,999	3.33	3.04	2.76	2.48	2.20	1.92	1.64	1.07

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.61	0.34						
21,000-26,999	1.00	0.73	0.45					
27,000-32,999	1.39	1.12	0.84	0.56				
33,000-38,999	1.78	1.50	1.23	0.95	0.68			
39,000-44,999	2.17	1.89	1.62	1.34	1.06	0.79		
45,000-53,999	2.56	2.28	2.01	1.73	1.45	1.18	0.90	
54,000-64,999	3.34	3.06	2.78	2.51	2.23	1.95	1.68	1.13

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.62	0.35						
21,000-26,999	1.01	0.74	0.47					
27,000-32,999	1.40	1.13	0.86	0.59				
33,000-38,999	1.79	1.52	1.25	0.98	0.71			
39,000-44,999	2.18	1.91	1.64	1.37	1.09	0.82		
45,000-53,999	2.57	2.30	2.03	1.75	1.48	1.21	0.94	
54,000-64,999	3.35	3.07	2.80	2.53	2.26	1.99	1.72	1.18
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.63	0.37						
21,000-26,999	1.02	0.76	0.49					
27,000-32,999	1.41	1.15	0.88	0.61				
33,000-38,999	1.80	1.53	1.27	1.00	0.73			
39,000-44,999	2.19	1.92	1.66	1.39	1.12	0.86		
45,000-53,999	2.58	2.31	2.05	1.78	1.51	1.25	0.98	
54,000-64,999	3.36	3.09	2.82	2.56	2.29	2.02	1.76	1.22
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.64	0.38						
21,000-26,999	1.03	0.76	0.50					
27,000-32,999	1.42	1.15	0.89	0.63				
33,000-38,999	1.81	1.54	1.28	1.02	0.75			
39,000-44,999	2.19	1.93	1.67	1.40	1.14	0.88		
45,000-53,999	2.58	2.32	2.06	1.79	1.53	1.27	1.00	
54,000-64,999	3.36	3.10	2.83	2.57	2.31	2.04	1.78	1.25

Table 462: Central Winter Demand Savings for 6.8 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.76	0.43						
21,000-26,999	1.23	0.90	0.57					
27,000-32,999	1.70	1.37	1.04	0.72				
33,000-38,999	2.18	1.85	1.52	1.19	0.86			
39,000-44,999	2.65	2.32	1.99	1.66	1.33	1.00		
45,000-53,999	3.12	2.79	2.46	2.13	1.80	1.47	1.14	
54,000-64,999	4.07	3.74	3.41	3.08	2.75	2.42	2.09	1.43
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.34							
15,000-20,999	0.81	0.51						
21,000-26,999	1.29	0.99	0.68					
27,000-32,999	1.76	1.46	1.16	0.85				
33,000-38,999	2.23	1.93	1.63	1.33	1.03			
39,000-44,999	2.70	2.40	2.10	1.80	1.50	1.20		
45,000-53,999	3.18	2.88	2.57	2.27	1.97	1.67	1.37	
54,000-64,999	4.12	3.82	3.52	3.22	2.92	2.61	2.31	1.71
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.37							
15,000-20,999	0.84	0.56						
21,000-26,999	1.32	1.03	0.74					
27,000-32,999	1.79	1.50	1.21	0.93				
33,000-38,999	2.26	1.97	1.69	1.40	1.11			
39,000-44,999	2.73	2.45	2.16	1.87	1.59	1.30		
45,000-53,999	3.21	2.92	2.63	2.34	2.06	1.77	1.48	

54,000-64,999	4.15	3.86	3.58	3.29	3.00	2.72	2.43	1.85
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.38							
15,000-20,999	0.85	0.57						
21,000-26,999	1.33	1.05	0.76					
27,000-32,999	1.80	1.52	1.24	0.95				
33,000-38,999	2.27	1.99	1.71	1.43	1.15			
39,000-44,999	2.74	2.46	2.18	1.90	1.62	1.34		
45,000-53,999	3.22	2.94	2.65	2.37	2.09	1.81	1.53	
54,000-64,999	4.16	3.88	3.60	3.32	3.04	2.75	2.47	1.91
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.39							
15,000-20,999	0.86	0.59						
21,000-26,999	1.34	1.06	0.78					
27,000-32,999	1.81	1.53	1.26	0.98				
33,000-38,999	2.28	2.01	1.73	1.45	1.18			
39,000-44,999	2.75	2.48	2.20	1.93	1.65	1.37		
45,000-53,999	3.23	2.95	2.67	2.40	2.12	1.85	1.57	
54,000-64,999	4.17	3.90	3.62	3.34	3.07	2.79	2.51	1.96
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.40							
15,000-20,999	0.87	0.60						
21,000-26,999	1.35	1.08	0.80					
27,000-32,999	1.82	1.55	1.28	1.01				
33,000-38,999	2.29	2.02	1.75	1.48	1.21			
39,000-44,999	2.77	2.49	2.22	1.95	1.68	1.41		
45,000-53,999	3.24	2.97	2.70	2.42	2.15	1.88	1.61	

54,000-64,999	4.18	3.91	3.64	3.37	3.10	2.83	2.55	2.01
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.41							
15,000-20,999	0.88	0.62						
21,000-26,999	1.36	1.09	0.82					
27,000-32,999	1.83	1.56	1.30	1.03				
33,000-38,999	2.30	2.04	1.77	1.50	1.24			
39,000-44,999	2.77	2.51	2.24	1.98	1.71	1.44		
45,000-53,999	3.25	2.98	2.71	2.45	2.18	1.92	1.65	
54,000-64,999	4.19	3.93	3.66	3.39	3.13	2.86	2.59	2.06
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.42							
15,000-20,999	0.89	0.63						
21,000-26,999	1.36	1.10	0.84					
27,000-32,999	1.84	1.57	1.31	1.04				
33,000-38,999	2.31	2.04	1.78	1.52	1.25			
39,000-44,999	2.78	2.52	2.25	1.99	1.73	1.46		
45,000-53,999	3.25	2.99	2.73	2.46	2.20	1.94	1.67	
54,000-64,999	4.20	3.93	3.67	3.41	3.14	2.88	2.62	2.09

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 463: Central Winter Demand Savings for 7.7 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.09							
15,000-20,999	0.38	0.13						
21,000-26,999	0.67	0.43	0.18					
27,000-32,999	0.97	0.72	0.47	0.22				
33,000-38,999	1.26	1.01	0.76	0.52	0.27			
39,000-44,999	1.55	1.30	1.06	0.81	0.56	0.31		
45,000-53,999	1.84	1.60	1.35	1.10	0.85	0.60	0.36	
54,000-64,999	2.43	2.18	1.93	1.68	1.44	1.19	0.94	0.45
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.42	0.20						
21,000-26,999	0.72	0.49	0.26					
27,000-32,999	1.01	0.78	0.55	0.33				
33,000-38,999	1.30	1.07	0.85	0.62	0.39			
39,000-44,999	1.59	1.37	1.14	0.91	0.69	0.46		
45,000-53,999	1.89	1.66	1.43	1.21	0.98	0.75	0.53	
54,000-64,999	2.47	2.24	2.02	1.79	1.56	1.34	1.11	0.66

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.45	0.23						
21,000-26,999	0.74	0.52	0.31					
27,000-32,999	1.03	0.81	0.60	0.38				
33,000-38,999	1.32	1.11	0.89	0.67	0.46			
39,000-44,999	1.61	1.40	1.18	0.97	0.75	0.54		
45,000-53,999	1.91	1.69	1.48	1.26	1.04	0.83	0.61	
54,000-64,999	2.49	2.28	2.06	1.84	1.63	1.41	1.20	0.77
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.45	0.24						
21,000-26,999	0.75	0.53	0.32					
27,000-32,999	1.04	0.83	0.61	0.40				
33,000-38,999	1.33	1.12	0.91	0.70	0.48			
39,000-44,999	1.62	1.41	1.20	0.99	0.78	0.56		
45,000-53,999	1.92	1.70	1.49	1.28	1.07	0.86	0.65	
54,000-64,999	2.50	2.29	2.08	1.86	1.65	1.44	1.23	0.81
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.46	0.25						
21,000-26,999	0.75	0.55	0.34					
27,000-32,999	1.05	0.84	0.63	0.42				
33,000-38,999	1.34	1.13	0.92	0.72	0.51			
39,000-44,999	1.63	1.42	1.22	1.01	0.80	0.59		
45,000-53,999	1.92	1.72	1.51	1.30	1.09	0.88	0.68	
54,000-64,999	2.51	2.30	2.09	1.88	1.68	1.47	1.26	0.85

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.47	0.27						
21,000-26,999	0.76	0.56	0.35					
27,000-32,999	1.05	0.85	0.65	0.44				
33,000-38,999	1.35	1.14	0.94	0.73	0.53			
39,000-44,999	1.64	1.43	1.23	1.03	0.82	0.62		
45,000-53,999	1.93	1.73	1.52	1.32	1.11	0.91	0.71	
54,000-64,999	2.52	2.31	2.11	1.90	1.70	1.50	1.29	0.88

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.48	0.28						
21,000-26,999	0.77	0.57	0.37					
27,000-32,999	1.06	0.86	0.66	0.46				
33,000-38,999	1.35	1.15	0.95	0.75	0.55			
39,000-44,999	1.65	1.45	1.25	1.04	0.84	0.64		
45,000-53,999	1.94	1.74	1.54	1.34	1.14	0.94	0.74	
54,000-64,999	2.52	2.32	2.12	1.92	1.72	1.52	1.32	0.92

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.19							
15,000-20,999	0.48	0.28						
21,000-26,999	0.77	0.57	0.38					
27,000-32,999	1.07	0.87	0.67	0.47				
33,000-38,999	1.36	1.16	0.96	0.76	0.57			
39,000-44,999	1.65	1.45	1.25	1.06	0.86	0.66		
45,000-53,999	1.94	1.74	1.55	1.35	1.15	0.95	0.75	
54,000-64,999	2.53	2.33	2.13	1.93	1.73	1.54	1.34	0.94

Table 464: Central Winter Demand Savings for 6.8 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.22							
15,000-20,999	0.57	0.32						
21,000-26,999	0.93	0.68	0.43					
27,000-32,999	1.28	1.03	0.79	0.54				
33,000-38,999	1.64	1.39	1.14	0.89	0.65			
39,000-44,999	1.99	1.74	1.50	1.25	1.00	0.75		
45,000-53,999	2.35	2.10	1.85	1.60	1.36	1.11	0.86	
54,000-64,999	3.06	2.81	2.56	2.31	2.07	1.82	1.57	1.08
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.26							
15,000-20,999	0.61	0.39						
21,000-26,999	0.97	0.74	0.51					
27,000-32,999	1.32	1.10	0.87	0.64				
33,000-38,999	1.68	1.45	1.22	1.00	0.77			
39,000-44,999	2.03	1.81	1.58	1.35	1.13	0.90		
45,000-53,999	2.39	2.16	1.93	1.71	1.48	1.25	1.03	
54,000-64,999	3.10	2.87	2.65	2.42	2.19	1.97	1.74	1.29
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.28							
15,000-20,999	0.63	0.42						
21,000-26,999	0.99	0.77	0.56					
27,000-32,999	1.34	1.13	0.91	0.70				
33,000-38,999	1.70	1.48	1.27	1.05	0.84			
39,000-44,999	2.05	1.84	1.62	1.41	1.19	0.98		
45,000-53,999	2.41	2.19	1.98	1.76	1.55	1.33	1.12	

54,000-64,999	3.12	2.90	2.69	2.47	2.26	2.04	1.83	1.39
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.64	0.43						
21,000-26,999	1.00	0.79	0.57					
27,000-32,999	1.35	1.14	0.93	0.72				
33,000-38,999	1.71	1.50	1.28	1.07	0.86			
39,000-44,999	2.06	1.85	1.64	1.43	1.22	1.00		
45,000-53,999	2.42	2.21	1.99	1.78	1.57	1.36	1.15	
54,000-64,999	3.13	2.92	2.71	2.49	2.28	2.07	1.86	1.44
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.65	0.44						
21,000-26,999	1.01	0.80	0.59					
27,000-32,999	1.36	1.15	0.95	0.74				
33,000-38,999	1.72	1.51	1.30	1.09	0.88			
39,000-44,999	2.07	1.86	1.66	1.45	1.24	1.03		
45,000-53,999	2.43	2.22	2.01	1.80	1.60	1.39	1.18	
54,000-64,999	3.14	2.93	2.72	2.51	2.31	2.10	1.89	1.47
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.30							
15,000-20,999	0.66	0.45						
21,000-26,999	1.01	0.81	0.61					
27,000-32,999	1.37	1.16	0.96	0.76				
33,000-38,999	1.72	1.52	1.32	1.11	0.91			
39,000-44,999	2.08	1.87	1.67	1.47	1.26	1.06		
45,000-53,999	2.43	2.23	2.03	1.82	1.62	1.41	1.21	

54,000-64,999	3.14	2.94	2.74	2.53	2.33	2.12	1.92	1.51
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.31							
15,000-20,999	0.67	0.46						
21,000-26,999	1.02	0.82	0.62					
27,000-32,999	1.38	1.18	0.97	0.77				
33,000-38,999	1.73	1.53	1.33	1.13	0.93			
39,000-44,999	2.09	1.89	1.69	1.48	1.28	1.08		
45,000-53,999	2.44	2.24	2.04	1.84	1.64	1.44	1.24	
54,000-64,999	3.15	2.95	2.75	2.55	2.35	2.15	1.95	1.55
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.31							
15,000-20,999	0.67	0.47						
21,000-26,999	1.02	0.83	0.63					
27,000-32,999	1.38	1.18	0.98	0.79				
33,000-38,999	1.73	1.54	1.34	1.14	0.94			
39,000-44,999	2.09	1.89	1.69	1.50	1.30	1.10		
45,000-53,999	2.45	2.25	2.05	1.85	1.65	1.45	1.26	
54,000-64,999	3.16	2.96	2.76	2.56	2.36	2.16	1.97	1.57

Climate Zone 5: West Region El Paso Weather Data

Table 465: Central Winter Demand Savings for 7.7 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.08							
15,000-20,999	0.33	0.12						
21,000-26,999	0.58	0.37	0.15					
27,000-32,999	0.83	0.62	0.40	0.19				
33,000-38,999	1.08	0.87	0.66	0.44	0.23			
39,000-44,999	1.33	1.12	0.91	0.69	0.48	0.27		
45,000-53,999	1.58	1.37	1.16	0.94	0.73	0.52	0.31	
54,000-64,999	2.09	1.87	1.66	1.45	1.23	1.02	0.81	0.38
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.36	0.17						
21,000-26,999	0.61	0.42	0.23					
27,000-32,999	0.87	0.67	0.48	0.28				
33,000-38,999	1.12	0.92	0.73	0.53	0.34			
39,000-44,999	1.37	1.17	0.98	0.78	0.59	0.39		
45,000-53,999	1.62	1.42	1.23	1.04	0.84	0.65	0.45	
54,000-64,999	2.12	1.93	1.73	1.54	1.34	1.15	0.95	0.56

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.38	0.20						
21,000-26,999	0.63	0.45	0.26					
27,000-32,999	0.88	0.70	0.51	0.33				
33,000-38,999	1.14	0.95	0.77	0.58	0.39			
39,000-44,999	1.39	1.20	1.02	0.83	0.65	0.46		
45,000-53,999	1.64	1.45	1.27	1.08	0.90	0.71	0.53	
54,000-64,999	2.14	1.95	1.77	1.58	1.40	1.21	1.03	0.66

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.14							
15,000-20,999	0.39	0.21						
21,000-26,999	0.64	0.46	0.28					
27,000-32,999	0.89	0.71	0.53	0.35				
33,000-38,999	1.14	0.96	0.78	0.60	0.42			
39,000-44,999	1.39	1.21	1.03	0.85	0.67	0.48		
45,000-53,999	1.64	1.46	1.28	1.10	0.92	0.74	0.55	
54,000-64,999	2.15	1.97	1.78	1.60	1.42	1.24	1.06	0.69

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.40	0.22						
21,000-26,999	0.65	0.47	0.29					
27,000-32,999	0.90	0.72	0.54	0.36				
33,000-38,999	1.15	0.97	0.79	0.61	0.44			
39,000-44,999	1.40	1.22	1.04	0.87	0.69	0.51		
45,000-53,999	1.65	1.47	1.29	1.12	0.94	0.76	0.58	
54,000-64,999	2.15	1.98	1.80	1.62	1.44	1.26	1.08	0.73

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.40	0.23						
21,000-26,999	0.65	0.48	0.30					
27,000-32,999	0.90	0.73	0.55	0.38				
33,000-38,999	1.16	0.98	0.81	0.63	0.46			
39,000-44,999	1.41	1.23	1.06	0.88	0.71	0.53		
45,000-53,999	1.66	1.48	1.31	1.13	0.96	0.78	0.61	
54,000-64,999	2.16	1.99	1.81	1.63	1.46	1.28	1.11	0.76

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.41	0.24						
21,000-26,999	0.66	0.49	0.32					
27,000-32,999	0.91	0.74	0.57	0.40				
33,000-38,999	1.16	0.99	0.82	0.65	0.47			
39,000-44,999	1.41	1.24	1.07	0.90	0.73	0.55		
45,000-53,999	1.66	1.49	1.32	1.15	0.98	0.80	0.63	
54,000-64,999	2.17	1.99	1.82	1.65	1.48	1.31	1.13	0.79

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.41	0.24						
21,000-26,999	0.66	0.49	0.32					
27,000-32,999	0.91	0.74	0.57	0.40				
33,000-38,999	1.17	1.00	0.83	0.66	0.49			
39,000-44,999	1.42	1.25	1.08	0.91	0.74	0.57		
45,000-53,999	1.67	1.50	1.33	1.16	0.99	0.82	0.65	
54,000-64,999	2.17	2.00	1.83	1.66	1.49	1.32	1.15	0.81

Table 466: Central Winter Demand Savings for 6.8 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.49	0.28						
21,000-26,999	0.79	0.58	0.37					
27,000-32,999	1.10	0.89	0.67	0.46				
33,000-38,999	1.40	1.19	0.98	0.77	0.55			
39,000-44,999	1.71	1.50	1.28	1.07	0.86	0.65		
45,000-53,999	2.02	1.80	1.59	1.38	1.16	0.95	0.74	
54,000-64,999	2.63	2.41	2.20	1.99	1.77	1.56	1.35	0.92
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.22							
15,000-20,999	0.53	0.33						
21,000-26,999	0.83	0.64	0.44					
27,000-32,999	1.14	0.94	0.75	0.55				
33,000-38,999	1.44	1.25	1.05	0.86	0.66			
39,000-44,999	1.75	1.55	1.36	1.16	0.97	0.77		
45,000-53,999	2.05	1.86	1.66	1.47	1.27	1.08	0.88	
54,000-64,999	2.66	2.47	2.27	2.08	1.88	1.69	1.49	1.10
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.54	0.36						
21,000-26,999	0.85	0.66	0.48					
27,000-32,999	1.15	0.97	0.78	0.60				
33,000-38,999	1.46	1.27	1.09	0.90	0.72			
39,000-44,999	1.76	1.58	1.39	1.21	1.02	0.84		
45,000-53,999	2.07	1.88	1.70	1.51	1.33	1.14	0.96	

54,000-64,999	2.68	2.49	2.31	2.12	1.94	1.75	1.57	1.20
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.55	0.37						
21,000-26,999	0.86	0.67	0.49					
27,000-32,999	1.16	0.98	0.80	0.62				
33,000-38,999	1.47	1.28	1.10	0.92	0.74			
39,000-44,999	1.77	1.59	1.41	1.23	1.04	0.86		
45,000-53,999	2.08	1.90	1.71	1.53	1.35	1.17	0.99	
54,000-64,999	2.69	2.51	2.32	2.14	1.96	1.78	1.60	1.23
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.56	0.38						
21,000-26,999	0.86	0.69	0.51					
27,000-32,999	1.17	0.99	0.81	0.63				
33,000-38,999	1.47	1.30	1.12	0.94	0.76			
39,000-44,999	1.78	1.60	1.42	1.24	1.06	0.89		
45,000-53,999	2.08	1.91	1.73	1.55	1.37	1.19	1.01	
54,000-64,999	2.69	2.52	2.34	2.16	1.98	1.80	1.62	1.27
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.26							
15,000-20,999	0.56	0.39						
21,000-26,999	0.87	0.69	0.52					
27,000-32,999	1.18	1.00	0.82	0.65				
33,000-38,999	1.48	1.30	1.13	0.95	0.78			
39,000-44,999	1.79	1.61	1.43	1.26	1.08	0.91		
45,000-53,999	2.09	1.92	1.74	1.56	1.39	1.21	1.04	

54,000-64,999	2.70	2.53	2.35	2.17	2.00	1.82	1.65	1.30
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.27							
15,000-20,999	0.57	0.40						
21,000-26,999	0.88	0.70	0.53					
27,000-32,999	1.18	1.01	0.84	0.67				
33,000-38,999	1.49	1.31	1.14	0.97	0.80			
39,000-44,999	1.79	1.62	1.45	1.28	1.10	0.93		
45,000-53,999	2.10	1.92	1.75	1.58	1.41	1.24	1.06	
54,000-64,999	2.71	2.53	2.36	2.19	2.02	1.85	1.67	1.33
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.27							
15,000-20,999	0.57	0.40						
21,000-26,999	0.88	0.71	0.54					
27,000-32,999	1.18	1.01	0.84	0.67				
33,000-38,999	1.49	1.32	1.15	0.98	0.81			
39,000-44,999	1.80	1.62	1.45	1.28	1.11	0.94		
45,000-53,999	2.10	1.93	1.76	1.59	1.42	1.25	1.08	
54,000-64,999	2.71	2.54	2.37	2.20	2.03	1.86	1.69	1.35

Early Retirement—Replacement of an Electric Resistance Furnace

See Table 452 through Table 456 for the winter demand savings (kW) per heating load type associated with a central heat pump replacing an electric resistance furnace for all five Texas climate zones.

4 APPENDIX B: MINI-SPLIT AIR CONDITIONER AND HEAT PUMP DEEMED SAVINGS TABLES

Deemed Energy Savings Tables[421]

Cooling, New Construction

Refer to Appendix A, Table 387 through Table 391.

Cooling, Replace-on-burnout

Refer to Appendix A, Table 392 through Table 396.

Cooling, Early Retirement

Refer to Appendix A, Table 397 through Table 406. These savings can be used with the Replace-on-burnout energy savings in Table 392 through Table 396 to calculate annual cooling savings.

Heating, New Construction or Replace-on-burnout of a Heat Pump

Table 467 through Table 471 present the energy savings (kWh) for heating load types associated with a mini-split heat pump being installed during new construction or replacing a burned-out central heat pump for all five Texas climate zones.

The following deemed savings assume no back-up electric resistance heat for the efficient case.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 467: Mini-split Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	216							
15,000-20,999	1,255	325						
21,000-26,999	2,293	1,363	433					
27,000-32,999	3,332	2,402	1,471	541				
33,000-38,999	4,370	3,440	2,510	1,580	649			
39,000-44,999	5,409	4,479	3,548	2,618	1,688	757		

421 Rated capacity ranges are specified based on normal rounding convention between capacity categories (values at and above the midpoint round up, while values below the midpoint round down).

45,000-53,999	6,447	5,517	4,587	3,656	2,726	1,796	866	
54,000-64,999	8,524	7,594	6,664	5,733	4,803	3,873	2,943	1,082
9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	374							
15,000-20,999	1,413	561						
21,000-26,999	2,451	1,600	748					
27,000-32,999	3,490	2,638	1,787	935				
33,000-38,999	4,528	3,677	2,825	1,974	1,122			
39,000-44,999	5,566	4,715	3,864	3,012	2,161	1,309		
45,000-53,999	6,605	5,754	4,902	4,051	3,199	2,348	1,496	
54,000-64,999	8,682	7,830	6,979	6,128	5,276	4,425	3,573	1,870
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	456							
15,000-20,999	1,494	684						
21,000-26,999	2,533	1,722	912					
27,000-32,999	3,571	2,761	1,950	1,140				
33,000-38,999	4,610	3,799	2,989	2,178	1,368			
39,000-44,999	5,648	4,838	4,027	3,217	2,406	1,596		
45,000-53,999	6,687	5,876	5,066	4,255	3,445	2,634	1,824	
54,000-64,999	8,764	7,953	7,143	6,332	5,522	4,711	3,901	2,280
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	487							
15,000-20,999	1,525	730						
21,000-26,999	2,564	1,769	974					
27,000-32,999	3,602	2,807	2,012	1,217				
33,000-38,999	4,641	3,846	3,050	2,255	1,460			

39,000-44,999	5,679	4,884	4,089	3,294	2,499	1,704		
45,000-53,999	6,718	5,923	5,127	4,332	3,537	2,742	1,947	
54,000-64,999	8,795	7,999	7,204	6,409	5,614	4,819	4,024	2,434
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	516							
15,000-20,999	1,555	775						
21,000-26,999	2,593	1,813	1,033					
27,000-32,999	3,632	2,852	2,071	1,291				
33,000-38,999	4,670	3,890	3,110	2,329	1,549			
39,000-44,999	5,709	4,928	4,148	3,368	2,588	1,807		
45,000-53,999	6,747	5,967	5,187	4,406	3,626	2,846	2,066	
54,000-64,999	8,824	8,044	7,264	6,483	5,703	4,923	4,143	2,582
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	545							
15,000-20,999	1,583	817						
21,000-26,999	2,622	1,856	1,090					
27,000-32,999	3,660	2,894	2,128	1,362				
33,000-38,999	4,699	3,933	3,167	2,401	1,635			
39,000-44,999	5,737	4,971	4,205	3,439	2,673	1,907		
45,000-53,999	6,776	6,010	5,244	4,478	3,712	2,946	2,180	
54,000-64,999	8,853	8,087	7,321	6,555	5,789	5,023	4,257	2,725
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	572							
15,000-20,999	1,611	859						
21,000-26,999	2,649	1,897	1,145					
27,000-32,999	3,688	2,936	2,183	1,431				

33,000-38,999	4,726	3,974	3,222	2,470	1,717			
39,000-44,999	5,765	5,013	4,260	3,508	2,756	2,004		
45,000-53,999	6,803	6,051	5,299	4,547	3,794	3,042	2,290	
54,000-64,999	8,880	8,128	7,376	6,624	5,871	5,119	4,367	2,862

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	589							
15,000-20,999	1,627	883						
21,000-26,999	2,665	1,921	1,177					
27,000-32,999	3,704	2,960	2,216	1,471				
33,000-38,999	4,742	3,998	3,254	2,510	1,766			
39,000-44,999	5,781	5,037	4,292	3,548	2,804	2,060		
45,000-53,999	6,819	6,075	5,331	4,587	3,843	3,098	2,354	
54,000-64,999	8,896	8,152	7,408	6,664	5,919	5,175	4,431	2,943

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 468: Mini-split Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	90							
15,000-20,999	661	135						
21,000-26,999	1,231	706	180					
27,000-32,999	1,802	1,276	751	225				
33,000-38,999	2,373	1,847	1,321	796	270			
39,000-44,999	2,943	2,418	1,892	1,367	841	315		
45,000-53,999	3,514	2,988	2,463	1,937	1,412	886	360	
54,000-64,999	4,655	4,130	3,604	3,079	2,553	2,027	1,502	450

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	179							
15,000-20,999	750	269						
21,000-26,999	1,321	839	358					
27,000-32,999	1,891	1,410	929	448				
33,000-38,999	2,462	1,981	1,500	1,019	537			
39,000-44,999	3,033	2,551	2,070	1,589	1,108	627		
45,000-53,999	3,603	3,122	2,641	2,160	1,679	1,198	717	
54,000-64,999	4,745	4,263	3,782	3,301	2,820	2,339	1,858	896
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	225							
15,000-20,999	796	338						
21,000-26,999	1,367	909	451					
27,000-32,999	1,937	1,479	1,022	564				
33,000-38,999	2,508	2,050	1,592	1,134	676			
39,000-44,999	3,079	2,621	2,163	1,705	1,247	789		
45,000-53,999	3,649	3,191	2,734	2,276	1,818	1,360	902	
54,000-64,999	4,791	4,333	3,875	3,417	2,959	2,501	2,043	1,127
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	243							
15,000-20,999	813	364						
21,000-26,999	1,384	935	486					
27,000-32,999	1,955	1,506	1,056	607				
33,000-38,999	2,526	2,076	1,627	1,178	728			
39,000-44,999	3,096	2,647	2,198	1,748	1,299	850		
45,000-53,999	3,667	3,218	2,768	2,319	1,870	1,421	971	

54,000-64,999	4,808	4,359	3,910	3,460	3,011	2,562	2,113	1,214
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	260							
15,000-20,999	830	389						
21,000-26,999	1,401	960	519					
27,000-32,999	1,972	1,531	1,090	649				
33,000-38,999	2,542	2,101	1,660	1,220	779			
39,000-44,999	3,113	2,672	2,231	1,790	1,349	909		
45,000-53,999	3,684	3,243	2,802	2,361	1,920	1,479	1,038	
54,000-64,999	4,825	4,384	3,943	3,502	3,061	2,621	2,180	1,298
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	276							
15,000-20,999	846	414						
21,000-26,999	1,417	984	551					
27,000-32,999	1,988	1,555	1,122	689				
33,000-38,999	2,558	2,126	1,693	1,260	827			
39,000-44,999	3,129	2,696	2,263	1,831	1,398	965		
45,000-53,999	3,700	3,267	2,834	2,401	1,968	1,536	1,103	
54,000-64,999	4,841	4,408	3,975	3,543	3,110	2,677	2,244	1,379
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	291							
15,000-20,999	862	437						
21,000-26,999	1,433	1,008	583					
27,000-32,999	2,003	1,578	1,153	728				
33,000-38,999	2,574	2,149	1,724	1,299	874			
39,000-44,999	3,145	2,720	2,295	1,869	1,444	1,019		

45,000-53,999	3,715	3,290	2,865	2,440	2,015	1,590	1,165	
54,000-64,999	4,857	4,432	4,007	3,582	3,156	2,731	2,306	1,456
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	300							
15,000-20,999	871	450						
21,000-26,999	1,442	1,021	601					
27,000-32,999	2,012	1,592	1,171	751				
33,000-38,999	2,583	2,163	1,742	1,321	901			
39,000-44,999	3,154	2,733	2,313	1,892	1,472	1,051		
45,000-53,999	3,724	3,304	2,883	2,463	2,042	1,622	1,201	
54,000-64,999	4,866	4,445	4,025	3,604	3,184	2,763	2,343	1,502

Climate Zone 3: South Region, Houston Weather Data

Table 469: Mini-split Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	51							
15,000-20,999	420	77						
21,000-26,999	789	446	102					
27,000-32,999	1,158	815	471	128				
33,000-38,999	1,527	1,184	840	497	154			
39,000-44,999	1,896	1,552	1,209	866	523	179		
45,000-53,999	2,265	1,921	1,578	1,235	892	548	205	
54,000-64,999	3,003	2,659	2,316	1,973	1,629	1,286	943	256

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	109							
15,000-20,999	478	164						
21,000-26,999	847	533	219					
27,000-32,999	1,216	902	588	274				
33,000-38,999	1,585	1,271	957	642	328			
39,000-44,999	1,954	1,640	1,326	1,011	697	383		
45,000-53,999	2,323	2,009	1,694	1,380	1,066	752	438	
54,000-64,999	3,061	2,747	2,432	2,118	1,804	1,490	1,176	547
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	140							
15,000-20,999	509	209						
21,000-26,999	877	578	279					
27,000-32,999	1,246	947	648	349				
33,000-38,999	1,615	1,316	1,017	718	419			
39,000-44,999	1,984	1,685	1,386	1,087	788	489		
45,000-53,999	2,353	2,054	1,755	1,456	1,157	858	559	
54,000-64,999	3,091	2,792	2,493	2,194	1,895	1,595	1,296	698
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	151							
15,000-20,999	520	226						
21,000-26,999	889	595	302					
27,000-32,999	1,258	964	671	377				
33,000-38,999	1,627	1,333	1,040	746	453			
39,000-44,999	1,996	1,702	1,409	1,115	822	528		
45,000-53,999	2,364	2,071	1,778	1,484	1,191	897	604	

54,000-64,999	3,102	2,809	2,515	2,222	1,929	1,635	1,342	755
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	162							
15,000-20,999	531	243						
21,000-26,999	900	612	324					
27,000-32,999	1,269	981	693	405				
33,000-38,999	1,638	1,350	1,062	774	486			
39,000-44,999	2,006	1,719	1,431	1,143	855	567		
45,000-53,999	2,375	2,087	1,800	1,512	1,224	936	648	
54,000-64,999	3,113	2,825	2,537	2,249	1,961	1,674	1,386	810
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	172							
15,000-20,999	541	259						
21,000-26,999	910	628	345					
27,000-32,999	1,279	997	714	431				
33,000-38,999	1,648	1,365	1,083	800	517			
39,000-44,999	2,017	1,734	1,452	1,169	886	604		
45,000-53,999	2,386	2,103	1,821	1,538	1,255	973	690	
54,000-64,999	3,124	2,841	2,558	2,276	1,993	1,710	1,428	862
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	183							
15,000-20,999	552	274						
21,000-26,999	920	643	365					
27,000-32,999	1,289	1,012	734	457				
33,000-38,999	1,658	1,381	1,103	825	548			
39,000-44,999	2,027	1,750	1,472	1,194	917	639		

45,000-53,999	2,396	2,119	1,841	1,563	1,286	1,008	731	
54,000-64,999	3,134	2,856	2,579	2,301	2,024	1,746	1,468	913
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	189							
15,000-20,999	557	283						
21,000-26,999	926	652	377					
27,000-32,999	1,295	1,021	746	471				
33,000-38,999	1,664	1,390	1,115	840	566			
39,000-44,999	2,033	1,758	1,484	1,209	935	660		
45,000-53,999	2,402	2,127	1,853	1,578	1,303	1,029	754	
54,000-64,999	3,140	2,865	2,591	2,316	2,041	1,767	1,492	943

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 470: Mini-split Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	34							
15,000-20,999	282	52						
21,000-26,999	529	299	69					
27,000-32,999	776	546	316	86				
33,000-38,999	1,024	794	563	333	103			
39,000-44,999	1,271	1,041	811	581	350	120		
45,000-53,999	1,518	1,288	1,058	828	598	368	137	
54,000-64,999	2,013	1,783	1,553	1,323	1,092	862	632	172

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	73							
15,000-20,999	321	110						
21,000-26,999	568	357	147					
27,000-32,999	815	605	394	183				
33,000-38,999	1,063	852	641	431	220			
39,000-44,999	1,310	1,099	889	678	467	257		
45,000-53,999	1,557	1,347	1,136	925	715	504	293	
54,000-64,999	2,052	1,841	1,631	1,420	1,209	999	788	367
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	94							
15,000-20,999	341	140						
21,000-26,999	588	388	187					
27,000-32,999	836	635	435	234				
33,000-38,999	1,083	882	682	481	281			
39,000-44,999	1,330	1,130	929	729	528	328		
45,000-53,999	1,578	1,377	1,177	976	776	575	374	
54,000-64,999	2,072	1,872	1,671	1,471	1,270	1,070	869	468
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	101							
15,000-20,999	349	152						
21,000-26,999	596	399	202					
27,000-32,999	843	647	450	253				
33,000-38,999	1,091	894	697	500	304			
39,000-44,999	1,338	1,141	944	748	551	354		
45,000-53,999	1,585	1,389	1,192	995	798	602	405	

54,000-64,999	2,080	1,883	1,686	1,490	1,293	1,096	900	506
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	109							
15,000-20,999	356	163						
21,000-26,999	603	410	217					
27,000-32,999	851	658	464	271				
33,000-38,999	1,098	905	712	519	326			
39,000-44,999	1,345	1,152	959	766	573	380		
45,000-53,999	1,593	1,400	1,206	1,013	820	627	434	
54,000-64,999	2,087	1,894	1,701	1,508	1,315	1,122	929	543
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	116							
15,000-20,999	363	173						
21,000-26,999	610	421	231					
27,000-32,999	858	668	479	289				
33,000-38,999	1,105	915	726	536	347			
39,000-44,999	1,352	1,163	973	784	594	405		
45,000-53,999	1,600	1,410	1,221	1,031	842	652	463	
54,000-64,999	2,094	1,905	1,715	1,526	1,336	1,147	957	578
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	122							
15,000-20,999	370	184						
21,000-26,999	617	431	245					
27,000-32,999	864	678	492	306				
33,000-38,999	1,112	926	740	553	367			
39,000-44,999	1,359	1,173	987	801	615	429		

45,000-53,999	1,606	1,420	1,234	1,048	862	676	490	
54,000-64,999	2,101	1,915	1,729	1,543	1,357	1,171	984	612
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	126							
15,000-20,999	374	190						
21,000-26,999	621	437	253					
27,000-32,999	868	684	500	316				
33,000-38,999	1,116	932	747	563	379			
39,000-44,999	1,363	1,179	995	811	627	442		
45,000-53,999	1,610	1,426	1,242	1,058	874	690	506	
54,000-64,999	2,105	1,921	1,737	1,553	1,369	1,184	1,000	632

Climate Zone 5: West Region El Paso Weather Data

Table 471: Mini-split Energy Savings (Heating kWh) for 8.2 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	81							
15,000-20,999	667	122						
21,000-26,999	1,253	708	163					
27,000-32,999	1,839	1,294	749	203				
33,000-38,999	2,425	1,880	1,334	789	244			
39,000-44,999	3,011	2,465	1,920	1,375	830	285		
45,000-53,999	3,596	3,051	2,506	1,961	1,416	871	325	
54,000-64,999	4,768	4,223	3,678	3,133	2,587	2,042	1,497	407

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	174							
15,000-20,999	760	261						
21,000-26,999	1,345	846	348					
27,000-32,999	1,931	1,432	933	434				
33,000-38,999	2,517	2,018	1,519	1,020	521			
39,000-44,999	3,103	2,604	2,105	1,606	1,107	608		
45,000-53,999	3,689	3,190	2,691	2,192	1,693	1,194	695	
54,000-64,999	4,861	4,362	3,863	3,364	2,865	2,366	1,867	869
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	222							
15,000-20,999	808	333						
21,000-26,999	1,393	918	443					
27,000-32,999	1,979	1,504	1,029	554				
33,000-38,999	2,565	2,090	1,615	1,140	665			
39,000-44,999	3,151	2,676	2,201	1,726	1,251	776		
45,000-53,999	3,737	3,262	2,787	2,312	1,837	1,362	887	
54,000-64,999	4,908	4,434	3,959	3,484	3,009	2,534	2,059	1,109
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	240							
15,000-20,999	826	360						
21,000-26,999	1,411	946	480					
27,000-32,999	1,997	1,531	1,065	599				
33,000-38,999	2,583	2,117	1,651	1,185	719			
39,000-44,999	3,169	2,703	2,237	1,771	1,305	839		
45,000-53,999	3,755	3,289	2,823	2,357	1,891	1,425	959	

54,000-64,999	4,927	4,461	3,995	3,529	3,063	2,597	2,131	1,199
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	257							
15,000-20,999	843	386						
21,000-26,999	1,429	972	514					
27,000-32,999	2,015	1,557	1,100	643				
33,000-38,999	2,601	2,143	1,686	1,229	771			
39,000-44,999	3,186	2,729	2,272	1,815	1,357	900		
45,000-53,999	3,772	3,315	2,858	2,400	1,943	1,486	1,029	
54,000-64,999	4,944	4,487	4,029	3,572	3,115	2,658	2,200	1,286
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	274							
15,000-20,999	860	411						
21,000-26,999	1,446	997	548					
27,000-32,999	2,031	1,583	1,134	685				
33,000-38,999	2,617	2,168	1,719	1,271	822			
39,000-44,999	3,203	2,754	2,305	1,856	1,408	959		
45,000-53,999	3,789	3,340	2,891	2,442	1,993	1,544	1,096	
54,000-64,999	4,961	4,512	4,063	3,614	3,165	2,716	2,267	1,369
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	290							
15,000-20,999	876	435						
21,000-26,999	1,462	1,021	580					
27,000-32,999	2,048	1,607	1,166	725				
33,000-38,999	2,633	2,193	1,752	1,311	870			
39,000-44,999	3,219	2,778	2,338	1,897	1,456	1,015		

45,000-53,999	3,805	3,364	2,923	2,483	2,042	1,601	1,160	
54,000-64,999	4,977	4,536	4,095	3,654	3,213	2,773	2,332	1,450

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	299							
15,000-20,999	885	449						
21,000-26,999	1,471	1,035	599					
27,000-32,999	2,057	1,621	1,185	749				
33,000-38,999	2,643	2,207	1,771	1,334	898			
39,000-44,999	3,229	2,793	2,356	1,920	1,484	1,048		
45,000-53,999	3,814	3,378	2,942	2,506	2,070	1,634	1,198	
54,000-64,999	4,986	4,550	4,114	3,678	3,242	2,806	2,369	1,497

Heating, Replace-on-burnout—Replacement of an Electric Resistance Furnace

Table 472 through Table 476 present the energy savings (kWh) per heating load type associated with a mini-split heat pump replacing on burnout an electric resistance furnace for all five Texas climate zones.

The following deemed savings assume no back-up electric resistance heat for the efficient case.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 472: Mini-split Energy Savings (Heating kWh) for 3.41 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,390							
15,000-20,999	7,516	6,586						
21,000-26,999	10,641	9,711	8,781					
27,000-32,999	13,767	12,836	11,906	10,976				
33,000-38,999	16,892	15,962	15,032	14,101	13,171			
39,000-44,999	20,018	19,087	18,157	17,227	16,297	15,366		
45,000-53,999	23,143	22,213	21,283	20,352	19,422	18,492	17,561	
54,000-64,999	29,394	28,464	27,533	26,603	25,673	24,743	23,812	21,952

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,548							
15,000-20,999	7,673	6,822						
21,000-26,999	10,799	9,947	9,096					
27,000-32,999	13,924	13,073	12,222	11,370				
33,000-38,999	17,050	16,198	15,347	14,496	13,644			
39,000-44,999	20,175	19,324	18,472	17,621	16,770	15,918		
45,000-53,999	23,301	22,449	21,598	20,746	19,895	19,044	18,192	
54,000-64,999	29,552	28,700	27,849	26,997	26,146	25,294	24,443	22,740
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,630							
15,000-20,999	7,755	6,945						
21,000-26,999	10,881	10,070	9,260					
27,000-32,999	14,006	13,196	12,385	11,575				
33,000-38,999	17,132	16,321	15,511	14,700	13,890			
39,000-44,999	20,257	19,447	18,636	17,826	17,015	16,205		
45,000-53,999	23,383	22,572	21,762	20,951	20,141	19,330	18,520	
54,000-64,999	29,633	28,823	28,012	27,202	26,392	25,581	24,771	23,150
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,661							
15,000-20,999	7,786	6,991						
21,000-26,999	10,912	10,116	9,321					
27,000-32,999	14,037	13,242	12,447	11,652				
33,000-38,999	17,162	16,367	15,572	14,777	13,982			
39,000-44,999	20,288	19,493	18,698	17,903	17,108	16,312		
45,000-53,999	23,413	22,618	21,823	21,028	20,233	19,438	18,643	

54,000-64,999	29,664	28,869	28,074	27,279	26,484	25,689	24,894	23,303
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,690							
15,000-20,999	7,816	7,036						
21,000-26,999	10,941	10,161	9,381					
27,000-32,999	14,067	13,286	12,506	11,726				
33,000-38,999	17,192	16,412	15,632	14,851	14,071			
39,000-44,999	20,318	19,537	18,757	17,977	17,196	16,416		
45,000-53,999	23,443	22,663	21,882	21,102	20,322	19,542	18,761	
54,000-64,999	29,694	28,914	28,133	27,353	26,573	25,793	25,012	23,452
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,719							
15,000-20,999	7,844	7,078						
21,000-26,999	10,970	10,204	9,438					
27,000-32,999	14,095	13,329	12,563	11,797				
33,000-38,999	17,221	16,455	15,689	14,923	14,157			
39,000-44,999	20,346	19,580	18,814	18,048	17,282	16,516		
45,000-53,999	23,472	22,706	21,940	21,174	20,408	19,642	18,876	
54,000-64,999	29,722	28,956	28,190	27,424	26,658	25,892	25,126	23,594
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,746							
15,000-20,999	7,872	7,120						
21,000-26,999	10,997	10,245	9,493					
27,000-32,999	14,123	13,371	12,618	11,866				
33,000-38,999	17,248	16,496	15,744	14,991	14,239			
39,000-44,999	20,374	19,621	18,869	18,117	17,365	16,612		

45,000-53,999	23,499	22,747	21,995	21,242	20,490	19,738	18,986	
54,000-64,999	29,750	28,998	28,246	27,493	26,741	25,989	25,237	23,732

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	4,762							
15,000-20,999	7,888	7,144						
21,000-26,999	11,013	10,269	9,525					
27,000-32,999	14,139	13,395	12,650	11,906				
33,000-38,999	17,264	16,520	15,776	15,032	14,287			
39,000-44,999	20,390	19,645	18,901	18,157	17,413	16,669		
45,000-53,999	23,515	22,771	22,027	21,283	20,538	19,794	19,050	
54,000-64,999	29,766	29,022	28,278	27,533	26,789	26,045	25,301	23,812

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 473: Mini-split Energy Savings (Heating kWh) for 3.41HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,473							
15,000-20,999	4,235	3,710						
21,000-26,999	5,997	5,472	4,946					
27,000-32,999	7,760	7,234	6,708	6,183				
33,000-38,999	9,522	8,996	8,471	7,945	7,419			
39,000-44,999	11,284	10,758	10,233	9,707	9,181	8,656		
45,000-53,999	13,046	12,521	11,995	11,469	10,944	10,418	9,892	
54,000-64,999	16,571	16,045	15,519	14,994	14,468	13,942	13,417	12,365

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,562							
15,000-20,999	4,324	3,843						
21,000-26,999	6,087	5,605	5,124					
27,000-32,999	7,849	7,368	6,887	6,405				
33,000-38,999	9,611	9,130	8,649	8,168	7,687			
39,000-44,999	11,373	10,892	10,411	9,930	9,449	8,968		
45,000-53,999	13,135	12,654	12,173	11,692	11,211	10,730	10,249	
54,000-64,999	16,660	16,179	15,697	15,216	14,735	14,254	13,773	12,811
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,608							
15,000-20,999	4,371	3,913						
21,000-26,999	6,133	5,675	5,217					
27,000-32,999	7,895	7,437	6,979	6,521				
33,000-38,999	9,657	9,199	8,741	8,283	7,825			
39,000-44,999	11,419	10,961	10,503	10,045	9,588	9,130		
45,000-53,999	13,182	12,724	12,266	11,808	11,350	10,892	10,434	
54,000-64,999	16,706	16,248	15,790	15,332	14,874	14,416	13,958	13,042
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,626							
15,000-20,999	4,388	3,939						
21,000-26,999	6,150	5,701	5,252					
27,000-32,999	7,912	7,463	7,014	6,565				
33,000-38,999	9,675	9,225	8,776	8,327	7,878			
39,000-44,999	11,437	10,987	10,538	10,089	9,640	9,190		
45,000-53,999	13,199	12,750	12,300	11,851	11,402	10,953	10,503	

54,000-64,999	16,723	16,274	15,825	15,375	14,926	14,477	14,028	13,129
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,643							
15,000-20,999	4,405	3,964						
21,000-26,999	6,167	5,726	5,285					
27,000-32,999	7,929	7,488	7,047	6,606				
33,000-38,999	9,691	9,250	8,810	8,369	7,928			
39,000-44,999	11,453	11,013	10,572	10,131	9,690	9,249		
45,000-53,999	13,216	12,775	12,334	11,893	11,452	11,011	10,570	
54,000-64,999	16,740	16,299	15,858	15,417	14,976	14,536	14,095	13,213
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,659							
15,000-20,999	4,421	3,988						
21,000-26,999	6,183	5,750	5,317					
27,000-32,999	7,945	7,512	7,080	6,647				
33,000-38,999	9,707	9,275	8,842	8,409	7,976			
39,000-44,999	11,470	11,037	10,604	10,171	9,738	9,306		
45,000-53,999	13,232	12,799	12,366	11,933	11,501	11,068	10,635	
54,000-64,999	16,756	16,323	15,891	15,458	15,025	14,592	14,159	13,294
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,674							
15,000-20,999	4,436	4,011						
21,000-26,999	6,199	5,774	5,349					
27,000-32,999	7,961	7,536	7,111	6,686				
33,000-38,999	9,723	9,298	8,873	8,448	8,023			
39,000-44,999	11,485	11,060	10,635	10,210	9,785	9,360		

45,000-53,999	13,247	12,822	12,397	11,972	11,547	11,122	10,697	
54,000-64,999	16,772	16,347	15,922	15,497	15,072	14,647	14,221	13,371

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,683							
15,000-20,999	4,446	4,025						
21,000-26,999	6,208	5,787	5,367					
27,000-32,999	7,970	7,549	7,129	6,708				
33,000-38,999	9,732	9,312	8,891	8,471	8,050			
39,000-44,999	11,494	11,074	10,653	10,233	9,812	9,392		
45,000-53,999	13,256	12,836	12,415	11,995	11,574	11,154	10,733	
54,000-64,999	16,781	16,360	15,940	15,519	15,099	14,678	14,258	13,417

Climate Zone 3: South Region, Houston Weather Data

Table 474: Mini-split Energy Savings (Heating kWh) for 3.41 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,613							
15,000-20,999	2,764	2,420						
21,000-26,999	3,914	3,570	3,227					
27,000-32,999	5,064	4,720	4,377	4,034				
33,000-38,999	6,214	5,870	5,527	5,184	4,840			
39,000-44,999	7,364	7,020	6,677	6,334	5,991	5,647		
45,000-53,999	8,514	8,170	7,827	7,484	7,141	6,797	6,454	
54,000-64,999	10,814	10,470	10,127	9,784	9,441	9,097	8,754	8,067

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,672							
15,000-20,999	2,822	2,508						
21,000-26,999	3,972	3,658	3,343					
27,000-32,999	5,122	4,808	4,493	4,179				
33,000-38,999	6,272	5,958	5,643	5,329	5,015			
39,000-44,999	7,422	7,108	6,793	6,479	6,165	5,851		
45,000-53,999	8,572	8,258	7,944	7,629	7,315	7,001	6,687	
54,000-64,999	10,872	10,558	10,244	9,929	9,615	9,301	8,987	8,358
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,702							
15,000-20,999	2,852	2,553						
21,000-26,999	4,002	3,703	3,404					
27,000-32,999	5,152	4,853	4,554	4,255				
33,000-38,999	6,302	6,003	5,704	5,405	5,106			
39,000-44,999	7,452	7,153	6,854	6,555	6,256	5,957		
45,000-53,999	8,602	8,303	8,004	7,705	7,406	7,107	6,808	
54,000-64,999	10,902	10,603	10,304	10,005	9,706	9,407	9,108	8,509
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,713							
15,000-20,999	2,863	2,570						
21,000-26,999	4,013	3,720	3,427					
27,000-32,999	5,163	4,870	4,577	4,283				
33,000-38,999	6,313	6,020	5,727	5,433	5,140			
39,000-44,999	7,463	7,170	6,877	6,583	6,290	5,996		
45,000-53,999	8,613	8,320	8,027	7,733	7,440	7,146	6,853	

54,000-64,999	10,914	10,620	10,327	10,033	9,740	9,446	9,153	8,566
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,724							
15,000-20,999	2,874	2,586						
21,000-26,999	4,024	3,736	3,448					
27,000-32,999	5,174	4,886	4,598	4,310				
33,000-38,999	6,324	6,036	5,748	5,461	5,173			
39,000-44,999	7,474	7,186	6,898	6,611	6,323	6,035		
45,000-53,999	8,624	8,336	8,049	7,761	7,473	7,185	6,897	
54,000-64,999	10,924	10,637	10,349	10,061	9,773	9,485	9,197	8,621
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,735							
15,000-20,999	2,885	2,602						
21,000-26,999	4,035	3,752	3,469					
27,000-32,999	5,185	4,902	4,619	4,337				
33,000-38,999	6,335	6,052	5,770	5,487	5,204			
39,000-44,999	7,485	7,202	6,920	6,637	6,354	6,072		
45,000-53,999	8,635	8,352	8,070	7,787	7,504	7,222	6,939	
54,000-64,999	10,935	10,652	10,370	10,087	9,804	9,522	9,239	8,674
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,745							
15,000-20,999	2,895	2,617						
21,000-26,999	4,045	3,767	3,490					
27,000-32,999	5,195	4,917	4,640	4,362				
33,000-38,999	6,345	6,067	5,790	5,512	5,235			
39,000-44,999	7,495	7,217	6,940	6,662	6,385	6,107		

45,000-53,999	8,645	8,368	8,090	7,812	7,535	7,257	6,980	
54,000-64,999	10,945	10,668	10,390	10,112	9,835	9,557	9,280	8,724
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,751							
15,000-20,999	2,901	2,626						
21,000-26,999	4,051	3,776	3,502					
27,000-32,999	5,201	4,926	4,652	4,377				
33,000-38,999	6,351	6,076	5,802	5,527	5,252			
39,000-44,999	7,501	7,226	6,952	6,677	6,402	6,128		
45,000-53,999	8,651	8,376	8,102	7,827	7,552	7,278	7,003	
54,000-64,999	10,951	10,676	10,402	10,127	9,853	9,578	9,303	8,754

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 475: Mini-split Energy Savings (Heating kWh) for 3.41 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,083							
15,000-20,999	1,855	1,625						
21,000-26,999	2,627	2,397	2,167					
27,000-32,999	3,399	3,169	2,939	2,709				
33,000-38,999	4,171	3,941	3,711	3,481	3,250			
39,000-44,999	4,943	4,713	4,483	4,253	4,022	3,792		
45,000-53,999	5,715	5,485	5,255	5,024	4,794	4,564	4,334	
54,000-64,999	7,259	7,029	6,798	6,568	6,338	6,108	5,878	5,417

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,123							
15,000-20,999	1,894	1,684						
21,000-26,999	2,666	2,456	2,245					
27,000-32,999	3,438	3,228	3,017	2,806				
33,000-38,999	4,210	3,999	3,789	3,578	3,368			
39,000-44,999	4,982	4,771	4,561	4,350	4,139	3,929		
45,000-53,999	5,754	5,543	5,333	5,122	4,911	4,701	4,490	
54,000-64,999	7,298	7,087	6,876	6,666	6,455	6,244	6,034	5,613
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,143							
15,000-20,999	1,915	1,714						
21,000-26,999	2,687	2,486	2,286					
27,000-32,999	3,458	3,258	3,057	2,857				
33,000-38,999	4,230	4,030	3,829	3,629	3,428			
39,000-44,999	5,002	4,802	4,601	4,401	4,200	4,000		
45,000-53,999	5,774	5,574	5,373	5,173	4,972	4,772	4,571	
54,000-64,999	7,318	7,117	6,917	6,716	6,516	6,315	6,115	5,714
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,150							
15,000-20,999	1,922	1,726						
21,000-26,999	2,694	2,497	2,301					
27,000-32,999	3,466	3,269	3,073	2,876				
33,000-38,999	4,238	4,041	3,845	3,648	3,451			
39,000-44,999	5,010	4,813	4,616	4,420	4,223	4,026		
45,000-53,999	5,782	5,585	5,388	5,192	4,995	4,798	4,602	

54,000-64,999	7,326	7,129	6,932	6,735	6,539	6,342	6,145	5,752
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,158							
15,000-20,999	1,930	1,737						
21,000-26,999	2,702	2,508	2,315					
27,000-32,999	3,473	3,280	3,087	2,894				
33,000-38,999	4,245	4,052	3,859	3,666	3,473			
39,000-44,999	5,017	4,824	4,631	4,438	4,245	4,052		
45,000-53,999	5,789	5,596	5,403	5,210	5,017	4,824	4,631	
54,000-64,999	7,333	7,140	6,947	6,754	6,561	6,368	6,175	5,789
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,165							
15,000-20,999	1,937	1,747						
21,000-26,999	2,709	2,519	2,330					
27,000-32,999	3,480	3,291	3,101	2,912				
33,000-38,999	4,252	4,063	3,873	3,684	3,494			
39,000-44,999	5,024	4,835	4,645	4,456	4,266	4,077		
45,000-53,999	5,796	5,607	5,417	5,228	5,038	4,849	4,659	
54,000-64,999	7,340	7,150	6,961	6,771	6,582	6,392	6,203	5,824
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,172							
15,000-20,999	1,943	1,757						
21,000-26,999	2,715	2,529	2,343					
27,000-32,999	3,487	3,301	3,115	2,929				
33,000-38,999	4,259	4,073	3,887	3,701	3,515			
39,000-44,999	5,031	4,845	4,659	4,473	4,287	4,101		

45,000-53,999	5,803	5,617	5,431	5,245	5,059	4,872	4,686	
54,000-64,999	7,347	7,161	6,975	6,788	6,602	6,416	6,230	5,858
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,176							
15,000-20,999	1,947	1,763						
21,000-26,999	2,719	2,535	2,351					
27,000-32,999	3,491	3,307	3,123	2,939				
33,000-38,999	4,263	4,079	3,895	3,711	3,527			
39,000-44,999	5,035	4,851	4,667	4,483	4,299	4,114		
45,000-53,999	5,807	5,623	5,439	5,255	5,070	4,886	4,702	
54,000-64,999	7,351	7,167	6,983	6,798	6,614	6,430	6,246	5,878

Climate Zone 5: West Region El Paso Weather Data

Table 476: Mini-split Energy Savings (Heating kWh) for 3.41 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,563							
15,000-20,999	4,390	3,844						
21,000-26,999	6,216	5,671	5,126					
27,000-32,999	8,043	7,498	6,953	6,407				
33,000-38,999	9,870	9,324	8,779	8,234	7,689			
39,000-44,999	11,696	11,151	10,606	10,061	9,516	8,970		
45,000-53,999	13,523	12,978	12,432	11,887	11,342	10,797	10,252	
54,000-64,999	17,176	16,631	16,086	15,541	14,995	14,450	13,905	12,815

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,655							
15,000-20,999	4,482	3,983						
21,000-26,999	6,309	5,810	5,311					
27,000-32,999	8,135	7,636	7,137	6,638				
33,000-38,999	9,962	9,463	8,964	8,465	7,966			
39,000-44,999	11,789	11,290	10,791	10,292	9,793	9,294		
45,000-53,999	13,615	13,116	12,617	12,118	11,619	11,120	10,621	
54,000-64,999	17,268	16,770	16,271	15,772	15,273	14,774	14,275	13,277
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,703							
15,000-20,999	4,530	4,055						
21,000-26,999	6,357	5,882	5,407					
27,000-32,999	8,183	7,708	7,233	6,758				
33,000-38,999	10,010	9,535	9,060	8,585	8,110			
39,000-44,999	11,837	11,362	10,887	10,412	9,937	9,462		
45,000-53,999	13,663	13,188	12,713	12,238	11,763	11,288	10,813	
54,000-64,999	17,316	16,841	16,367	15,892	15,417	14,942	14,467	13,517
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,721							
15,000-20,999	4,548	4,082						
21,000-26,999	6,375	5,909	5,443					
27,000-32,999	8,201	7,735	7,269	6,803				
33,000-38,999	10,028	9,562	9,096	8,630	8,164			
39,000-44,999	11,855	11,389	10,923	10,457	9,991	9,525		
45,000-53,999	13,681	13,215	12,749	12,283	11,817	11,351	10,886	

54,000-64,999	17,334	16,869	16,403	15,937	15,471	15,005	14,539	13,607
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,739							
15,000-20,999	4,565	4,108						
21,000-26,999	6,392	5,935	5,478					
27,000-32,999	8,219	7,761	7,304	6,847				
33,000-38,999	10,045	9,588	9,131	8,674	8,216			
39,000-44,999	11,872	11,415	10,957	10,500	10,043	9,586		
45,000-53,999	13,699	13,241	12,784	12,327	11,870	11,412	10,955	
54,000-64,999	17,352	16,895	16,437	15,980	15,523	15,066	14,608	13,694
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,755							
15,000-20,999	4,582	4,133						
21,000-26,999	6,409	5,960	5,511					
27,000-32,999	8,235	7,787	7,338	6,889				
33,000-38,999	10,062	9,613	9,164	8,715	8,266			
39,000-44,999	11,889	11,440	10,991	10,542	10,093	9,644		
45,000-53,999	13,715	13,266	12,818	12,369	11,920	11,471	11,022	
54,000-64,999	17,369	16,920	16,471	16,022	15,573	15,124	14,675	13,777
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,772							
15,000-20,999	4,598	4,157						
21,000-26,999	6,425	5,984	5,543					
27,000-32,999	8,252	7,811	7,370	6,929				
33,000-38,999	10,078	9,637	9,197	8,756	8,315			
39,000-44,999	11,905	11,464	11,023	10,582	10,141	9,701		

45,000-53,999	13,731	13,291	12,850	12,409	11,968	11,527	11,086	
54,000-64,999	17,385	16,944	16,503	16,062	15,621	15,181	14,740	13,858
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2,781							
15,000-20,999	4,608	4,172						
21,000-26,999	6,434	5,998	5,562					
27,000-32,999	8,261	7,825	7,389	6,953				
33,000-38,999	10,088	9,651	9,215	8,779	8,343			
39,000-44,999	11,914	11,478	11,042	10,606	10,170	9,734		
45,000-53,999	13,741	13,305	12,869	12,432	11,996	11,560	11,124	
54,000-64,999	17,394	16,958	16,522	16,086	15,650	15,213	14,777	13,905

Heating, Early Retirement—Replacement of a Heat Pump

See Table 477 through Table 486 for the energy savings (kWh) per heating load type associated with a mini-split heat pump replacing another heat pump for all five Texas climate zones.

The following deemed savings assume no back-up electric resistance heat for the efficient case.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 477: Mini-split Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	413							
15,000-20,999	1,550	620						
21,000-26,999	2,687	1,756	826					
27,000-32,999	3,823	2,893	1,963	1,033				
33,000-38,999	4,960	4,030	3,100	2,170	1,239			
39,000-44,999	6,097	5,167	4,237	3,306	2,376	1,446		
45,000-53,999	7,234	6,304	5,373	4,443	3,513	2,583	1,652	
54,000-64,999	9,508	8,577	7,647	6,717	5,786	4,856	3,926	2,065

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	571							
15,000-20,999	1,708	856						
21,000-26,999	2,844	1,993	1,142					
27,000-32,999	3,981	3,130	2,278	1,427				
33,000-38,999	5,118	4,267	3,415	2,564	1,712			
39,000-44,999	6,255	5,403	4,552	3,700	2,849	1,998		
45,000-53,999	7,392	6,540	5,689	4,837	3,986	3,134	2,283	
54,000-64,999	9,665	8,814	7,962	7,111	6,259	5,408	4,557	2,854
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	653							
15,000-20,999	1,789	979						
21,000-26,999	2,926	2,116	1,305					
27,000-32,999	4,063	3,253	2,442	1,632				
33,000-38,999	5,200	4,389	3,579	2,768	1,958			
39,000-44,999	6,337	5,526	4,716	3,905	3,095	2,284		
45,000-53,999	7,473	6,663	5,852	5,042	4,231	3,421	2,611	
54,000-64,999	9,747	8,937	8,126	7,316	6,505	5,695	4,884	3,263
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	683							
15,000-20,999	1,820	1,025						
21,000-26,999	2,957	2,162	1,367					
27,000-32,999	4,094	3,299	2,504	1,709				
33,000-38,999	5,231	4,436	3,640	2,845	2,050			
39,000-44,999	6,367	5,572	4,777	3,982	3,187	2,392		
45,000-53,999	7,504	6,709	5,914	5,119	4,324	3,529	2,734	

54,000-64,999	9,778	8,983	8,188	7,393	6,597	5,802	5,007	3,417
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	713							
15,000-20,999	1,850	1,070						
21,000-26,999	2,987	2,206	1,426					
27,000-32,999	4,123	3,343	2,563	1,783				
33,000-38,999	5,260	4,480	3,700	2,919	2,139			
39,000-44,999	6,397	5,617	4,837	4,056	3,276	2,496		
45,000-53,999	7,534	6,754	5,973	5,193	4,413	3,632	2,852	
54,000-64,999	9,807	9,027	8,247	7,467	6,686	5,906	5,126	3,565
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	742							
15,000-20,999	1,878	1,112						
21,000-26,999	3,015	2,249	1,483					
27,000-32,999	4,152	3,386	2,620	1,854				
33,000-38,999	5,289	4,523	3,757	2,991	2,225			
39,000-44,999	6,426	5,660	4,894	4,128	3,362	2,596		
45,000-53,999	7,562	6,796	6,030	5,264	4,498	3,732	2,966	
54,000-64,999	9,836	9,070	8,304	7,538	6,772	6,006	5,240	3,708
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	769							
15,000-20,999	1,906	1,154						
21,000-26,999	3,043	2,291	1,538					
27,000-32,999	4,180	3,427	2,675	1,923				
33,000-38,999	5,316	4,564	3,812	3,060	2,307			
39,000-44,999	6,453	5,701	4,949	4,196	3,444	2,692		

45,000-53,999	7,590	6,838	6,085	5,333	4,581	3,829	3,077	
54,000-64,999	9,864	9,111	8,359	7,607	6,855	6,102	5,350	3,846

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	785							
15,000-20,999	1,922	1,178						
21,000-26,999	3,059	2,315	1,570					
27,000-32,999	4,196	3,451	2,707	1,963				
33,000-38,999	5,332	4,588	3,844	3,100	2,356			
39,000-44,999	6,469	5,725	4,981	4,237	3,492	2,748		
45,000-53,999	7,606	6,862	6,118	5,373	4,629	3,885	3,141	
54,000-64,999	9,880	9,135	8,391	7,647	6,903	6,159	5,414	3,926

Table 478: Mini-split Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	886							
15,000-20,999	2,259	1,328						
21,000-26,999	3,632	2,701	1,771					
27,000-32,999	5,005	4,074	3,144	2,214				
33,000-38,999	6,378	5,447	4,517	3,587	2,657			
39,000-44,999	7,751	6,820	5,890	4,960	4,030	3,099		
45,000-53,999	9,124	8,193	7,263	6,333	5,403	4,472	3,542	
54,000-64,999	11,870	10,940	10,009	9,079	8,149	7,218	6,288	4,428

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,043							
15,000-20,999	2,416	1,565						
21,000-26,999	3,789	2,938	2,086					
27,000-32,999	5,162	4,311	3,459	2,608				
33,000-38,999	6,535	5,684	4,832	3,981	3,130			
39,000-44,999	7,908	7,057	6,206	5,354	4,503	3,651		
45,000-53,999	9,281	8,430	7,579	6,727	5,876	5,024	4,173	
54,000-64,999	12,027	11,176	10,325	9,473	8,622	7,770	6,919	5,216
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,125							
15,000-20,999	2,498	1,688						
21,000-26,999	3,871	3,061	2,250					
27,000-32,999	5,244	4,434	3,623	2,813				
33,000-38,999	6,617	5,807	4,996	4,186	3,375			
39,000-44,999	7,990	7,180	6,369	5,559	4,748	3,938		
45,000-53,999	9,363	8,553	7,742	6,932	6,121	5,311	4,500	
54,000-64,999	12,109	11,299	10,488	9,678	8,867	8,057	7,246	5,625
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,156							
15,000-20,999	2,529	1,734						
21,000-26,999	3,902	3,107	2,312					
27,000-32,999	5,275	4,480	3,685	2,890				
33,000-38,999	6,648	5,853	5,058	4,263	3,468			
39,000-44,999	8,021	7,226	6,431	5,636	4,841	4,046		
45,000-53,999	9,394	8,599	7,804	7,009	6,214	5,419	4,623	

54,000-64,999	12,140	11,345	10,550	9,755	8,960	8,165	7,370	5,779
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,186							
15,000-20,999	2,559	1,778						
21,000-26,999	3,932	3,151	2,371					
27,000-32,999	5,305	4,524	3,744	2,964				
33,000-38,999	6,678	5,897	5,117	4,337	3,557			
39,000-44,999	8,051	7,270	6,490	5,710	4,930	4,149		
45,000-53,999	9,424	8,643	7,863	7,083	6,303	5,522	4,742	
54,000-64,999	12,170	11,389	10,609	9,829	9,049	8,268	7,488	5,928
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,214							
15,000-20,999	2,587	1,821						
21,000-26,999	3,960	3,194	2,428					
27,000-32,999	5,333	4,567	3,801	3,035				
33,000-38,999	6,706	5,940	5,174	4,408	3,642			
39,000-44,999	8,079	7,313	6,547	5,781	5,015	4,249		
45,000-53,999	9,452	8,686	7,920	7,154	6,388	5,622	4,856	
54,000-64,999	12,198	11,432	10,666	9,900	9,134	8,368	7,602	6,070
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,242							
15,000-20,999	2,615	1,862						
21,000-26,999	3,988	3,235	2,483					
27,000-32,999	5,361	4,608	3,856	3,104				
33,000-38,999	6,734	5,981	5,229	4,477	3,725			
39,000-44,999	8,107	7,355	6,602	5,850	5,098	4,346		

45,000-53,999	9,480	8,728	7,975	7,223	6,471	5,719	4,966	
54,000-64,999	12,226	11,474	10,721	9,969	9,217	8,465	7,712	6,208

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1,258							
15,000-20,999	2,631	1,886						
21,000-26,999	4,004	3,259	2,515					
27,000-32,999	5,377	4,633	3,888	3,144				
33,000-38,999	6,750	6,006	5,261	4,517	3,773			
39,000-44,999	8,123	7,379	6,634	5,890	5,146	4,402		
45,000-53,999	9,496	8,752	8,007	7,263	6,519	5,775	5,031	
54,000-64,999	12,242	11,498	10,753	10,009	9,265	8,521	7,777	6,288

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 479: Mini-split Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	201							
15,000-20,999	827	302						
21,000-26,999	1,454	928	402					
27,000-32,999	2,080	1,554	1,029	503				
33,000-38,999	2,706	2,180	1,655	1,129	604			
39,000-44,999	3,332	2,807	2,281	1,755	1,230	704		
45,000-53,999	3,959	3,433	2,907	2,382	1,856	1,330	805	
54,000-64,999	5,211	4,685	4,160	3,634	3,109	2,583	2,057	1,006

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	290							
15,000-20,999	917	435						
21,000-26,999	1,543	1,062	581					
27,000-32,999	2,169	1,688	1,207	726				
33,000-38,999	2,795	2,314	1,833	1,352	871			
39,000-44,999	3,421	2,940	2,459	1,978	1,497	1,016		
45,000-53,999	4,048	3,567	3,085	2,604	2,123	1,642	1,161	
54,000-64,999	5,300	4,819	4,338	3,857	3,376	2,895	2,414	1,451
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	337							
15,000-20,999	963	505						
21,000-26,999	1,589	1,131	673					
27,000-32,999	2,215	1,757	1,299	841				
33,000-38,999	2,841	2,384	1,926	1,468	1,010			
39,000-44,999	3,468	3,010	2,552	2,094	1,636	1,178		
45,000-53,999	4,094	3,636	3,178	2,720	2,262	1,804	1,346	
54,000-64,999	5,346	4,888	4,430	3,973	3,515	3,057	2,599	1,683
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	354							
15,000-20,999	980	531						
21,000-26,999	1,606	1,157	708					
27,000-32,999	2,233	1,783	1,334	885				
33,000-38,999	2,859	2,410	1,960	1,511	1,062			
39,000-44,999	3,485	3,036	2,587	2,137	1,688	1,239		
45,000-53,999	4,111	3,662	3,213	2,764	2,314	1,865	1,416	

54,000-64,999	5,364	4,915	4,465	4,016	3,567	3,117	2,668	1,770
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	371							
15,000-20,999	997	556						
21,000-26,999	1,623	1,182	741					
27,000-32,999	2,249	1,808	1,368	927				
33,000-38,999	2,876	2,435	1,994	1,553	1,112			
39,000-44,999	3,502	3,061	2,620	2,179	1,738	1,297		
45,000-53,999	4,128	3,687	3,246	2,805	2,365	1,924	1,483	
54,000-64,999	5,381	4,940	4,499	4,058	3,617	3,176	2,735	1,853
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	387							
15,000-20,999	1,013	580						
21,000-26,999	1,639	1,206	774					
27,000-32,999	2,266	1,833	1,400	967				
33,000-38,999	2,892	2,459	2,026	1,593	1,160			
39,000-44,999	3,518	3,085	2,652	2,220	1,787	1,354		
45,000-53,999	4,144	3,711	3,279	2,846	2,413	1,980	1,547	
54,000-64,999	5,397	4,964	4,531	4,098	3,665	3,233	2,800	1,934
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	402							
15,000-20,999	1,029	604						
21,000-26,999	1,655	1,230	805					
27,000-32,999	2,281	1,856	1,431	1,006				
33,000-38,999	2,907	2,482	2,057	1,632	1,207			
39,000-44,999	3,534	3,108	2,683	2,258	1,833	1,408		

45,000-53,999	4,160	3,735	3,310	2,885	2,460	2,035	1,610	
54,000-64,999	5,412	4,987	4,562	4,137	3,712	3,287	2,862	2,012

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	411							
15,000-20,999	1,038	617						
21,000-26,999	1,664	1,243	823					
27,000-32,999	2,290	1,870	1,449	1,029				
33,000-38,999	2,916	2,496	2,075	1,655	1,234			
39,000-44,999	3,543	3,122	2,702	2,281	1,861	1,440		
45,000-53,999	4,169	3,748	3,328	2,907	2,487	2,066	1,646	
54,000-64,999	5,421	5,001	4,580	4,160	3,739	3,319	2,898	2,057

Table 480: Mini-split Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	468							
15,000-20,999	1,228	702						
21,000-26,999	1,988	1,462	936					
27,000-32,999	2,747	2,222	1,696	1,170				
33,000-38,999	3,507	2,981	2,456	1,930	1,404			
39,000-44,999	4,267	3,741	3,215	2,690	2,164	1,639		
45,000-53,999	5,026	4,501	3,975	3,449	2,924	2,398	1,873	
54,000-64,999	6,546	6,020	5,495	4,969	4,443	3,918	3,392	2,341

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	557							
15,000-20,999	1,317	836						
21,000-26,999	2,077	1,596	1,114					
27,000-32,999	2,836	2,355	1,874	1,393				
33,000-38,999	3,596	3,115	2,634	2,153	1,672			
39,000-44,999	4,356	3,875	3,394	2,913	2,431	1,950		
45,000-53,999	5,115	4,634	4,153	3,672	3,191	2,710	2,229	
54,000-64,999	6,635	6,154	5,673	5,192	4,711	4,229	3,748	2,786
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	603							
15,000-20,999	1,363	905						
21,000-26,999	2,123	1,665	1,207					
27,000-32,999	2,883	2,425	1,967	1,509				
33,000-38,999	3,642	3,184	2,726	2,268	1,810			
39,000-44,999	4,402	3,944	3,486	3,028	2,570	2,112		
45,000-53,999	5,162	4,704	4,246	3,788	3,330	2,872	2,414	
54,000-64,999	6,681	6,223	5,765	5,307	4,849	4,391	3,933	3,017
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	621							
15,000-20,999	1,381	931						
21,000-26,999	2,140	1,691	1,242					
27,000-32,999	2,900	2,451	2,001	1,552				
33,000-38,999	3,660	3,210	2,761	2,312	1,863			
39,000-44,999	4,419	3,970	3,521	3,072	2,622	2,173		
45,000-53,999	5,179	4,730	4,281	3,831	3,382	2,933	2,484	

54,000-64,999	6,699	6,249	5,800	5,351	4,902	4,452	4,003	3,104
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	638							
15,000-20,999	1,397	956						
21,000-26,999	2,157	1,716	1,275					
27,000-32,999	2,917	2,476	2,035	1,594				
33,000-38,999	3,676	3,236	2,795	2,354	1,913			
39,000-44,999	4,436	3,995	3,554	3,114	2,673	2,232		
45,000-53,999	5,196	4,755	4,314	3,873	3,432	2,991	2,551	
54,000-64,999	6,715	6,274	5,834	5,393	4,952	4,511	4,070	3,188
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	654							
15,000-20,999	1,413	981						
21,000-26,999	2,173	1,740	1,308					
27,000-32,999	2,933	2,500	2,067	1,634				
33,000-38,999	3,693	3,260	2,827	2,394	1,961			
39,000-44,999	4,452	4,019	3,587	3,154	2,721	2,288		
45,000-53,999	5,212	4,779	4,346	3,914	3,481	3,048	2,615	
54,000-64,999	6,731	6,299	5,866	5,433	5,000	4,567	4,135	3,269
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	669							
15,000-20,999	1,429	1,004						
21,000-26,999	2,189	1,764	1,339					
27,000-32,999	2,948	2,523	2,098	1,673				
33,000-38,999	3,708	3,283	2,858	2,433	2,008			
39,000-44,999	4,468	4,043	3,618	3,193	2,768	2,343		

45,000-53,999	5,228	4,803	4,377	3,952	3,527	3,102	2,677	
54,000-64,999	6,747	6,322	5,897	5,472	5,047	4,622	4,197	3,347
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	678							
15,000-20,999	1,438	1,018						
21,000-26,999	2,198	1,777	1,357					
27,000-32,999	2,958	2,537	2,117	1,696				
33,000-38,999	3,717	3,297	2,876	2,456	2,035			
39,000-44,999	4,477	4,056	3,636	3,215	2,795	2,374		
45,000-53,999	5,237	4,816	4,396	3,975	3,555	3,134	2,714	
54,000-64,999	6,756	6,336	5,915	5,495	5,074	4,654	4,233	3,392

Climate Zone 3: South Region, Houston Weather Data

Table 481: Mini-split Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	124							
15,000-20,999	529	186						
21,000-26,999	934	591	248					
27,000-32,999	1,339	996	653	310				
33,000-38,999	1,745	1,401	1,058	715	371			
39,000-44,999	2,150	1,807	1,463	1,120	777	433		
45,000-53,999	2,555	2,212	1,868	1,525	1,182	839	495	
54,000-64,999	3,365	3,022	2,679	2,336	1,992	1,649	1,306	619

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	182							
15,000-20,999	587	273						
21,000-26,999	992	678	364					
27,000-32,999	1,398	1,083	769	455				
33,000-38,999	1,803	1,489	1,174	860	546			
39,000-44,999	2,208	1,894	1,580	1,265	951	637		
45,000-53,999	2,613	2,299	1,985	1,671	1,356	1,042	728	
54,000-64,999	3,424	3,109	2,795	2,481	2,167	1,853	1,538	910
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	212							
15,000-20,999	617	318						
21,000-26,999	1,023	724	424					
27,000-32,999	1,428	1,129	830	531				
33,000-38,999	1,833	1,534	1,235	936	637			
39,000-44,999	2,238	1,939	1,640	1,341	1,042	743		
45,000-53,999	2,643	2,344	2,045	1,746	1,447	1,148	849	
54,000-64,999	3,454	3,155	2,856	2,557	2,257	1,958	1,659	1,061
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	224							
15,000-20,999	629	335						
21,000-26,999	1,034	741	447					
27,000-32,999	1,439	1,146	852	559				
33,000-38,999	1,844	1,551	1,258	964	671			
39,000-44,999	2,250	1,956	1,663	1,369	1,076	782		
45,000-53,999	2,655	2,361	2,068	1,775	1,481	1,188	894	

54,000-64,999	3,465	3,172	2,878	2,585	2,291	1,998	1,705	1,118
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	235							
15,000-20,999	640	352						
21,000-26,999	1,045	757	469					
27,000-32,999	1,450	1,162	874	586				
33,000-38,999	1,855	1,567	1,279	991	704			
39,000-44,999	2,260	1,973	1,685	1,397	1,109	821		
45,000-53,999	2,666	2,378	2,090	1,802	1,514	1,226	938	
54,000-64,999	3,476	3,188	2,900	2,612	2,324	2,036	1,748	1,173
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	245							
15,000-20,999	650	368						
21,000-26,999	1,055	773	490					
27,000-32,999	1,461	1,178	895	613				
33,000-38,999	1,866	1,583	1,300	1,018	735			
39,000-44,999	2,271	1,988	1,706	1,423	1,140	858		
45,000-53,999	2,676	2,394	2,111	1,828	1,546	1,263	980	
54,000-64,999	3,487	3,204	2,921	2,639	2,356	2,073	1,791	1,225
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	255							
15,000-20,999	660	383						
21,000-26,999	1,066	788	510					
27,000-32,999	1,471	1,193	916	638				
33,000-38,999	1,876	1,598	1,321	1,043	766			
39,000-44,999	2,281	2,004	1,726	1,448	1,171	893		

45,000-53,999	2,686	2,409	2,131	1,854	1,576	1,298	1,021	
54,000-64,999	3,497	3,219	2,942	2,664	2,386	2,109	1,831	1,276
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	261							
15,000-20,999	666	392						
21,000-26,999	1,072	797	522					
27,000-32,999	1,477	1,202	927	653				
33,000-38,999	1,882	1,607	1,333	1,058	783			
39,000-44,999	2,287	2,012	1,738	1,463	1,189	914		
45,000-53,999	2,692	2,418	2,143	1,868	1,594	1,319	1,045	
54,000-64,999	3,503	3,228	2,953	2,679	2,404	2,130	1,855	1,306

Table 482: Mini-split Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	298							
15,000-20,999	791	447						
21,000-26,999	1,283	940	596					
27,000-32,999	1,775	1,432	1,089	745				
33,000-38,999	2,268	1,924	1,581	1,238	894			
39,000-44,999	2,760	2,417	2,073	1,730	1,387	1,044		
45,000-53,999	3,252	2,909	2,566	2,223	1,879	1,536	1,193	
54,000-64,999	4,237	3,894	3,551	3,207	2,864	2,521	2,177	1,491

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	356							
15,000-20,999	849	535						
21,000-26,999	1,341	1,027	713					
27,000-32,999	1,833	1,519	1,205	891				
33,000-38,999	2,326	2,012	1,697	1,383	1,069			
39,000-44,999	2,818	2,504	2,190	1,876	1,561	1,247		
45,000-53,999	3,311	2,996	2,682	2,368	2,054	1,740	1,425	
54,000-64,999	4,295	3,981	3,667	3,353	3,039	2,724	2,410	1,782
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	387							
15,000-20,999	879	580						
21,000-26,999	1,371	1,072	773					
27,000-32,999	1,864	1,565	1,265	966				
33,000-38,999	2,356	2,057	1,758	1,459	1,160			
39,000-44,999	2,848	2,549	2,250	1,951	1,652	1,353		
45,000-53,999	3,341	3,042	2,743	2,444	2,144	1,845	1,546	
54,000-64,999	4,326	4,026	3,727	3,428	3,129	2,830	2,531	1,933
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	398							
15,000-20,999	890	597						
21,000-26,999	1,383	1,089	796					
27,000-32,999	1,875	1,582	1,288	995				
33,000-38,999	2,367	2,074	1,781	1,487	1,194			
39,000-44,999	2,860	2,566	2,273	1,980	1,686	1,393		
45,000-53,999	3,352	3,059	2,765	2,472	2,178	1,885	1,592	

54,000-64,999	4,337	4,043	3,750	3,457	3,163	2,870	2,576	1,990
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	409							
15,000-20,999	901	613						
21,000-26,999	1,394	1,106	818					
27,000-32,999	1,886	1,598	1,310	1,022				
33,000-38,999	2,378	2,090	1,802	1,515	1,227			
39,000-44,999	2,871	2,583	2,295	2,007	1,719	1,431		
45,000-53,999	3,363	3,075	2,787	2,499	2,211	1,923	1,635	
54,000-64,999	4,348	4,060	3,772	3,484	3,196	2,908	2,620	2,044
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	419							
15,000-20,999	912	629						
21,000-26,999	1,404	1,121	839					
27,000-32,999	1,897	1,614	1,331	1,048				
33,000-38,999	2,389	2,106	1,824	1,541	1,258			
39,000-44,999	2,881	2,599	2,316	2,033	1,751	1,468		
45,000-53,999	3,374	3,091	2,808	2,526	2,243	1,960	1,678	
54,000-64,999	4,358	4,076	3,793	3,510	3,228	2,945	2,662	2,097
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	430							
15,000-20,999	922	644						
21,000-26,999	1,414	1,137	859					
27,000-32,999	1,907	1,629	1,351	1,074				
33,000-38,999	2,399	2,121	1,844	1,566	1,289			
39,000-44,999	2,891	2,614	2,336	2,059	1,781	1,503		

45,000-53,999	3,384	3,106	2,829	2,551	2,273	1,996	1,718	
54,000-64,999	4,369	4,091	3,813	3,536	3,258	2,981	2,703	2,148
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	435							
15,000-20,999	928	653						
21,000-26,999	1,420	1,146	871					
27,000-32,999	1,913	1,638	1,363	1,089				
33,000-38,999	2,405	2,130	1,856	1,581	1,306			
39,000-44,999	2,897	2,623	2,348	2,073	1,799	1,524		
45,000-53,999	3,390	3,115	2,840	2,566	2,291	2,017	1,742	
54,000-64,999	4,374	4,100	3,825	3,551	3,276	3,001	2,727	2,177

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 483: Mini-split Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	83							
15,000-20,999	355	125						
21,000-26,999	626	396	166					
27,000-32,999	898	668	438	208				
33,000-38,999	1,170	939	709	479	249			
39,000-44,999	1,441	1,211	981	751	521	291		
45,000-53,999	1,713	1,483	1,253	1,022	792	562	332	
54,000-64,999	2,256	2,026	1,796	1,566	1,336	1,106	875	415

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	122							
15,000-20,999	394	183						
21,000-26,999	665	455	244					
27,000-32,999	937	726	516	305				
33,000-38,999	1,209	998	787	577	366			
39,000-44,999	1,480	1,270	1,059	848	638	427		
45,000-53,999	1,752	1,541	1,331	1,120	909	699	488	
54,000-64,999	2,295	2,085	1,874	1,663	1,453	1,242	1,031	610

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	142							
15,000-20,999	414	213						
21,000-26,999	686	485	285					
27,000-32,999	957	757	556	356				
33,000-38,999	1,229	1,028	828	627	427			
39,000-44,999	1,501	1,300	1,100	899	698	498		
45,000-53,999	1,772	1,572	1,371	1,171	970	770	569	
54,000-64,999	2,316	2,115	1,915	1,714	1,513	1,313	1,112	711

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	150							
15,000-20,999	422	225						
21,000-26,999	693	496	300					
27,000-32,999	965	768	571	375				
33,000-38,999	1,237	1,040	843	646	450			
39,000-44,999	1,508	1,311	1,115	918	721	525		
45,000-53,999	1,780	1,583	1,386	1,190	993	796	600	

54,000-64,999	2,323	2,126	1,930	1,733	1,536	1,340	1,143	749
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	157							
15,000-20,999	429	236						
21,000-26,999	701	507	314					
27,000-32,999	972	779	586	393				
33,000-38,999	1,244	1,051	858	665	472			
39,000-44,999	1,516	1,322	1,129	936	743	550		
45,000-53,999	1,787	1,594	1,401	1,208	1,015	822	629	
54,000-64,999	2,331	2,137	1,944	1,751	1,558	1,365	1,172	786
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	164							
15,000-20,999	436	246						
21,000-26,999	708	518	329					
27,000-32,999	979	790	600	411				
33,000-38,999	1,251	1,061	872	682	493			
39,000-44,999	1,523	1,333	1,144	954	765	575		
45,000-53,999	1,794	1,605	1,415	1,226	1,036	847	657	
54,000-64,999	2,338	2,148	1,959	1,769	1,580	1,390	1,200	821
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	171							
15,000-20,999	443	257						
21,000-26,999	714	528	342					
27,000-32,999	986	800	614	428				
33,000-38,999	1,258	1,072	886	699	513			
39,000-44,999	1,529	1,343	1,157	971	785	599		

45,000-53,999	1,801	1,615	1,429	1,243	1,057	871	684	
54,000-64,999	2,344	2,158	1,972	1,786	1,600	1,414	1,228	855

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	175							
15,000-20,999	447	263						
21,000-26,999	718	534	350					
27,000-32,999	990	806	622	438				
33,000-38,999	1,262	1,078	893	709	525			
39,000-44,999	1,533	1,349	1,165	981	797	613		
45,000-53,999	1,805	1,621	1,437	1,253	1,069	884	700	
54,000-64,999	2,348	2,164	1,980	1,796	1,612	1,428	1,244	875

Table 484: Mini-split Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	200							
15,000-20,999	530	300						
21,000-26,999	860	630	400					
27,000-32,999	1,190	960	730	500				
33,000-38,999	1,520	1,290	1,060	830	600			
39,000-44,999	1,850	1,620	1,390	1,160	930	700		
45,000-53,999	2,181	1,950	1,720	1,490	1,260	1,030	800	
54,000-64,999	2,841	2,611	2,380	2,150	1,920	1,690	1,460	999

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	239							
15,000-20,999	569	358						
21,000-26,999	899	688	478					
27,000-32,999	1,229	1,019	808	597				
33,000-38,999	1,559	1,349	1,138	927	717			
39,000-44,999	1,889	1,679	1,468	1,257	1,047	836		
45,000-53,999	2,220	2,009	1,798	1,588	1,377	1,166	956	
54,000-64,999	2,880	2,669	2,458	2,248	2,037	1,826	1,616	1,195
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	259							
15,000-20,999	589	389						
21,000-26,999	919	719	518					
27,000-32,999	1,249	1,049	848	648				
33,000-38,999	1,580	1,379	1,179	978	777			
39,000-44,999	1,910	1,709	1,509	1,308	1,108	907		
45,000-53,999	2,240	2,039	1,839	1,638	1,438	1,237	1,037	
54,000-64,999	2,900	2,699	2,499	2,298	2,098	1,897	1,697	1,296
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	267							
15,000-20,999	597	400						
21,000-26,999	927	730	534					
27,000-32,999	1,257	1,060	864	667				
33,000-38,999	1,587	1,390	1,194	997	800			
39,000-44,999	1,917	1,721	1,524	1,327	1,130	934		
45,000-53,999	2,247	2,051	1,854	1,657	1,461	1,264	1,067	

54,000-64,999	2,908	2,711	2,514	2,317	2,121	1,924	1,727	1,334
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	274							
15,000-20,999	604	411						
21,000-26,999	934	741	548					
27,000-32,999	1,264	1,071	878	685				
33,000-38,999	1,595	1,401	1,208	1,015	822			
39,000-44,999	1,925	1,732	1,539	1,345	1,152	959		
45,000-53,999	2,255	2,062	1,869	1,676	1,483	1,290	1,096	
54,000-64,999	2,915	2,722	2,529	2,336	2,143	1,950	1,757	1,371
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	281							
15,000-20,999	611	422						
21,000-26,999	941	752	562					
27,000-32,999	1,271	1,082	892	703				
33,000-38,999	1,602	1,412	1,223	1,033	844			
39,000-44,999	1,932	1,742	1,553	1,363	1,174	984		
45,000-53,999	2,262	2,072	1,883	1,693	1,504	1,314	1,125	
54,000-64,999	2,922	2,733	2,543	2,353	2,164	1,974	1,785	1,406
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	288							
15,000-20,999	618	432						
21,000-26,999	948	762	576					
27,000-32,999	1,278	1,092	906	720				
33,000-38,999	1,608	1,422	1,236	1,050	864			
39,000-44,999	1,939	1,752	1,566	1,380	1,194	1,008		

45,000-53,999	2,269	2,083	1,896	1,710	1,524	1,338	1,152	
54,000-64,999	2,929	2,743	2,557	2,370	2,184	1,998	1,812	1,440
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	292							
15,000-20,999	622	438						
21,000-26,999	952	768	584					
27,000-32,999	1,282	1,098	914	730				
33,000-38,999	1,612	1,428	1,244	1,060	876			
39,000-44,999	1,942	1,758	1,574	1,390	1,206	1,022		
45,000-53,999	2,273	2,088	1,904	1,720	1,536	1,352	1,168	
54,000-64,999	2,933	2,749	2,565	2,380	2,196	2,012	1,828	1,460

Climate Zone 5: West Region El Paso Weather Data

Table 485: Mini-split Energy Savings (Heating kWh) for 7.7 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	197							
15,000-20,999	840	295						
21,000-26,999	1,484	938	393					
27,000-32,999	2,127	1,582	1,037	492				
33,000-38,999	2,770	2,225	1,680	1,135	590			
39,000-44,999	3,414	2,869	2,324	1,778	1,233	688		
45,000-53,999	4,057	3,512	2,967	2,422	1,877	1,332	786	
54,000-64,999	5,344	4,799	4,254	3,709	3,164	2,619	2,073	983

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	289							
15,000-20,999	932	434						
21,000-26,999	1,576	1,077	578					
27,000-32,999	2,219	1,720	1,221	723				
33,000-38,999	2,863	2,364	1,865	1,366	867			
39,000-44,999	3,506	3,007	2,508	2,009	1,511	1,012		
45,000-53,999	4,150	3,651	3,152	2,653	2,154	1,655	1,156	
54,000-64,999	5,437	4,938	4,439	3,940	3,441	2,942	2,443	1,445
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	337							
15,000-20,999	980	505						
21,000-26,999	1,624	1,149	674					
27,000-32,999	2,267	1,792	1,317	842				
33,000-38,999	2,911	2,436	1,961	1,486	1,011			
39,000-44,999	3,554	3,079	2,604	2,129	1,654	1,179		
45,000-53,999	4,198	3,723	3,248	2,773	2,298	1,823	1,348	
54,000-64,999	5,485	5,010	4,535	4,060	3,585	3,110	2,635	1,685
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	355							
15,000-20,999	999	533						
21,000-26,999	1,642	1,176	710					
27,000-32,999	2,285	1,819	1,354	888				
33,000-38,999	2,929	2,463	1,997	1,531	1,065			
39,000-44,999	3,572	3,106	2,640	2,175	1,709	1,243		
45,000-53,999	4,216	3,750	3,284	2,818	2,352	1,886	1,420	

54,000-64,999	5,503	5,037	4,571	4,105	3,639	3,173	2,707	1,775
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	372							
15,000-20,999	1,016	559						
21,000-26,999	1,659	1,202	745					
27,000-32,999	2,303	1,846	1,388	931				
33,000-38,999	2,946	2,489	2,032	1,574	1,117			
39,000-44,999	3,590	3,132	2,675	2,218	1,761	1,303		
45,000-53,999	4,233	3,776	3,319	2,861	2,404	1,947	1,490	
54,000-64,999	5,520	5,063	4,606	4,148	3,691	3,234	2,777	1,862
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	389							
15,000-20,999	1,033	584						
21,000-26,999	1,676	1,227	778					
27,000-32,999	2,320	1,871	1,422	973				
33,000-38,999	2,963	2,514	2,065	1,616	1,167			
39,000-44,999	3,606	3,158	2,709	2,260	1,811	1,362		
45,000-53,999	4,250	3,801	3,352	2,903	2,454	2,005	1,557	
54,000-64,999	5,537	5,088	4,639	4,190	3,741	3,292	2,844	1,946
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	405							
15,000-20,999	1,049	608						
21,000-26,999	1,692	1,251	811					
27,000-32,999	2,336	1,895	1,454	1,013				
33,000-38,999	2,979	2,538	2,097	1,657	1,216			
39,000-44,999	3,623	3,182	2,741	2,300	1,859	1,418		

45,000-53,999	4,266	3,825	3,384	2,944	2,503	2,062	1,621	
54,000-64,999	5,553	5,112	4,671	4,231	3,790	3,349	2,908	2,026
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	415							
15,000-20,999	1,058	622						
21,000-26,999	1,702	1,265	829					
27,000-32,999	2,345	1,909	1,473	1,037				
33,000-38,999	2,989	2,552	2,116	1,680	1,244			
39,000-44,999	3,632	3,196	2,760	2,324	1,888	1,451		
45,000-53,999	4,275	3,839	3,403	2,967	2,531	2,095	1,659	
54,000-64,999	5,562	5,126	4,690	4,254	3,818	3,382	2,946	2,073

Table 486: Mini-split Energy Savings (Heating kWh) for 6.8 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	473							
15,000-20,999	1,255	710						
21,000-26,999	2,037	1,492	947					
27,000-32,999	2,819	2,274	1,729	1,184				
33,000-38,999	3,601	3,056	2,511	1,966	1,420			
39,000-44,999	4,383	3,838	3,293	2,748	2,202	1,657		
45,000-53,999	5,165	4,620	4,075	3,529	2,984	2,439	1,894	
54,000-64,999	6,729	6,184	5,638	5,093	4,548	4,003	3,458	2,367

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	566							
15,000-20,999	1,348	849						
21,000-26,999	2,130	1,631	1,132					
27,000-32,999	2,912	2,413	1,914	1,415				
33,000-38,999	3,693	3,195	2,696	2,197	1,698			
39,000-44,999	4,475	3,976	3,477	2,979	2,480	1,981		
45,000-53,999	5,257	4,758	4,259	3,760	3,261	2,763	2,264	
54,000-64,999	6,821	6,322	5,823	5,324	4,825	4,326	3,827	2,829
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	614							
15,000-20,999	1,396	921						
21,000-26,999	2,178	1,703	1,228					
27,000-32,999	2,960	2,485	2,010	1,535				
33,000-38,999	3,741	3,267	2,792	2,317	1,842			
39,000-44,999	4,523	4,048	3,573	3,098	2,624	2,149		
45,000-53,999	5,305	4,830	4,355	3,880	3,405	2,930	2,455	
54,000-64,999	6,869	6,394	5,919	5,444	4,969	4,494	4,019	3,069
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	632							
15,000-20,999	1,414	948						
21,000-26,999	2,196	1,730	1,264					
27,000-32,999	2,978	2,512	2,046	1,580				
33,000-38,999	3,760	3,294	2,828	2,362	1,896			
39,000-44,999	4,541	4,075	3,610	3,144	2,678	2,212		
45,000-53,999	5,323	4,857	4,391	3,925	3,460	2,994	2,528	

54,000-64,999	6,887	6,421	5,955	5,489	5,023	4,557	4,091	3,160
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	649							
15,000-20,999	1,431	974						
21,000-26,999	2,213	1,756	1,299					
27,000-32,999	2,995	2,538	2,080	1,623				
33,000-38,999	3,777	3,320	2,862	2,405	1,948			
39,000-44,999	4,559	4,102	3,644	3,187	2,730	2,272		
45,000-53,999	5,341	4,883	4,426	3,969	3,512	3,054	2,597	
54,000-64,999	6,905	6,447	5,990	5,533	5,075	4,618	4,161	3,246
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	666							
15,000-20,999	1,448	999						
21,000-26,999	2,230	1,781	1,332					
27,000-32,999	3,012	2,563	2,114	1,665				
33,000-38,999	3,794	3,345	2,896	2,447	1,998			
39,000-44,999	4,576	4,127	3,678	3,229	2,780	2,331		
45,000-53,999	5,357	4,909	4,460	4,011	3,562	3,113	2,664	
54,000-64,999	6,921	6,472	6,023	5,575	5,126	4,677	4,228	3,330
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	682							
15,000-20,999	1,464	1,023						
21,000-26,999	2,246	1,805	1,364					
27,000-32,999	3,028	2,587	2,146	1,705				
33,000-38,999	3,810	3,369	2,928	2,487	2,046			
39,000-44,999	4,592	4,151	3,710	3,269	2,828	2,388		

45,000-53,999	5,374	4,933	4,492	4,051	3,610	3,169	2,729	
54,000-64,999	6,937	6,497	6,056	5,615	5,174	4,733	4,292	3,411
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	692							
15,000-20,999	1,473	1,037						
21,000-26,999	2,255	1,819	1,383					
27,000-32,999	3,037	2,601	2,165	1,729				
33,000-38,999	3,819	3,383	2,947	2,511	2,075			
39,000-44,999	4,601	4,165	3,729	3,293	2,857	2,420		
45,000-53,999	5,383	4,947	4,511	4,075	3,638	3,202	2,766	
54,000-64,999	6,947	6,511	6,075	5,638	5,202	4,766	4,330	3,458

Heating, Early Retirement—Replacement of an Electric Resistance Furnace

Table 472 through Table 476 present the energy savings (kWh) per heating load type associated with a mini-split heat pump replacing on burnout an electric resistance furnace for all five Texas climate zones.

Deemed Summer Demand Savings Tables[422]

Systems rated at 17 SEER or greater are assumed to be two-stage systems, while those under 17 SEER are assumed to be single-stage systems. This results in slightly lower summer demand savings for 17.0-17.9 SEER systems as compared to 16.0-16.9 SEER systems.

New Construction

Refer to Appendix A, Table 427 through Table 431.

Replace-on-burnout

Refer to Appendix A, Table 432 through Table 436.

Early Retirement

Refer to Appendix A, Table 437 through Table 446. These savings can be used with the Replace-on-burnout energy savings in Table 432 through Table 436 to calculate summer demand savings.

[422] Rated capacity ranges are specified based on normal rounding convention between capacity categories (values at and above the midpoint round up, while values below the midpoint round down).

Deemed Winter Demand Savings Tables[423]

New Construction or Replace-on-burnout of a Heat Pump

Table 487 through Table 491 present the winter demand savings (kW) associated with a mini-split heat pump being installed during new construction or replacing a burned-out central heat pump.

The rightsizing savings specified in the tables below are only applicable to Replace-on-burnout projects. New construction projects are not eligible to receive deemed savings for system rightsizing.[424]

The following deemed savings assume no back-up electric resistance heat for the efficient case.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 487: Mini-split Winter Demand Savings for 8.2 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.60							
15,000-20,999	1.26	0.89						
21,000-26,999	1.93	1.56	1.19					
27,000-32,999	2.60	2.23	1.86	1.49				
33,000-38,999	3.26	2.89	2.53	2.16	1.79			
39,000-44,999	3.93	3.56	3.19	2.82	2.45	2.08		
45,000-53,999	4.60	4.23	3.86	3.49	3.12	2.75	2.38	
54,000-64,999	5.93	5.56	5.19	4.82	4.46	4.09	3.72	2.98

423 Rated capacity ranges are specified with a 5 percent tolerance in accordance with AHRI Standard 210/240 to account for systems that are rated slightly below the applicable nominal capacity. AHRI Standard 210/240. Table J1. http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_210-240_2017.pdf.

424 For projects using a custom baseline see TRMv6.0 Volume 4.

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.66							
15,000-20,999	1.33	0.99						
21,000-26,999	1.99	1.65	1.32					
27,000-32,999	2.66	2.32	1.98	1.65				
33,000-38,999	3.33	2.99	2.65	2.31	1.97			
39,000-44,999	3.99	3.66	3.32	2.98	2.64	2.30		
45,000-53,999	4.66	4.32	3.99	3.65	3.31	2.97	2.63	
54,000-64,999	6.00	5.66	5.32	4.98	4.64	4.31	3.97	3.29
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.69							
15,000-20,999	1.36	1.04						
21,000-26,999	2.03	1.70	1.38					
27,000-32,999	2.69	2.37	2.05	1.73				
33,000-38,999	3.36	3.04	2.72	2.39	2.07			
39,000-44,999	4.03	3.70	3.38	3.06	2.74	2.42		
45,000-53,999	4.69	4.37	4.05	3.73	3.41	3.08	2.76	
54,000-64,999	6.03	5.71	5.38	5.06	4.74	4.42	4.10	3.45
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.70							
15,000-20,999	1.37	1.05						
21,000-26,999	2.04	1.72	1.41					
27,000-32,999	2.70	2.39	2.07	1.76				
33,000-38,999	3.37	3.06	2.74	2.42	2.11			
39,000-44,999	4.04	3.72	3.41	3.09	2.78	2.46		
45,000-53,999	4.71	4.39	4.07	3.76	3.44	3.13	2.81	

54,000-64,999	6.04	5.72	5.41	5.09	4.78	4.46	4.15	3.51
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.71							
15,000-20,999	1.38	1.07						
21,000-26,999	2.05	1.74	1.43					
27,000-32,999	2.72	2.41	2.10	1.79				
33,000-38,999	3.38	3.07	2.76	2.45	2.14			
39,000-44,999	4.05	3.74	3.43	3.12	2.81	2.50		
45,000-53,999	4.72	4.41	4.10	3.79	3.48	3.17	2.86	
54,000-64,999	6.05	5.74	5.43	5.12	4.81	4.50	4.19	3.57
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.73							
15,000-20,999	1.39	1.09						
21,000-26,999	2.06	1.76	1.45					
27,000-32,999	2.73	2.42	2.12	1.82				
33,000-38,999	3.39	3.09	2.79	2.48	2.18			
39,000-44,999	4.06	3.76	3.45	3.15	2.85	2.54		
45,000-53,999	4.73	4.42	4.12	3.82	3.51	3.21	2.90	
54,000-64,999	6.06	5.76	5.46	5.15	4.85	4.54	4.24	3.63
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.74							
15,000-20,999	1.40	1.11						
21,000-26,999	2.07	1.77	1.47					
27,000-32,999	2.74	2.44	2.14	1.84				
33,000-38,999	3.41	3.11	2.81	2.51	2.21			
39,000-44,999	4.07	3.77	3.48	3.18	2.88	2.58		

45,000-53,999	4.74	4.44	4.14	3.84	3.55	3.25	2.95	
54,000-64,999	6.07	5.78	5.48	5.18	4.88	4.58	4.28	3.69
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.74							
15,000-20,999	1.41	1.12						
21,000-26,999	2.08	1.78	1.49					
27,000-32,999	2.74	2.45	2.15	1.86				
33,000-38,999	3.41	3.12	2.82	2.53	2.23			
39,000-44,999	4.08	3.78	3.49	3.19	2.90	2.60		
45,000-53,999	4.75	4.45	4.16	3.86	3.56	3.27	2.97	
54,000-64,999	6.08	5.79	5.49	5.19	4.90	4.60	4.31	3.72

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 488: Mini-split Winter Demand Savings for 8.2 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.50							
15,000-20,999	1.12	0.75						
21,000-26,999	1.74	1.37	1.00					
27,000-32,999	2.36	1.99	1.62	1.25				
33,000-38,999	2.98	2.61	2.24	1.87	1.50			
39,000-44,999	3.61	3.23	2.86	2.49	2.12	1.75		
45,000-53,999	4.23	3.86	3.48	3.11	2.74	2.37	2.00	
54,000-64,999	5.47	5.10	4.73	4.36	3.98	3.61	3.24	2.50

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.56							
15,000-20,999	1.18	0.84						
21,000-26,999	1.81	1.47	1.13					
27,000-32,999	2.43	2.09	1.75	1.41				
33,000-38,999	3.05	2.71	2.37	2.03	1.69			
39,000-44,999	3.67	3.33	2.99	2.65	2.31	1.97		
45,000-53,999	4.29	3.95	3.61	3.27	2.93	2.59	2.25	
54,000-64,999	5.53	5.19	4.85	4.51	4.17	3.83	3.49	2.81

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.60							
15,000-20,999	1.22	0.89						
21,000-26,999	1.84	1.51	1.19					
27,000-32,999	2.46	2.14	1.81	1.49				
33,000-38,999	3.08	2.76	2.43	2.11	1.79			
39,000-44,999	3.70	3.38	3.05	2.73	2.41	2.08		
45,000-53,999	4.32	4.00	3.68	3.35	3.03	2.71	2.38	
54,000-64,999	5.57	5.24	4.92	4.60	4.27	3.95	3.62	2.98

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.61							
15,000-20,999	1.23	0.91						
21,000-26,999	1.85	1.53	1.22					
27,000-32,999	2.47	2.15	1.84	1.52				
33,000-38,999	3.09	2.78	2.46	2.14	1.82			
39,000-44,999	3.71	3.40	3.08	2.76	2.44	2.13		
45,000-53,999	4.34	4.02	3.70	3.38	3.07	2.75	2.43	

54,000-64,999	5.58	5.26	4.94	4.63	4.31	3.99	3.67	3.04
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.62							
15,000-20,999	1.24	0.93						
21,000-26,999	1.86	1.55	1.24					
27,000-32,999	2.48	2.17	1.86	1.55				
33,000-38,999	3.10	2.79	2.48	2.17	1.86			
39,000-44,999	3.73	3.41	3.10	2.79	2.48	2.17		
45,000-53,999	4.35	4.04	3.72	3.41	3.10	2.79	2.48	
54,000-64,999	5.59	5.28	4.97	4.66	4.34	4.03	3.72	3.10
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.63							
15,000-20,999	1.25	0.95						
21,000-26,999	1.87	1.57	1.26					
27,000-32,999	2.49	2.19	1.88	1.58				
33,000-38,999	3.12	2.81	2.50	2.20	1.89			
39,000-44,999	3.74	3.43	3.13	2.82	2.51	2.21		
45,000-53,999	4.36	4.05	3.75	3.44	3.14	2.83	2.52	
54,000-64,999	5.60	5.30	4.99	4.68	4.38	4.07	3.77	3.16
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.64							
15,000-20,999	1.26	0.96						
21,000-26,999	1.88	1.58	1.28					
27,000-32,999	2.51	2.21	1.91	1.61				
33,000-38,999	3.13	2.83	2.53	2.23	1.93			
39,000-44,999	3.75	3.45	3.15	2.85	2.55	2.25		

45,000-53,999	4.37	4.07	3.77	3.47	3.17	2.87	2.57	
54,000-64,999	5.61	5.31	5.01	4.71	4.41	4.11	3.81	3.21
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.65							
15,000-20,999	1.27	0.97						
21,000-26,999	1.89	1.59	1.30					
27,000-32,999	2.51	2.22	1.92	1.62				
33,000-38,999	3.13	2.84	2.54	2.24	1.95			
39,000-44,999	3.75	3.46	3.16	2.86	2.57	2.27		
45,000-53,999	4.38	4.08	3.78	3.48	3.19	2.89	2.59	
54,000-64,999	5.62	5.32	5.02	4.73	4.43	4.13	3.84	3.24

Climate Zone 3: South Region, Houston Weather Data

Table 489: Mini-split Winter Demand Savings for 8.2 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.05							
15,000-20,999	0.40	0.07						
21,000-26,999	0.76	0.43	0.10					
27,000-32,999	1.11	0.78	0.45	0.12				
33,000-38,999	1.47	1.14	0.81	0.48	0.15			
39,000-44,999	1.82	1.49	1.16	0.83	0.50	0.17		
45,000-53,999	2.17	1.84	1.51	1.19	0.86	0.53	0.20	
54,000-64,999	2.88	2.55	2.22	1.89	1.56	1.23	0.90	0.25

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.46	0.16						
21,000-26,999	0.81	0.51	0.21					
27,000-32,999	1.17	0.87	0.56	0.26				
33,000-38,999	1.52	1.22	0.92	0.62	0.32			
39,000-44,999	1.88	1.57	1.27	0.97	0.67	0.37		
45,000-53,999	2.23	1.93	1.63	1.32	1.02	0.72	0.42	
54,000-64,999	2.94	2.64	2.33	2.03	1.73	1.43	1.13	0.53

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.49	0.20						
21,000-26,999	0.84	0.56	0.27					
27,000-32,999	1.20	0.91	0.62	0.34				
33,000-38,999	1.55	1.26	0.98	0.69	0.40			
39,000-44,999	1.90	1.62	1.33	1.04	0.76	0.47		
45,000-53,999	2.26	1.97	1.68	1.40	1.11	0.82	0.54	
54,000-64,999	2.97	2.68	2.39	2.11	1.82	1.53	1.24	0.67

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.14							
15,000-20,999	0.50	0.22						
21,000-26,999	0.85	0.57	0.29					
27,000-32,999	1.21	0.93	0.64	0.36				
33,000-38,999	1.56	1.28	1.00	0.72	0.43			
39,000-44,999	1.92	1.63	1.35	1.07	0.79	0.51		
45,000-53,999	2.27	1.99	1.71	1.42	1.14	0.86	0.58	

54,000-64,999	2.98	2.70	2.41	2.13	1.85	1.57	1.29	0.72
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.51	0.23						
21,000-26,999	0.86	0.59	0.31					
27,000-32,999	1.22	0.94	0.66	0.39				
33,000-38,999	1.57	1.30	1.02	0.74	0.47			
39,000-44,999	1.93	1.65	1.37	1.10	0.82	0.54		
45,000-53,999	2.28	2.00	1.73	1.45	1.17	0.90	0.62	
54,000-64,999	2.99	2.71	2.44	2.16	1.88	1.61	1.33	0.78
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.52	0.25						
21,000-26,999	0.87	0.60	0.33					
27,000-32,999	1.23	0.96	0.69	0.41				
33,000-38,999	1.58	1.31	1.04	0.77	0.50			
39,000-44,999	1.94	1.66	1.39	1.12	0.85	0.58		
45,000-53,999	2.29	2.02	1.75	1.48	1.20	0.93	0.66	
54,000-64,999	3.00	2.73	2.46	2.18	1.91	1.64	1.37	0.83
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.53	0.26						
21,000-26,999	0.88	0.62	0.35					
27,000-32,999	1.24	0.97	0.70	0.44				
33,000-38,999	1.59	1.33	1.06	0.79	0.53			
39,000-44,999	1.95	1.68	1.41	1.15	0.88	0.61		

45,000-53,999	2.30	2.03	1.77	1.50	1.23	0.97	0.70	
54,000-64,999	3.01	2.74	2.47	2.21	1.94	1.68	1.41	0.88
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.53	0.27						
21,000-26,999	0.89	0.63	0.36					
27,000-32,999	1.24	0.98	0.72	0.45				
33,000-38,999	1.60	1.33	1.07	0.81	0.54			
39,000-44,999	1.95	1.69	1.42	1.16	0.90	0.63		
45,000-53,999	2.31	2.04	1.78	1.51	1.25	0.99	0.72	
54,000-64,999	3.01	2.75	2.49	2.22	1.96	1.70	1.43	0.90

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 490: Mini-split Winter Demand Savings for 8.2 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.04							
15,000-20,999	0.30	0.06						
21,000-26,999	0.57	0.32	0.07					
27,000-32,999	0.84	0.59	0.34	0.09				
33,000-38,999	1.10	0.85	0.61	0.36	0.11			
39,000-44,999	1.37	1.12	0.87	0.62	0.38	0.13		
45,000-53,999	1.63	1.39	1.14	0.89	0.64	0.40	0.15	
54,000-64,999	2.17	1.92	1.67	1.42	1.18	0.93	0.68	0.18

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.08							
15,000-20,999	0.35	0.12						
21,000-26,999	0.61	0.38	0.16					
27,000-32,999	0.88	0.65	0.42	0.20				
33,000-38,999	1.14	0.92	0.69	0.46	0.24			
39,000-44,999	1.41	1.18	0.96	0.73	0.50	0.28		
45,000-53,999	1.68	1.45	1.22	1.00	0.77	0.54	0.32	
54,000-64,999	2.21	1.98	1.75	1.53	1.30	1.07	0.85	0.39

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.10							
15,000-20,999	0.37	0.15						
21,000-26,999	0.63	0.42	0.20					
27,000-32,999	0.90	0.68	0.47	0.25				
33,000-38,999	1.17	0.95	0.73	0.52	0.30			
39,000-44,999	1.43	1.22	1.00	0.78	0.57	0.35		
45,000-53,999	1.70	1.48	1.27	1.05	0.83	0.62	0.40	
54,000-64,999	2.23	2.01	1.80	1.58	1.37	1.15	0.94	0.50

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.38	0.16						
21,000-26,999	0.64	0.43	0.22					
27,000-32,999	0.91	0.70	0.48	0.27				
33,000-38,999	1.17	0.96	0.75	0.54	0.33			
39,000-44,999	1.44	1.23	1.02	0.80	0.59	0.38		
45,000-53,999	1.71	1.49	1.28	1.07	0.86	0.65	0.44	

54,000-64,999	2.24	2.03	1.81	1.60	1.39	1.18	0.97	0.54
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.38	0.18						
21,000-26,999	0.65	0.44	0.23					
27,000-32,999	0.92	0.71	0.50	0.29				
33,000-38,999	1.18	0.97	0.77	0.56	0.35			
39,000-44,999	1.45	1.24	1.03	0.82	0.62	0.41		
45,000-53,999	1.71	1.51	1.30	1.09	0.88	0.67	0.47	
54,000-64,999	2.25	2.04	1.83	1.62	1.41	1.21	1.00	0.58
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.39	0.19						
21,000-26,999	0.66	0.45	0.25					
27,000-32,999	0.92	0.72	0.51	0.31				
33,000-38,999	1.19	0.98	0.78	0.58	0.37			
39,000-44,999	1.45	1.25	1.05	0.84	0.64	0.44		
45,000-53,999	1.72	1.52	1.31	1.11	0.91	0.70	0.50	
54,000-64,999	2.25	2.05	1.85	1.64	1.44	1.23	1.03	0.62
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.40	0.20						
21,000-26,999	0.66	0.46	0.26					
27,000-32,999	0.93	0.73	0.53	0.33				
33,000-38,999	1.20	1.00	0.80	0.60	0.40			
39,000-44,999	1.46	1.26	1.06	0.86	0.66	0.46		

45,000-53,999	1.73	1.53	1.33	1.13	0.93	0.73	0.53	
54,000-64,999	2.26	2.06	1.86	1.66	1.46	1.26	1.06	0.66
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.14							
15,000-20,999	0.40	0.20						
21,000-26,999	0.67	0.47	0.27					
27,000-32,999	0.93	0.74	0.54	0.34				
33,000-38,999	1.20	1.00	0.80	0.61	0.41			
39,000-44,999	1.47	1.27	1.07	0.87	0.67	0.48		
45,000-53,999	1.73	1.53	1.34	1.14	0.94	0.74	0.54	
54,000-64,999	2.26	2.07	1.87	1.67	1.47	1.27	1.08	0.68

Climate Zone 5: West Region El Paso Weather Data

Table 491: Mini-split Winter Demand Savings for 8.2 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.03							
15,000-20,999	0.26	0.05						
21,000-26,999	0.49	0.28	0.06					
27,000-32,999	0.72	0.50	0.29	0.08				
33,000-38,999	0.95	0.73	0.52	0.31	0.10			
39,000-44,999	1.17	0.96	0.75	0.54	0.32	0.11		
45,000-53,999	1.40	1.19	0.98	0.77	0.55	0.34	0.13	
54,000-64,999	1.86	1.65	1.43	1.22	1.01	0.80	0.58	0.16

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.07							
15,000-20,999	0.30	0.10						
21,000-26,999	0.52	0.33	0.14					
27,000-32,999	0.75	0.56	0.36	0.17				
33,000-38,999	0.98	0.79	0.59	0.40	0.20			
39,000-44,999	1.21	1.02	0.82	0.63	0.43	0.24		
45,000-53,999	1.44	1.24	1.05	0.86	0.66	0.47	0.27	
54,000-64,999	1.90	1.70	1.51	1.31	1.12	0.92	0.73	0.34
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.09							
15,000-20,999	0.32	0.13						
21,000-26,999	0.54	0.36	0.17					
27,000-32,999	0.77	0.59	0.40	0.22				
33,000-38,999	1.00	0.82	0.63	0.44	0.26			
39,000-44,999	1.23	1.04	0.86	0.67	0.49	0.30		
45,000-53,999	1.46	1.27	1.09	0.90	0.72	0.53	0.35	
54,000-64,999	1.92	1.73	1.54	1.36	1.17	0.99	0.80	0.43
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.09							
15,000-20,999	0.32	0.14						
21,000-26,999	0.55	0.37	0.19					
27,000-32,999	0.78	0.60	0.42	0.23				
33,000-38,999	1.01	0.83	0.64	0.46	0.28			
39,000-44,999	1.24	1.05	0.87	0.69	0.51	0.33		
45,000-53,999	1.46	1.28	1.10	0.92	0.74	0.56	0.37	

54,000-64,999	1.92	1.74	1.56	1.38	1.19	1.01	0.83	0.47

10.5-10.9 HSPF

Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.10							
15,000-20,999	0.33	0.15						
21,000-26,999	0.56	0.38	0.20					
27,000-32,999	0.79	0.61	0.43	0.25				
33,000-38,999	1.01	0.84	0.66	0.48	0.30			
39,000-44,999	1.24	1.06	0.89	0.71	0.53	0.35		
45,000-53,999	1.47	1.29	1.11	0.94	0.76	0.58	0.40	
54,000-64,999	1.93	1.75	1.57	1.39	1.22	1.04	0.86	0.50

11.0-11.4 HSPF

Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.34	0.16						
21,000-26,999	0.56	0.39	0.21					
27,000-32,999	0.79	0.62	0.44	0.27				
33,000-38,999	1.02	0.85	0.67	0.50	0.32			
39,000-44,999	1.25	1.07	0.90	0.72	0.55	0.37		
45,000-53,999	1.48	1.30	1.13	0.95	0.78	0.60	0.43	
54,000-64,999	1.94	1.76	1.59	1.41	1.23	1.06	0.88	0.53

11.5-11.9 HSPF

Size (Btuh) Post	< 15,000	15,000-20,999	21,000-26,999	27,000-32,999	33,000-38,999	39,000-44,999	45,000-53,999	54,000-64,999
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.34	0.17						
21,000-26,999	0.57	0.40	0.23					
27,000-32,999	0.80	0.63	0.45	0.28				
33,000-38,999	1.03	0.86	0.68	0.51	0.34			
39,000-44,999	1.26	1.08	0.91	0.74	0.57	0.40		

45,000-53,999	1.48	1.31	1.14	0.97	0.80	0.62	0.45	
54,000-64,999	1.94	1.77	1.60	1.43	1.25	1.08	0.91	0.57
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.35	0.18						
21,000-26,999	0.57	0.40	0.23					
27,000-32,999	0.80	0.63	0.46	0.29				
33,000-38,999	1.03	0.86	0.69	0.52	0.35			
39,000-44,999	1.26	1.09	0.92	0.75	0.58	0.41		
45,000-53,999	1.49	1.32	1.15	0.98	0.81	0.64	0.47	
54,000-64,999	1.95	1.78	1.61	1.43	1.26	1.09	0.92	0.58

Replace-on-burnout—*Replacement of Electric Resistance Furnace*

Table 492 through Table 496 present the winter demand savings (kW) per heating load type associated with a mini-split heat pump replacing an electric resistance furnace for all five climate zones.

The following deemed savings assume no back-up electric resistance heat for the efficient case.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 492: Mini-split Winter Demand Savings for 3.41 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.06							
15,000-20,999	3.46	3.09						
21,000-26,999	4.86	4.49	4.12					
27,000-32,999	6.26	5.89	5.52	5.15				
33,000-38,999	7.66	7.29	6.92	6.55	6.18			
39,000-44,999	9.06	8.69	8.32	7.95	7.58	7.21		
45,000-53,999	10.45	10.09	9.72	9.35	8.98	8.61	8.24	
54,000-64,999	13.25	12.88	12.51	12.14	11.78	11.41	11.04	10.30

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.12							
15,000-20,999	3.52	3.18						
21,000-26,999	4.92	4.58	4.24					
27,000-32,999	6.32	5.98	5.64	5.31				
33,000-38,999	7.72	7.38	7.04	6.70	6.37			
39,000-44,999	9.12	8.78	8.44	8.10	7.77	7.43		
45,000-53,999	10.52	10.18	9.84	9.50	9.17	8.83	8.49	
54,000-64,999	13.32	12.98	12.64	12.30	11.96	11.63	11.29	10.61

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.15							
15,000-20,999	3.55	3.23						
21,000-26,999	4.95	4.63	4.31					
27,000-32,999	6.35	6.03	5.71	5.39				
33,000-38,999	7.75	7.43	7.11	6.79	6.46			
39,000-44,999	9.15	8.83	8.51	8.19	7.86	7.54		
45,000-53,999	10.55	10.23	9.91	9.58	9.26	8.94	8.62	
54,000-64,999	13.35	13.03	12.70	12.38	12.06	11.74	11.42	10.77

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.17							
15,000-20,999	3.57	3.25						
21,000-26,999	4.97	4.65	4.33					
27,000-32,999	6.36	6.05	5.73	5.42				
33,000-38,999	7.76	7.45	7.13	6.82	6.50			
39,000-44,999	9.16	8.85	8.53	8.22	7.90	7.58		
45,000-53,999	10.56	10.25	9.93	9.61	9.30	8.98	8.67	

54,000-64,999	13.36	13.04	12.73	12.41	12.10	11.78	11.47	10.83
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.18							
15,000-20,999	3.58	3.27						
21,000-26,999	4.98	4.67	4.36					
27,000-32,999	6.38	6.07	5.76	5.45				
33,000-38,999	7.78	7.47	7.16	6.85	6.54			
39,000-44,999	9.17	8.86	8.56	8.25	7.94	7.63		
45,000-53,999	10.57	10.26	9.95	9.64	9.33	9.02	8.71	
54,000-64,999	13.37	13.06	12.75	12.44	12.13	11.82	11.51	10.89
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.19							
15,000-20,999	3.59	3.29						
21,000-26,999	4.99	4.68	4.38					
27,000-32,999	6.39	6.08	5.78	5.48				
33,000-38,999	7.79	7.48	7.18	6.87	6.57			
39,000-44,999	9.19	8.88	8.58	8.27	7.97	7.67		
45,000-53,999	10.59	10.28	9.98	9.67	9.37	9.06	8.76	
54,000-64,999	13.38	13.08	12.78	12.47	12.17	11.86	11.56	10.95
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.20							
15,000-20,999	3.60	3.30						
21,000-26,999	5.00	4.70	4.40					
27,000-32,999	6.40	6.10	5.80	5.50				
33,000-38,999	7.80	7.50	7.20	6.90	6.60			
39,000-44,999	9.20	8.90	8.60	8.30	8.00	7.70		

45,000-53,999	10.60	10.30	10.00	9.70	9.40	9.10	8.80	
54,000-64,999	13.39	13.10	12.80	12.50	12.20	11.90	11.60	11.01
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.21							
15,000-20,999	3.61	3.31						
21,000-26,999	5.01	4.71	4.41					
27,000-32,999	6.40	6.11	5.81	5.52				
33,000-38,999	7.80	7.51	7.21	6.92	6.62			
39,000-44,999	9.20	8.91	8.61	8.32	8.02	7.73		
45,000-53,999	10.60	10.31	10.01	9.72	9.42	9.13	8.83	
54,000-64,999	13.40	13.11	12.81	12.51	12.22	11.92	11.63	11.04

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 493: Mini-split Winter Demand Savings for 3.41 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.00							
15,000-20,999	3.37	3.00						
21,000-26,999	4.74	4.37	4.00					
27,000-32,999	6.11	5.74	5.37	5.00				
33,000-38,999	7.48	7.11	6.74	6.37	6.00			
39,000-44,999	8.85	8.48	8.11	7.74	7.37	7.00		
45,000-53,999	10.22	9.85	9.48	9.11	8.74	8.37	8.00	
54,000-64,999	12.96	12.59	12.22	11.85	11.48	11.11	10.74	9.99

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.06							
15,000-20,999	3.43	3.09						
21,000-26,999	4.80	4.46	4.12					
27,000-32,999	6.17	5.83	5.49	5.15				
33,000-38,999	7.54	7.20	6.86	6.52	6.19			
39,000-44,999	8.91	8.58	8.24	7.90	7.56	7.22		
45,000-53,999	10.29	9.95	9.61	9.27	8.93	8.59	8.25	
54,000-64,999	13.03	12.69	12.35	12.01	11.67	11.33	10.99	10.31

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.09							
15,000-20,999	3.47	3.14						
21,000-26,999	4.84	4.51	4.19					
27,000-32,999	6.21	5.88	5.56	5.24				
33,000-38,999	7.58	7.25	6.93	6.61	6.28			
39,000-44,999	8.95	8.62	8.30	7.98	7.65	7.33		
45,000-53,999	10.32	9.99	9.67	9.35	9.02	8.70	8.38	
54,000-64,999	13.06	12.74	12.41	12.09	11.77	11.44	11.12	10.47

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.11							
15,000-20,999	3.48	3.16						
21,000-26,999	4.85	4.53	4.21					
27,000-32,999	6.22	5.90	5.58	5.27				
33,000-38,999	7.59	7.27	6.95	6.64	6.32			
39,000-44,999	8.96	8.64	8.33	8.01	7.69	7.37		
45,000-53,999	10.33	10.01	9.70	9.38	9.06	8.74	8.43	

54,000-64,999	13.07	12.75	12.44	12.12	11.80	11.49	11.17	10.53
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.12							
15,000-20,999	3.49	3.18						
21,000-26,999	4.86	4.55	4.24					
27,000-32,999	6.23	5.92	5.61	5.30				
33,000-38,999	7.60	7.29	6.98	6.67	6.36			
39,000-44,999	8.97	8.66	8.35	8.04	7.73	7.41		
45,000-53,999	10.34	10.03	9.72	9.41	9.10	8.79	8.47	
54,000-64,999	13.08	12.77	12.46	12.15	11.84	11.53	11.22	10.59
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.13							
15,000-20,999	3.50	3.19						
21,000-26,999	4.87	4.57	4.26					
27,000-32,999	6.24	5.94	5.63	5.32				
33,000-38,999	7.61	7.31	7.00	6.70	6.39			
39,000-44,999	8.98	8.68	8.37	8.07	7.76	7.45		
45,000-53,999	10.35	10.05	9.74	9.44	9.13	8.83	8.52	
54,000-64,999	13.09	12.79	12.48	12.18	11.87	11.57	11.26	10.65
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.14							
15,000-20,999	3.51	3.21						
21,000-26,999	4.88	4.58	4.28					
27,000-32,999	6.25	5.95	5.65	5.35				
33,000-38,999	7.62	7.32	7.02	6.72	6.42			
39,000-44,999	8.99	8.69	8.39	8.09	7.79	7.49		

45,000-53,999	10.36	10.06	9.76	9.46	9.16	8.86	8.56	
54,000-64,999	13.11	12.81	12.51	12.21	11.91	11.61	11.30	10.70
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	2.15							
15,000-20,999	3.52	3.22						
21,000-26,999	4.89	4.59	4.29					
27,000-32,999	6.26	5.96	5.67	5.37				
33,000-38,999	7.63	7.33	7.04	6.74	6.44			
39,000-44,999	9.00	8.70	8.41	8.11	7.81	7.52		
45,000-53,999	10.37	10.07	9.78	9.48	9.18	8.89	8.59	
54,000-64,999	13.11	12.82	12.52	12.22	11.92	11.63	11.33	10.74

Climate Zone 3: South Region, Houston Weather Data

Table 494: Mini-split Winter Demand Savings for 3.41 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.51							
15,000-20,999	2.60	2.27						
21,000-26,999	3.68	3.35	3.02					
27,000-32,999	4.77	4.44	4.11	3.78				
33,000-38,999	5.85	5.52	5.19	4.86	4.53			
39,000-44,999	6.94	6.61	6.28	5.95	5.62	5.29		
45,000-53,999	8.02	7.69	7.36	7.03	6.70	6.37	6.05	
54,000-64,999	10.19	9.86	9.53	9.20	8.87	8.54	8.22	7.56

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.57							
15,000-20,999	2.65	2.35						
21,000-26,999	3.74	3.44	3.13					
27,000-32,999	4.82	4.52	4.22	3.92				
33,000-38,999	5.91	5.61	5.30	5.00	4.70			
39,000-44,999	6.99	6.69	6.39	6.09	5.79	5.48		
45,000-53,999	8.08	7.78	7.47	7.17	6.87	6.57	6.27	
54,000-64,999	10.25	9.95	9.64	9.34	9.04	8.74	8.44	7.84
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.60							
15,000-20,999	2.68	2.39						
21,000-26,999	3.77	3.48	3.19					
27,000-32,999	4.85	4.56	4.28	3.99				
33,000-38,999	5.94	5.65	5.36	5.08	4.79			
39,000-44,999	7.02	6.73	6.45	6.16	5.87	5.59		
45,000-53,999	8.11	7.82	7.53	7.25	6.96	6.67	6.38	
54,000-64,999	10.28	9.99	9.70	9.42	9.13	8.84	8.55	7.98
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.61							
15,000-20,999	2.69	2.41						
21,000-26,999	3.78	3.50	3.21					
27,000-32,999	4.86	4.58	4.30	4.02				
33,000-38,999	5.95	5.67	5.38	5.10	4.82			
39,000-44,999	7.03	6.75	6.47	6.19	5.91	5.62		
45,000-53,999	8.12	7.84	7.55	7.27	6.99	6.71	6.43	

54,000-64,999	10.29	10.01	9.72	9.44	9.16	8.88	8.60	8.03
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.62							
15,000-20,999	2.70	2.43						
21,000-26,999	3.79	3.51	3.23					
27,000-32,999	4.87	4.60	4.32	4.04				
33,000-38,999	5.96	5.68	5.41	5.13	4.85			
39,000-44,999	7.04	6.77	6.49	6.21	5.94	5.66		
45,000-53,999	8.13	7.85	7.58	7.30	7.02	6.75	6.47	
54,000-64,999	10.30	10.02	9.75	9.47	9.19	8.92	8.64	8.09
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.63							
15,000-20,999	2.71	2.44						
21,000-26,999	3.80	3.53	3.26					
27,000-32,999	4.88	4.61	4.34	4.07				
33,000-38,999	5.97	5.70	5.43	5.15	4.88			
39,000-44,999	7.05	6.78	6.51	6.24	5.97	5.70		
45,000-53,999	8.14	7.87	7.60	7.32	7.05	6.78	6.51	
54,000-64,999	10.31	10.04	9.77	9.49	9.22	8.95	8.68	8.14
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.64							
15,000-20,999	2.72	2.46						
21,000-26,999	3.81	3.54	3.27					
27,000-32,999	4.89	4.63	4.36	4.09				
33,000-38,999	5.98	5.71	5.44	5.18	4.91			
39,000-44,999	7.06	6.80	6.53	6.26	6.00	5.73		

45,000-53,999	8.15	7.88	7.62	7.35	7.08	6.82	6.55	
54,000-64,999	10.32	10.05	9.79	9.52	9.25	8.99	8.72	8.19
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.64							
15,000-20,999	2.73	2.46						
21,000-26,999	3.81	3.55	3.29					
27,000-32,999	4.90	4.63	4.37	4.11				
33,000-38,999	5.98	5.72	5.46	5.19	4.93			
39,000-44,999	7.07	6.80	6.54	6.28	6.01	5.75		
45,000-53,999	8.15	7.89	7.63	7.36	7.10	6.84	6.57	
54,000-64,999	10.32	10.06	9.80	9.53	9.27	9.01	8.74	8.22

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 495: Mini-split Winter Demand Savings for 3.41 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.16							
15,000-20,999	1.99	1.74						
21,000-26,999	2.82	2.57	2.32					
27,000-32,999	3.65	3.40	3.15	2.90				
33,000-38,999	4.47	4.23	3.98	3.73	3.48			
39,000-44,999	5.30	5.05	4.81	4.56	4.31	4.06		
45,000-53,999	6.13	5.88	5.63	5.39	5.14	4.89	4.64	
54,000-64,999	7.79	7.54	7.29	7.04	6.80	6.55	6.30	5.80

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.20							
15,000-20,999	2.03	1.80						
21,000-26,999	2.86	2.63	2.41					
27,000-32,999	3.69	3.46	3.23	3.01				
33,000-38,999	4.52	4.29	4.06	3.84	3.61			
39,000-44,999	5.34	5.12	4.89	4.66	4.44	4.21		
45,000-53,999	6.17	5.94	5.72	5.49	5.26	5.04	4.81	
54,000-64,999	7.83	7.60	7.37	7.15	6.92	6.69	6.47	6.01

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.22							
15,000-20,999	2.05	1.84						
21,000-26,999	2.88	2.67	2.45					
27,000-32,999	3.71	3.49	3.28	3.06				
33,000-38,999	4.54	4.32	4.11	3.89	3.67			
39,000-44,999	5.37	5.15	4.93	4.72	4.50	4.29		
45,000-53,999	6.19	5.98	5.76	5.55	5.33	5.11	4.90	
54,000-64,999	7.85	7.63	7.42	7.20	6.99	6.77	6.55	6.12

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.23							
15,000-20,999	2.06	1.85						
21,000-26,999	2.89	2.68	2.47					
27,000-32,999	3.72	3.51	3.29	3.08				
33,000-38,999	4.55	4.33	4.12	3.91	3.70			
39,000-44,999	5.37	5.16	4.95	4.74	4.53	4.32		
45,000-53,999	6.20	5.99	5.78	5.57	5.35	5.14	4.93	

54,000-64,999	7.86	7.65	7.43	7.22	7.01	6.80	6.59	6.16
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.24							
15,000-20,999	2.07	1.86						
21,000-26,999	2.90	2.69	2.48					
27,000-32,999	3.73	3.52	3.31	3.10				
33,000-38,999	4.55	4.35	4.14	3.93	3.72			
39,000-44,999	5.38	5.17	4.97	4.76	4.55	4.34		
45,000-53,999	6.21	6.00	5.79	5.59	5.38	5.17	4.96	
54,000-64,999	7.87	7.66	7.45	7.24	7.03	6.83	6.62	6.20
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.25							
15,000-20,999	2.08	1.87						
21,000-26,999	2.90	2.70	2.50					
27,000-32,999	3.73	3.53	3.32	3.12				
33,000-38,999	4.56	4.36	4.15	3.95	3.75			
39,000-44,999	5.39	5.18	4.98	4.78	4.57	4.37		
45,000-53,999	6.22	6.01	5.81	5.61	5.40	5.20	4.99	
54,000-64,999	7.87	7.67	7.47	7.26	7.06	6.85	6.65	6.24
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.26							
15,000-20,999	2.08	1.88						
21,000-26,999	2.91	2.71	2.51					
27,000-32,999	3.74	3.54	3.34	3.14				
33,000-38,999	4.57	4.37	4.17	3.97	3.77			
39,000-44,999	5.40	5.20	5.00	4.80	4.60	4.39		

45,000-53,999	6.22	6.02	5.82	5.62	5.42	5.22	5.02	
54,000-64,999	7.88	7.68	7.48	7.28	7.08	6.88	6.68	6.28
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.26							
15,000-20,999	2.09	1.89						
21,000-26,999	2.92	2.72	2.52					
27,000-32,999	3.74	3.55	3.35	3.15				
33,000-38,999	4.57	4.37	4.18	3.98	3.78			
39,000-44,999	5.40	5.20	5.00	4.81	4.61	4.41		
45,000-53,999	6.23	6.03	5.83	5.63	5.44	5.24	5.04	
54,000-64,999	7.88	7.69	7.49	7.29	7.09	6.89	6.70	6.30

Climate Zone 5: West Region El Paso Weather Data

Table 496: Mini-split Winter Demand Savings for 3.41 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.00							
15,000-20,999	1.72	1.50						
21,000-26,999	2.43	2.22	2.00					
27,000-32,999	3.14	2.93	2.72	2.51				
33,000-38,999	3.86	3.65	3.43	3.22	3.01			
39,000-44,999	4.57	4.36	4.15	3.93	3.72	3.51		
45,000-53,999	5.29	5.07	4.86	4.65	4.43	4.22	4.01	
54,000-64,999	6.71	6.50	6.29	6.08	5.86	5.65	5.44	5.01

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.04							
15,000-20,999	1.75	1.56						
21,000-26,999	2.47	2.27	2.08					
27,000-32,999	3.18	2.99	2.79	2.60				
33,000-38,999	3.89	3.70	3.50	3.31	3.12			
39,000-44,999	4.61	4.41	4.22	4.02	3.83	3.63		
45,000-53,999	5.32	5.13	4.93	4.74	4.54	4.35	4.15	
54,000-64,999	6.75	6.55	6.36	6.17	5.97	5.78	5.58	5.19
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.06							
15,000-20,999	1.77	1.59						
21,000-26,999	2.48	2.30	2.11					
27,000-32,999	3.20	3.01	2.83	2.64				
33,000-38,999	3.91	3.73	3.54	3.36	3.17			
39,000-44,999	4.63	4.44	4.26	4.07	3.89	3.70		
45,000-53,999	5.34	5.16	4.97	4.78	4.60	4.41	4.23	
54,000-64,999	6.77	6.58	6.40	6.21	6.03	5.84	5.66	5.29
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.06							
15,000-20,999	1.78	1.60						
21,000-26,999	2.49	2.31	2.13					
27,000-32,999	3.21	3.02	2.84	2.66				
33,000-38,999	3.92	3.74	3.56	3.37	3.19			
39,000-44,999	4.63	4.45	4.27	4.09	3.91	3.72		
45,000-53,999	5.35	5.17	4.98	4.80	4.62	4.44	4.26	

54,000-64,999	6.78	6.59	6.41	6.23	6.05	5.87	5.68	5.32
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.07							
15,000-20,999	1.78	1.61						
21,000-26,999	2.50	2.32	2.14					
27,000-32,999	3.21	3.03	2.86	2.68				
33,000-38,999	3.93	3.75	3.57	3.39	3.21			
39,000-44,999	4.64	4.46	4.28	4.11	3.93	3.75		
45,000-53,999	5.35	5.18	5.00	4.82	4.64	4.46	4.28	
54,000-64,999	6.78	6.60	6.43	6.25	6.07	5.89	5.71	5.35
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.08							
15,000-20,999	1.79	1.62						
21,000-26,999	2.51	2.33	2.15					
27,000-32,999	3.22	3.04	2.87	2.69				
33,000-38,999	3.93	3.76	3.58	3.41	3.23			
39,000-44,999	4.65	4.47	4.30	4.12	3.95	3.77		
45,000-53,999	5.36	5.19	5.01	4.84	4.66	4.48	4.31	
54,000-64,999	6.79	6.61	6.44	6.26	6.09	5.91	5.74	5.39
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.08							
15,000-20,999	1.80	1.63						
21,000-26,999	2.51	2.34	2.17					
27,000-32,999	3.23	3.05	2.88	2.71				
33,000-38,999	3.94	3.77	3.60	3.42	3.25			
39,000-44,999	4.65	4.48	4.31	4.14	3.97	3.79		

45,000-53,999	5.37	5.19	5.02	4.85	4.68	4.51	4.34	
54,000-64,999	6.79	6.62	6.45	6.28	6.11	5.93	5.76	5.42

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.09							
15,000-20,999	1.80	1.63						
21,000-26,999	2.52	2.35	2.17					
27,000-32,999	3.23	3.06	2.89	2.72				
33,000-38,999	3.94	3.77	3.60	3.43	3.26			
39,000-44,999	4.66	4.49	4.32	4.15	3.98	3.81		
45,000-53,999	5.37	5.20	5.03	4.86	4.69	4.52	4.35	
54,000-64,999	6.80	6.63	6.46	6.29	6.12	5.95	5.78	5.44

Early Retirement—Replacement of a Heat Pump

See Table 497 through Table 506 for the winter demand savings (kW) per heating load type associated with a mini-split heat pump replacing another heat pump for all five Texas climate zones.

The following deemed savings assume no back-up electric resistance heat for the efficient case.

Climate Zone 1: Panhandle Region, Amarillo Weather Data

Table 497: Mini-split Winter Demand Savings for 7.7 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.67							
15,000-20,999	1.38	1.01						
21,000-26,999	2.09	1.72	1.35					
27,000-32,999	2.79	2.42	2.05	1.68				
33,000-38,999	3.50	3.13	2.76	2.39	2.02			
39,000-44,999	4.20	3.84	3.47	3.10	2.73	2.36		
45,000-53,999	4.91	4.54	4.17	3.80	3.43	3.06	2.69	
54,000-64,999	6.32	5.95	5.58	5.22	4.85	4.48	4.11	3.37

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.74							
15,000-20,999	1.44	1.10						
21,000-26,999	2.15	1.81	1.47					
27,000-32,999	2.85	2.52	2.18	1.84				
33,000-38,999	3.56	3.22	2.89	2.55	2.21			
39,000-44,999	4.27	3.93	3.59	3.25	2.92	2.58		
45,000-53,999	4.97	4.64	4.30	3.96	3.62	3.28	2.95	
54,000-64,999	6.39	6.05	5.71	5.37	5.03	4.70	4.36	3.68
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.77							
15,000-20,999	1.48	1.15						
21,000-26,999	2.18	1.86	1.54					
27,000-32,999	2.89	2.57	2.24	1.92				
33,000-38,999	3.59	3.27	2.95	2.63	2.31			
39,000-44,999	4.30	3.98	3.66	3.33	3.01	2.69		
45,000-53,999	5.01	4.68	4.36	4.04	3.72	3.40	3.08	
54,000-64,999	6.42	6.10	5.77	5.45	5.13	4.81	4.49	3.84
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.78							
15,000-20,999	1.49	1.17						
21,000-26,999	2.19	1.88	1.56					
27,000-32,999	2.90	2.58	2.27	1.95				
33,000-38,999	3.61	3.29	2.97	2.66	2.34			
39,000-44,999	4.31	4.00	3.68	3.37	3.05	2.73		
45,000-53,999	5.02	4.70	4.39	4.07	3.76	3.44	3.12	

54,000-64,999	6.43	6.12	5.80	5.48	5.17	4.85	4.54	3.91
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.79							
15,000-20,999	1.50	1.19						
21,000-26,999	2.21	1.90	1.59					
27,000-32,999	2.91	2.60	2.29	1.98				
33,000-38,999	3.62	3.31	3.00	2.69	2.38			
39,000-44,999	4.32	4.01	3.70	3.39	3.08	2.77		
45,000-53,999	5.03	4.72	4.41	4.10	3.79	3.48	3.17	
54,000-64,999	6.44	6.13	5.82	5.51	5.20	4.89	4.58	3.96
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.80							
15,000-20,999	1.51	1.21						
21,000-26,999	2.22	1.91	1.61					
27,000-32,999	2.92	2.62	2.31	2.01				
33,000-38,999	3.63	3.32	3.02	2.72	2.41			
39,000-44,999	4.34	4.03	3.73	3.42	3.12	2.81		
45,000-53,999	5.04	4.74	4.43	4.13	3.82	3.52	3.22	
54,000-64,999	6.45	6.15	5.85	5.54	5.24	4.93	4.63	4.02
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.82							
15,000-20,999	1.52	1.22						
21,000-26,999	2.23	1.93	1.63					
27,000-32,999	2.93	2.64	2.34	2.04				
33,000-38,999	3.64	3.34	3.04	2.74	2.45			
39,000-44,999	4.35	4.05	3.75	3.45	3.15	2.85		

45,000-53,999	5.05	4.75	4.46	4.16	3.86	3.56	3.26	
54,000-64,999	6.46	6.17	5.87	5.57	5.27	4.97	4.67	4.08
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.82							
15,000-20,999	1.53	1.23						
21,000-26,999	2.23	1.94	1.64					
27,000-32,999	2.94	2.64	2.35	2.05				
33,000-38,999	3.65	3.35	3.06	2.76	2.46			
39,000-44,999	4.35	4.06	3.76	3.47	3.17	2.88		
45,000-53,999	5.06	4.76	4.47	4.17	3.88	3.58	3.29	
54,000-64,999	6.47	6.18	5.88	5.58	5.29	4.99	4.70	4.11

Table 498: Mini-split Winter Demand Savings for 6.8 HSPF Baseline—Zone 1

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.86							
15,000-20,999	1.66	1.29						
21,000-26,999	2.46	2.09	1.72					
27,000-32,999	3.26	2.89	2.52	2.15				
33,000-38,999	4.06	3.69	3.32	2.95	2.58			
39,000-44,999	4.86	4.49	4.12	3.75	3.38	3.01		
45,000-53,999	5.66	5.29	4.92	4.55	4.18	3.81	3.45	
54,000-64,999	7.26	6.89	6.52	6.15	5.78	5.41	5.05	4.31

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.92							
15,000-20,999	1.72	1.39						
21,000-26,999	2.52	2.19	1.85					
27,000-32,999	3.32	2.99	2.65	2.31				
33,000-38,999	4.12	3.79	3.45	3.11	2.77			
39,000-44,999	4.92	4.59	4.25	3.91	3.57	3.23		
45,000-53,999	5.72	5.39	5.05	4.71	4.37	4.03	3.70	
54,000-64,999	7.32	6.99	6.65	6.31	5.97	5.63	5.30	4.62

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.96							
15,000-20,999	1.76	1.43						
21,000-26,999	2.56	2.23	1.91					
27,000-32,999	3.36	3.03	2.71	2.39				
33,000-38,999	4.16	3.83	3.51	3.19	2.87			
39,000-44,999	4.96	4.63	4.31	3.99	3.67	3.35		
45,000-53,999	5.76	5.43	5.11	4.79	4.47	4.15	3.83	
54,000-64,999	7.36	7.03	6.71	6.39	6.07	5.75	5.43	4.78

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.97							
15,000-20,999	1.77	1.45						
21,000-26,999	2.57	2.25	1.94					
27,000-32,999	3.37	3.05	2.74	2.42				
33,000-38,999	4.17	3.85	3.54	3.22	2.91			
39,000-44,999	4.97	4.65	4.34	4.02	3.71	3.39		
45,000-53,999	5.77	5.45	5.14	4.82	4.51	4.19	3.87	

54,000-64,999	7.37	7.05	6.74	6.42	6.11	5.79	5.47	4.84
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.98							
15,000-20,999	1.78	1.47						
21,000-26,999	2.58	2.27	1.96					
27,000-32,999	3.38	3.07	2.76	2.45				
33,000-38,999	4.18	3.87	3.56	3.25	2.94			
39,000-44,999	4.98	4.67	4.36	4.05	3.74	3.43		
45,000-53,999	5.78	5.47	5.16	4.85	4.54	4.23	3.92	
54,000-64,999	7.38	7.07	6.76	6.45	6.14	5.83	5.52	4.90
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.99							
15,000-20,999	1.79	1.49						
21,000-26,999	2.59	2.29	1.98					
27,000-32,999	3.39	3.09	2.78	2.48				
33,000-38,999	4.19	3.89	3.58	3.28	2.98			
39,000-44,999	4.99	4.69	4.38	4.08	3.78	3.47		
45,000-53,999	5.79	5.49	5.18	4.88	4.58	4.27	3.97	
54,000-64,999	7.39	7.09	6.78	6.48	6.18	5.87	5.57	4.96
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.00							
15,000-20,999	1.80	1.50						
21,000-26,999	2.60	2.30	2.01					
27,000-32,999	3.40	3.10	2.81	2.51				
33,000-38,999	4.20	3.90	3.61	3.31	3.01			
39,000-44,999	5.00	4.70	4.41	4.11	3.81	3.51		

45,000-53,999	5.80	5.50	5.21	4.91	4.61	4.31	4.01	
54,000-64,999	7.40	7.10	6.81	6.51	6.21	5.91	5.61	5.01

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	1.01							
15,000-20,999	1.81	1.51						
21,000-26,999	2.61	2.31	2.02					
27,000-32,999	3.41	3.11	2.82	2.52				
33,000-38,999	4.21	3.91	3.62	3.32	3.03			
39,000-44,999	5.01	4.71	4.42	4.12	3.83	3.53		
45,000-53,999	5.81	5.51	5.22	4.92	4.63	4.33	4.04	
54,000-64,999	7.41	7.11	6.82	6.52	6.23	5.93	5.64	5.05

Climate Zone 2: North Region, Dallas / Fort Worth Weather Data

Table 499: Mini-split Winter Demand Savings for 7.7 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.58							
15,000-20,999	1.24	0.87						
21,000-26,999	1.90	1.53	1.16					
27,000-32,999	2.56	2.19	1.82	1.45				
33,000-38,999	3.22	2.85	2.48	2.11	1.74			
39,000-44,999	3.88	3.51	3.14	2.77	2.40	2.02		
45,000-53,999	4.54	4.17	3.80	3.43	3.06	2.69	2.31	
54,000-64,999	5.86	5.49	5.12	4.75	4.38	4.01	3.63	2.89

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.64							
15,000-20,999	1.30	0.96						
21,000-26,999	1.96	1.62	1.28					
27,000-32,999	2.62	2.28	1.94	1.60				
33,000-38,999	3.28	2.94	2.60	2.26	1.92			
39,000-44,999	3.94	3.60	3.26	2.92	2.58	2.24		
45,000-53,999	4.60	4.26	3.92	3.58	3.25	2.91	2.57	
54,000-64,999	5.93	5.59	5.25	4.91	4.57	4.23	3.89	3.21

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.67							
15,000-20,999	1.33	1.01						
21,000-26,999	1.99	1.67	1.35					
27,000-32,999	2.66	2.33	2.01	1.69				
33,000-38,999	3.32	2.99	2.67	2.35	2.02			
39,000-44,999	3.98	3.65	3.33	3.01	2.68	2.36		
45,000-53,999	4.64	4.31	3.99	3.67	3.34	3.02	2.70	
54,000-64,999	5.96	5.63	5.31	4.99	4.66	4.34	4.02	3.37

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.69							
15,000-20,999	1.35	1.03						
21,000-26,999	2.01	1.69	1.37					
27,000-32,999	2.67	2.35	2.03	1.72				
33,000-38,999	3.33	3.01	2.69	2.38	2.06			
39,000-44,999	3.99	3.67	3.35	3.04	2.72	2.40		
45,000-53,999	4.65	4.33	4.01	3.70	3.38	3.06	2.75	

54,000-64,999	5.97	5.65	5.34	5.02	4.70	4.38	4.07	3.43
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.70							
15,000-20,999	1.36	1.05						
21,000-26,999	2.02	1.71	1.40					
27,000-32,999	2.68	2.37	2.06	1.75				
33,000-38,999	3.34	3.03	2.72	2.41	2.09			
39,000-44,999	4.00	3.69	3.38	3.07	2.76	2.44		
45,000-53,999	4.66	4.35	4.04	3.73	3.42	3.10	2.79	
54,000-64,999	5.98	5.67	5.36	5.05	4.74	4.43	4.11	3.49
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.71							
15,000-20,999	1.37	1.06						
21,000-26,999	2.03	1.72	1.42					
27,000-32,999	2.69	2.39	2.08	1.77				
33,000-38,999	3.35	3.05	2.74	2.43	2.13			
39,000-44,999	4.01	3.71	3.40	3.09	2.79	2.48		
45,000-53,999	4.67	4.37	4.06	3.76	3.45	3.14	2.84	
54,000-64,999	5.99	5.69	5.38	5.08	4.77	4.46	4.16	3.55
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.72							
15,000-20,999	1.38	1.08						
21,000-26,999	2.04	1.74	1.44					
27,000-32,999	2.70	2.40	2.10	1.80				
33,000-38,999	3.36	3.06	2.76	2.46	2.16			
39,000-44,999	4.02	3.72	3.42	3.12	2.82	2.52		

45,000-53,999	4.68	4.38	4.08	3.78	3.48	3.18	2.88	
54,000-64,999	6.00	5.70	5.40	5.10	4.80	4.50	4.20	3.60
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.73							
15,000-20,999	1.39	1.09						
21,000-26,999	2.05	1.75	1.45					
27,000-32,999	2.71	2.41	2.11	1.82				
33,000-38,999	3.37	3.07	2.77	2.48	2.18			
39,000-44,999	4.03	3.73	3.44	3.14	2.84	2.54		
45,000-53,999	4.69	4.39	4.10	3.80	3.50	3.20	2.91	
54,000-64,999	6.01	5.71	5.42	5.12	4.82	4.53	4.23	3.63

Table 500: Mini-split Winter Demand Savings for 6.8 HSPF Baseline—Zone 2

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.77							
15,000-20,999	1.52	1.15						
21,000-26,999	2.28	1.91	1.53					
27,000-32,999	3.03	2.66	2.29	1.92				
33,000-38,999	3.79	3.41	3.04	2.67	2.30			
39,000-44,999	4.54	4.17	3.80	3.43	3.06	2.68		
45,000-53,999	5.30	4.92	4.55	4.18	3.81	3.44	3.07	
54,000-64,999	6.80	6.43	6.06	5.69	5.32	4.95	4.58	3.84

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.83							
15,000-20,999	1.58	1.24						
21,000-26,999	2.34	2.00	1.66					
27,000-32,999	3.09	2.75	2.41	2.07				
33,000-38,999	3.85	3.51	3.17	2.83	2.49			
39,000-44,999	4.60	4.26	3.92	3.58	3.24	2.90		
45,000-53,999	5.36	5.02	4.68	4.34	4.00	3.66	3.32	
54,000-64,999	6.87	6.53	6.19	5.85	5.51	5.17	4.83	4.15
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.86							
15,000-20,999	1.62	1.29						
21,000-26,999	2.37	2.05	1.73					
27,000-32,999	3.13	2.80	2.48	2.16				
33,000-38,999	3.88	3.56	3.23	2.91	2.59			
39,000-44,999	4.64	4.31	3.99	3.67	3.34	3.02		
45,000-53,999	5.39	5.07	4.74	4.42	4.10	3.77	3.45	
54,000-64,999	6.90	6.58	6.25	5.93	5.61	5.28	4.96	4.31
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.87							
15,000-20,999	1.63	1.31						
21,000-26,999	2.38	2.07	1.75					
27,000-32,999	3.14	2.82	2.50	2.19				
33,000-38,999	3.89	3.58	3.26	2.94	2.62			
39,000-44,999	4.65	4.33	4.01	3.70	3.38	3.06		
45,000-53,999	5.40	5.09	4.77	4.45	4.13	3.82	3.50	

54,000-64,999	6.91	6.60	6.28	5.96	5.64	5.33	5.01	4.37
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.89							
15,000-20,999	1.64	1.33						
21,000-26,999	2.40	2.08	1.77					
27,000-32,999	3.15	2.84	2.53	2.22				
33,000-38,999	3.91	3.59	3.28	2.97	2.66			
39,000-44,999	4.66	4.35	4.04	3.73	3.41	3.10		
45,000-53,999	5.42	5.10	4.79	4.48	4.17	3.86	3.55	
54,000-64,999	6.92	6.61	6.30	5.99	5.68	5.37	5.06	4.43
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.90							
15,000-20,999	1.65	1.35						
21,000-26,999	2.41	2.10	1.80					
27,000-32,999	3.16	2.86	2.55	2.25				
33,000-38,999	3.92	3.61	3.31	3.00	2.69			
39,000-44,999	4.67	4.37	4.06	3.75	3.45	3.14		
45,000-53,999	5.43	5.12	4.82	4.51	4.20	3.90	3.59	
54,000-64,999	6.94	6.63	6.32	6.02	5.71	5.41	5.10	4.49
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.91							
15,000-20,999	1.66	1.36						
21,000-26,999	2.42	2.12	1.82					
27,000-32,999	3.17	2.87	2.57	2.27				
33,000-38,999	3.93	3.63	3.33	3.03	2.73			
39,000-44,999	4.68	4.38	4.08	3.78	3.48	3.18		

45,000-53,999	5.44	5.14	4.84	4.54	4.24	3.94	3.64	
54,000-64,999	6.95	6.65	6.35	6.05	5.75	5.45	5.15	4.55
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.92							
15,000-20,999	1.67	1.37						
21,000-26,999	2.42	2.13	1.83					
27,000-32,999	3.18	2.88	2.59	2.29				
33,000-38,999	3.93	3.64	3.34	3.04	2.75			
39,000-44,999	4.69	4.39	4.10	3.80	3.50	3.20		
45,000-53,999	5.44	5.15	4.85	4.55	4.26	3.96	3.66	
54,000-64,999	6.95	6.66	6.36	6.06	5.77	5.47	5.17	4.58

Climate Zone 3: South Region, Houston Weather Data

Table 501: Mini-split Winter Demand Savings for 7.7 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.12							
15,000-20,999	0.51	0.18						
21,000-26,999	0.90	0.57	0.24					
27,000-32,999	1.29	0.96	0.63	0.30				
33,000-38,999	1.67	1.34	1.02	0.69	0.36			
39,000-44,999	2.06	1.73	1.40	1.07	0.75	0.42		
45,000-53,999	2.45	2.12	1.79	1.46	1.13	0.80	0.48	
54,000-64,999	3.23	2.90	2.57	2.24	1.91	1.58	1.25	0.59

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.56	0.26						
21,000-26,999	0.95	0.65	0.35					
27,000-32,999	1.34	1.04	0.74	0.44				
33,000-38,999	1.73	1.43	1.13	0.83	0.52			
39,000-44,999	2.12	1.82	1.52	1.21	0.91	0.61		
45,000-53,999	2.51	2.21	1.90	1.60	1.30	1.00	0.70	
54,000-64,999	3.29	2.98	2.68	2.38	2.08	1.78	1.48	0.87

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.20							
15,000-20,999	0.59	0.31						
21,000-26,999	0.98	0.69	0.41					
27,000-32,999	1.37	1.08	0.80	0.51				
33,000-38,999	1.76	1.47	1.19	0.90	0.61			
39,000-44,999	2.15	1.86	1.57	1.29	1.00	0.71		
45,000-53,999	2.54	2.25	1.96	1.68	1.39	1.10	0.81	
54,000-64,999	3.31	3.03	2.74	2.45	2.17	1.88	1.59	1.02

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.21							
15,000-20,999	0.60	0.32						
21,000-26,999	0.99	0.71	0.43					
27,000-32,999	1.38	1.10	0.82	0.54				
33,000-38,999	1.77	1.49	1.21	0.93	0.64			
39,000-44,999	2.16	1.88	1.60	1.31	1.03	0.75		
45,000-53,999	2.55	2.27	1.98	1.70	1.42	1.14	0.86	

54,000-64,999	3.33	3.04	2.76	2.48	2.20	1.92	1.64	1.07
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.23							
15,000-20,999	0.61	0.34						
21,000-26,999	1.00	0.73	0.45					
27,000-32,999	1.39	1.12	0.84	0.56				
33,000-38,999	1.78	1.50	1.23	0.95	0.68			
39,000-44,999	2.17	1.89	1.62	1.34	1.06	0.79		
45,000-53,999	2.56	2.28	2.01	1.73	1.45	1.18	0.90	
54,000-64,999	3.34	3.06	2.78	2.51	2.23	1.95	1.68	1.13
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.62	0.35						
21,000-26,999	1.01	0.74	0.47					
27,000-32,999	1.40	1.13	0.86	0.59				
33,000-38,999	1.79	1.52	1.25	0.98	0.71			
39,000-44,999	2.18	1.91	1.64	1.37	1.09	0.82		
45,000-53,999	2.57	2.30	2.03	1.75	1.48	1.21	0.94	
54,000-64,999	3.35	3.07	2.80	2.53	2.26	1.99	1.72	1.18
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.63	0.37						
21,000-26,999	1.02	0.76	0.49					
27,000-32,999	1.41	1.15	0.88	0.61				
33,000-38,999	1.80	1.53	1.27	1.00	0.73			
39,000-44,999	2.19	1.92	1.66	1.39	1.12	0.86		

45,000-53,999	2.58	2.31	2.05	1.78	1.51	1.25	0.98	
54,000-64,999	3.36	3.09	2.82	2.56	2.29	2.02	1.76	1.22
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.64	0.38						
21,000-26,999	1.03	0.76	0.50					
27,000-32,999	1.42	1.15	0.89	0.63				
33,000-38,999	1.81	1.54	1.28	1.02	0.75			
39,000-44,999	2.19	1.93	1.67	1.40	1.14	0.88		
45,000-53,999	2.58	2.32	2.06	1.79	1.53	1.27	1.00	
54,000-64,999	3.36	3.10	2.83	2.57	2.31	2.04	1.78	1.25

Table 502: Mini-split Winter Demand Savings for 6.8 HSPF Baseline—Zone 3

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.76	0.43						
21,000-26,999	1.23	0.90	0.57					
27,000-32,999	1.70	1.37	1.04	0.72				
33,000-38,999	2.18	1.85	1.52	1.19	0.86			
39,000-44,999	2.65	2.32	1.99	1.66	1.33	1.00		
45,000-53,999	3.12	2.79	2.46	2.13	1.80	1.47	1.14	
54,000-64,999	4.07	3.74	3.41	3.08	2.75	2.42	2.09	1.43

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.34							
15,000-20,999	0.81	0.51						
21,000-26,999	1.29	0.99	0.68					
27,000-32,999	1.76	1.46	1.16	0.85				
33,000-38,999	2.23	1.93	1.63	1.33	1.03			
39,000-44,999	2.70	2.40	2.10	1.80	1.50	1.20		
45,000-53,999	3.18	2.88	2.57	2.27	1.97	1.67	1.37	
54,000-64,999	4.12	3.82	3.52	3.22	2.92	2.61	2.31	1.71

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.37							
15,000-20,999	0.84	0.56						
21,000-26,999	1.32	1.03	0.74					
27,000-32,999	1.79	1.50	1.21	0.93				
33,000-38,999	2.26	1.97	1.69	1.40	1.11			
39,000-44,999	2.73	2.45	2.16	1.87	1.59	1.30		
45,000-53,999	3.21	2.92	2.63	2.34	2.06	1.77	1.48	
54,000-64,999	4.15	3.86	3.58	3.29	3.00	2.72	2.43	1.85

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.38							
15,000-20,999	0.85	0.57						
21,000-26,999	1.33	1.05	0.76					
27,000-32,999	1.80	1.52	1.24	0.95				
33,000-38,999	2.27	1.99	1.71	1.43	1.15			
39,000-44,999	2.74	2.46	2.18	1.90	1.62	1.34		
45,000-53,999	3.22	2.94	2.65	2.37	2.09	1.81	1.53	

54,000-64,999	4.16	3.88	3.60	3.32	3.04	2.75	2.47	1.91
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.39							
15,000-20,999	0.86	0.59						
21,000-26,999	1.34	1.06	0.78					
27,000-32,999	1.81	1.53	1.26	0.98				
33,000-38,999	2.28	2.01	1.73	1.45	1.18			
39,000-44,999	2.75	2.48	2.20	1.93	1.65	1.37		
45,000-53,999	3.23	2.95	2.67	2.40	2.12	1.85	1.57	
54,000-64,999	4.17	3.90	3.62	3.34	3.07	2.79	2.51	1.96
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.40							
15,000-20,999	0.87	0.60						
21,000-26,999	1.35	1.08	0.80					
27,000-32,999	1.82	1.55	1.28	1.01				
33,000-38,999	2.29	2.02	1.75	1.48	1.21			
39,000-44,999	2.77	2.49	2.22	1.95	1.68	1.41		
45,000-53,999	3.24	2.97	2.70	2.42	2.15	1.88	1.61	
54,000-64,999	4.18	3.91	3.64	3.37	3.10	2.83	2.55	2.01
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.41							
15,000-20,999	0.88	0.62						
21,000-26,999	1.36	1.09	0.82					
27,000-32,999	1.83	1.56	1.30	1.03				
33,000-38,999	2.30	2.04	1.77	1.50	1.24			
39,000-44,999	2.77	2.51	2.24	1.98	1.71	1.44		

45,000-53,999	3.25	2.98	2.71	2.45	2.18	1.92	1.65	
54,000-64,999	4.19	3.93	3.66	3.39	3.13	2.86	2.59	2.06
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.42							
15,000-20,999	0.89	0.63						
21,000-26,999	1.36	1.10	0.84					
27,000-32,999	1.84	1.57	1.31	1.04				
33,000-38,999	2.31	2.04	1.78	1.52	1.25			
39,000-44,999	2.78	2.52	2.25	1.99	1.73	1.46		
45,000-53,999	3.25	2.99	2.73	2.46	2.20	1.94	1.67	
54,000-64,999	4.20	3.93	3.67	3.41	3.14	2.88	2.62	2.09

Climate Zone 4: Valley Region Corpus Christi Weather Data

Table 503: Mini-split Winter Demand Savings for 7.7 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.09							
15,000-20,999	0.38	0.13						
21,000-26,999	0.67	0.43	0.18					
27,000-32,999	0.97	0.72	0.47	0.22				
33,000-38,999	1.26	1.01	0.76	0.52	0.27			
39,000-44,999	1.55	1.30	1.06	0.81	0.56	0.31		
45,000-53,999	1.84	1.60	1.35	1.10	0.85	0.60	0.36	
54,000-64,999	2.43	2.18	1.93	1.68	1.44	1.19	0.94	0.45

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.42	0.20						
21,000-26,999	0.72	0.49	0.26					
27,000-32,999	1.01	0.78	0.55	0.33				
33,000-38,999	1.30	1.07	0.85	0.62	0.39			
39,000-44,999	1.59	1.37	1.14	0.91	0.69	0.46		
45,000-53,999	1.89	1.66	1.43	1.21	0.98	0.75	0.53	
54,000-64,999	2.47	2.24	2.02	1.79	1.56	1.34	1.11	0.66
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.45	0.23						
21,000-26,999	0.74	0.52	0.31					
27,000-32,999	1.03	0.81	0.60	0.38				
33,000-38,999	1.32	1.11	0.89	0.67	0.46			
39,000-44,999	1.61	1.40	1.18	0.97	0.75	0.54		
45,000-53,999	1.91	1.69	1.48	1.26	1.04	0.83	0.61	
54,000-64,999	2.49	2.28	2.06	1.84	1.63	1.41	1.20	0.77
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.45	0.24						
21,000-26,999	0.75	0.53	0.32					
27,000-32,999	1.04	0.83	0.61	0.40				
33,000-38,999	1.33	1.12	0.91	0.70	0.48			
39,000-44,999	1.62	1.41	1.20	0.99	0.78	0.56		
45,000-53,999	1.92	1.70	1.49	1.28	1.07	0.86	0.65	

54,000-64,999	2.50	2.29	2.08	1.86	1.65	1.44	1.23	0.81
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.17							
15,000-20,999	0.46	0.25						
21,000-26,999	0.75	0.55	0.34					
27,000-32,999	1.05	0.84	0.63	0.42				
33,000-38,999	1.34	1.13	0.92	0.72	0.51			
39,000-44,999	1.63	1.42	1.22	1.01	0.80	0.59		
45,000-53,999	1.92	1.72	1.51	1.30	1.09	0.88	0.68	
54,000-64,999	2.51	2.30	2.09	1.88	1.68	1.47	1.26	0.85
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.47	0.27						
21,000-26,999	0.76	0.56	0.35					
27,000-32,999	1.05	0.85	0.65	0.44				
33,000-38,999	1.35	1.14	0.94	0.73	0.53			
39,000-44,999	1.64	1.43	1.23	1.03	0.82	0.62		
45,000-53,999	1.93	1.73	1.52	1.32	1.11	0.91	0.71	
54,000-64,999	2.52	2.31	2.11	1.90	1.70	1.50	1.29	0.88
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.48	0.28						
21,000-26,999	0.77	0.57	0.37					
27,000-32,999	1.06	0.86	0.66	0.46				
33,000-38,999	1.35	1.15	0.95	0.75	0.55			
39,000-44,999	1.65	1.45	1.25	1.04	0.84	0.64		

45,000-53,999	1.94	1.74	1.54	1.34	1.14	0.94	0.74	
54,000-64,999	2.52	2.32	2.12	1.92	1.72	1.52	1.32	0.92
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.19							
15,000-20,999	0.48	0.28						
21,000-26,999	0.77	0.57	0.38					
27,000-32,999	1.07	0.87	0.67	0.47				
33,000-38,999	1.36	1.16	0.96	0.76	0.57			
39,000-44,999	1.65	1.45	1.25	1.06	0.86	0.66		
45,000-53,999	1.94	1.74	1.55	1.35	1.15	0.95	0.75	
54,000-64,999	2.53	2.33	2.13	1.93	1.73	1.54	1.34	0.94

Table 504: Mini-split Winter Demand Savings for 6.8 HSPF Baseline—Zone 4

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.22							
15,000-20,999	0.57	0.32						
21,000-26,999	0.93	0.68	0.43					
27,000-32,999	1.28	1.03	0.79	0.54				
33,000-38,999	1.64	1.39	1.14	0.89	0.65			
39,000-44,999	1.99	1.74	1.50	1.25	1.00	0.75		
45,000-53,999	2.35	2.10	1.85	1.60	1.36	1.11	0.86	
54,000-64,999	3.06	2.81	2.56	2.31	2.07	1.82	1.57	1.08

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.26							
15,000-20,999	0.61	0.39						
21,000-26,999	0.97	0.74	0.51					
27,000-32,999	1.32	1.10	0.87	0.64				
33,000-38,999	1.68	1.45	1.22	1.00	0.77			
39,000-44,999	2.03	1.81	1.58	1.35	1.13	0.90		
45,000-53,999	2.39	2.16	1.93	1.71	1.48	1.25	1.03	
54,000-64,999	3.10	2.87	2.65	2.42	2.19	1.97	1.74	1.29
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.28							
15,000-20,999	0.63	0.42						
21,000-26,999	0.99	0.77	0.56					
27,000-32,999	1.34	1.13	0.91	0.70				
33,000-38,999	1.70	1.48	1.27	1.05	0.84			
39,000-44,999	2.05	1.84	1.62	1.41	1.19	0.98		
45,000-53,999	2.41	2.19	1.98	1.76	1.55	1.33	1.12	
54,000-64,999	3.12	2.90	2.69	2.47	2.26	2.04	1.83	1.39
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.64	0.43						
21,000-26,999	1.00	0.79	0.57					
27,000-32,999	1.35	1.14	0.93	0.72				
33,000-38,999	1.71	1.50	1.28	1.07	0.86			
39,000-44,999	2.06	1.85	1.64	1.43	1.22	1.00		
45,000-53,999	2.42	2.21	1.99	1.78	1.57	1.36	1.15	

54,000-64,999	3.13	2.92	2.71	2.49	2.28	2.07	1.86	1.44
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.29							
15,000-20,999	0.65	0.44						
21,000-26,999	1.01	0.80	0.59					
27,000-32,999	1.36	1.15	0.95	0.74				
33,000-38,999	1.72	1.51	1.30	1.09	0.88			
39,000-44,999	2.07	1.86	1.66	1.45	1.24	1.03		
45,000-53,999	2.43	2.22	2.01	1.80	1.60	1.39	1.18	
54,000-64,999	3.14	2.93	2.72	2.51	2.31	2.10	1.89	1.47
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.30							
15,000-20,999	0.66	0.45						
21,000-26,999	1.01	0.81	0.61					
27,000-32,999	1.37	1.16	0.96	0.76				
33,000-38,999	1.72	1.52	1.32	1.11	0.91			
39,000-44,999	2.08	1.87	1.67	1.47	1.26	1.06		
45,000-53,999	2.43	2.23	2.03	1.82	1.62	1.41	1.21	
54,000-64,999	3.14	2.94	2.74	2.53	2.33	2.12	1.92	1.51
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.31							
15,000-20,999	0.67	0.46						
21,000-26,999	1.02	0.82	0.62					
27,000-32,999	1.38	1.18	0.97	0.77				
33,000-38,999	1.73	1.53	1.33	1.13	0.93			
39,000-44,999	2.09	1.89	1.69	1.48	1.28	1.08		

45,000-53,999	2.44	2.24	2.04	1.84	1.64	1.44	1.24	
54,000-64,999	3.15	2.95	2.75	2.55	2.35	2.15	1.95	1.55
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.31							
15,000-20,999	0.67	0.47						
21,000-26,999	1.02	0.83	0.63					
27,000-32,999	1.38	1.18	0.98	0.79				
33,000-38,999	1.73	1.54	1.34	1.14	0.94			
39,000-44,999	2.09	1.89	1.69	1.50	1.30	1.10		
45,000-53,999	2.45	2.25	2.05	1.85	1.65	1.45	1.26	
54,000-64,999	3.16	2.96	2.76	2.56	2.36	2.16	1.97	1.57

Climate Zone 5: West Region El Paso Weather Data

Table 505: Mini-split Winter Demand Savings for 7.7 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.08							
15,000-20,999	0.33	0.12						
21,000-26,999	0.58	0.37	0.15					
27,000-32,999	0.83	0.62	0.40	0.19				
33,000-38,999	1.08	0.87	0.66	0.44	0.23			
39,000-44,999	1.33	1.12	0.91	0.69	0.48	0.27		
45,000-53,999	1.58	1.37	1.16	0.94	0.73	0.52	0.31	
54,000-64,999	2.09	1.87	1.66	1.45	1.23	1.02	0.81	0.38

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.11							
15,000-20,999	0.36	0.17						
21,000-26,999	0.61	0.42	0.23					
27,000-32,999	0.87	0.67	0.48	0.28				
33,000-38,999	1.12	0.92	0.73	0.53	0.34			
39,000-44,999	1.37	1.17	0.98	0.78	0.59	0.39		
45,000-53,999	1.62	1.42	1.23	1.04	0.84	0.65	0.45	
54,000-64,999	2.12	1.93	1.73	1.54	1.34	1.15	0.95	0.56

9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.13							
15,000-20,999	0.38	0.20						
21,000-26,999	0.63	0.45	0.26					
27,000-32,999	0.88	0.70	0.51	0.33				
33,000-38,999	1.14	0.95	0.77	0.58	0.39			
39,000-44,999	1.39	1.20	1.02	0.83	0.65	0.46		
45,000-53,999	1.64	1.45	1.27	1.08	0.90	0.71	0.53	
54,000-64,999	2.14	1.95	1.77	1.58	1.40	1.21	1.03	0.66

10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.14							
15,000-20,999	0.39	0.21						
21,000-26,999	0.64	0.46	0.28					
27,000-32,999	0.89	0.71	0.53	0.35				
33,000-38,999	1.14	0.96	0.78	0.60	0.42			
39,000-44,999	1.39	1.21	1.03	0.85	0.67	0.48		
45,000-53,999	1.64	1.46	1.28	1.10	0.92	0.74	0.55	

54,000-64,999	2.15	1.97	1.78	1.60	1.42	1.24	1.06	0.69

10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.40	0.22						
21,000-26,999	0.65	0.47	0.29					
27,000-32,999	0.90	0.72	0.54	0.36				
33,000-38,999	1.15	0.97	0.79	0.61	0.44			
39,000-44,999	1.40	1.22	1.04	0.87	0.69	0.51		
45,000-53,999	1.65	1.47	1.29	1.12	0.94	0.76	0.58	
54,000-64,999	2.15	1.98	1.80	1.62	1.44	1.26	1.08	0.73

11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.15							
15,000-20,999	0.40	0.23						
21,000-26,999	0.65	0.48	0.30					
27,000-32,999	0.90	0.73	0.55	0.38				
33,000-38,999	1.16	0.98	0.81	0.63	0.46			
39,000-44,999	1.41	1.23	1.06	0.88	0.71	0.53		
45,000-53,999	1.66	1.48	1.31	1.13	0.96	0.78	0.61	
54,000-64,999	2.16	1.99	1.81	1.63	1.46	1.28	1.11	0.76

11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.41	0.24						
21,000-26,999	0.66	0.49	0.32					
27,000-32,999	0.91	0.74	0.57	0.40				
33,000-38,999	1.16	0.99	0.82	0.65	0.47			
39,000-44,999	1.41	1.24	1.07	0.90	0.73	0.55		

45,000-53,999	1.66	1.49	1.32	1.15	0.98	0.80	0.63	
54,000-64,999	2.17	1.99	1.82	1.65	1.48	1.31	1.13	0.79

12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.16							
15,000-20,999	0.41	0.24						
21,000-26,999	0.66	0.49	0.32					
27,000-32,999	0.91	0.74	0.57	0.40				
33,000-38,999	1.17	1.00	0.83	0.66	0.49			
39,000-44,999	1.42	1.25	1.08	0.91	0.74	0.57		
45,000-53,999	1.67	1.50	1.33	1.16	0.99	0.82	0.65	
54,000-64,999	2.17	2.00	1.83	1.66	1.49	1.32	1.15	0.81

Table 506: Mini-split Winter Demand Savings for 6.8 HSPF Baseline—Zone 5

8.5-8.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.18							
15,000-20,999	0.49	0.28						
21,000-26,999	0.79	0.58	0.37					
27,000-32,999	1.10	0.89	0.67	0.46				
33,000-38,999	1.40	1.19	0.98	0.77	0.55			
39,000-44,999	1.71	1.50	1.28	1.07	0.86	0.65		
45,000-53,999	2.02	1.80	1.59	1.38	1.16	0.95	0.74	
54,000-64,999	2.63	2.41	2.20	1.99	1.77	1.56	1.35	0.92

9.0-9.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.22							
15,000-20,999	0.53	0.33						
21,000-26,999	0.83	0.64	0.44					
27,000-32,999	1.14	0.94	0.75	0.55				
33,000-38,999	1.44	1.25	1.05	0.86	0.66			
39,000-44,999	1.75	1.55	1.36	1.16	0.97	0.77		
45,000-53,999	2.05	1.86	1.66	1.47	1.27	1.08	0.88	
54,000-64,999	2.66	2.47	2.27	2.08	1.88	1.69	1.49	1.10
9.5-9.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.24							
15,000-20,999	0.54	0.36						
21,000-26,999	0.85	0.66	0.48					
27,000-32,999	1.15	0.97	0.78	0.60				
33,000-38,999	1.46	1.27	1.09	0.90	0.72			
39,000-44,999	1.76	1.58	1.39	1.21	1.02	0.84		
45,000-53,999	2.07	1.88	1.70	1.51	1.33	1.14	0.96	
54,000-64,999	2.68	2.49	2.31	2.12	1.94	1.75	1.57	1.20
10.0-10.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.55	0.37						
21,000-26,999	0.86	0.67	0.49					
27,000-32,999	1.16	0.98	0.80	0.62				
33,000-38,999	1.47	1.28	1.10	0.92	0.74			
39,000-44,999	1.77	1.59	1.41	1.23	1.04	0.86		
45,000-53,999	2.08	1.90	1.71	1.53	1.35	1.17	0.99	

54,000-64,999	2.69	2.51	2.32	2.14	1.96	1.78	1.60	1.23
10.5-10.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.25							
15,000-20,999	0.56	0.38						
21,000-26,999	0.86	0.69	0.51					
27,000-32,999	1.17	0.99	0.81	0.63				
33,000-38,999	1.47	1.30	1.12	0.94	0.76			
39,000-44,999	1.78	1.60	1.42	1.24	1.06	0.89		
45,000-53,999	2.08	1.91	1.73	1.55	1.37	1.19	1.01	
54,000-64,999	2.69	2.52	2.34	2.16	1.98	1.80	1.62	1.27
11.0-11.4 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.26							
15,000-20,999	0.56	0.39						
21,000-26,999	0.87	0.69	0.52					
27,000-32,999	1.18	1.00	0.82	0.65				
33,000-38,999	1.48	1.30	1.13	0.95	0.78			
39,000-44,999	1.79	1.61	1.43	1.26	1.08	0.91		
45,000-53,999	2.09	1.92	1.74	1.56	1.39	1.21	1.04	
54,000-64,999	2.70	2.53	2.35	2.17	2.00	1.82	1.65	1.30
11.5-11.9 HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.27							
15,000-20,999	0.57	0.40						
21,000-26,999	0.88	0.70	0.53					
27,000-32,999	1.18	1.01	0.84	0.67				
33,000-38,999	1.49	1.31	1.14	0.97	0.80			
39,000-44,999	1.79	1.62	1.45	1.28	1.10	0.93		

45,000-53,999	2.10	1.92	1.75	1.58	1.41	1.24	1.06	
54,000-64,999	2.71	2.53	2.36	2.19	2.02	1.85	1.67	1.33
12.0+ HSPF								
Size (Btuh) Post	**< 15,000**	**15,000-20,999**	**21,000-26,999**	**27,000-32,999**	**33,000-38,999**	**39,000-44,999**	**45,000-53,999**	**54,000-64,999**
Size (Btuh) Pre								
< 15,000	0.27							
15,000-20,999	0.57	0.40						
21,000-26,999	0.88	0.71	0.54					
27,000-32,999	1.18	1.01	0.84	0.67				
33,000-38,999	1.49	1.32	1.15	0.98	0.81			
39,000-44,999	1.80	1.62	1.45	1.28	1.11	0.94		
45,000-53,999	2.10	1.93	1.76	1.59	1.42	1.25	1.08	
54,000-64,999	2.71	2.54	2.37	2.20	2.03	1.86	1.69	1.35

Early Retirement—Replacement of an Electric Resistance Furnace

Table 492 through Table 496 present the winter demand savings (kW) per heating load type associated with a mini-split heat pump replacing an electric resistance furnace for all five climate zones.