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**HVAC**  
**FURNACE, COMMERCIAL**  
SWHC011-01

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## MEASURE NAME

High Efficiency Gas Furnace, Commercial

## STATEWIDE MEASURE ID

SWHC001-01

## TECHNOLOGY SUMMARY

A natural gas burning, forced-air furnace provides heat to the conditioned space by passing indoor air through a heat exchanger. A blower fan pulls cool air from inside the dwelling through the return air ducts and forces it through the furnace heat exchanger heating it by up to 50 °F. The combustion gases from the furnace are vented outside through flue connected to the combustion unit near the heat exchanger. A furnace with an Annual Fuel Utilization Efficiency (AFUE) rating of 90% or higher uses two heat exchangers that lower the temperature of the combustion gases to a point at which the moisture condenses and drains. These condensing furnaces use plastic flue piping making them easy to identify.

Most existing small-scale residential and small commercial furnace blowers are relatively low cost, low efficiency, single-speed permanent split capacitor (PSC) motors. These motors typically range in power between ⅓ hp to 2 hp and turn ON and OFF as required by thermostat control. This results in temperature variations, and high energy consumption of the furnace air handler blower motor.

Most major furnace manufacturers offer optional variable-speed motor (VSM) on furnace air handlers, some of which are built into the furnace unit. VSMs have integrated electronic controls that modulate the motor and fan speed based on the cooling or heating load of the system. Most VSMs are programmed to operate at lower speed most of the time. VSMs provide more efficient operation and improve the quality of the air distribution.

This measure is designed to encourage the installation of VSM air handlers in central natural gas furnaces. Because of the (ideally) cubic relationship between fan power and fan speed, a small reduction in fan speed can result in large energy savings.

## MEASURE CASE DESCRIPTION

The measure case is defined as a high-efficiency central natural gas furnace, with a built-in variable speed motor (VSM). Specific measure offerings, which are available by building type and for all California climate zones, are specified below.

### Measure Specification

Statewide Measure Offering ID	Measure Offering Description
SWHC011A	High Efficiency Furnace, Commercial, 95% AFUE, With VSM

## BASE CASE DESCRIPTION

The base case is defined as a nonresidential gas furnace that meets the 2015 federal standard requirements of 81% AFUE for weatherized furnaces. (See Code Requirements.)

## CODE REQUIREMENTS

This measure is governed by 1605.1 on Table E-6 of the California Appliance Efficiency Regulations (Title 20), which stipulates the minimum standard 81% AFUE for gas furnaces with less than 225,000 Btu/hr. This measure is also governed by the California Building Energy Efficiency Regulations (Title 24). Section 110.2 of Title 24 provides the minimum standard for warm-air, gas-fired furnaces as 81% AFUE.

Federal regulations (10 CFR Part 430)<sup>1</sup> apply to weatherized furnaces and central air conditioners and heat pumps. Because most commercial type furnaces with less than 225,000 Btu/hr input capacity are installed outside of the commercial building, they are considered to be weatherized for which the minimum AFUE is 81%.

### Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20 (2019)	Section 1605.1, Table E-6	January 1, 2019
CA Building Energy Efficiency Standards – Title 24 (2019)	Section 110.2	January 1, 2019
Federal Standards	10 CFR Part 430	

## NORMALIZING UNIT

Heating capacity (Cap-kBTU/h)

## PROGRAM REQUIREMENTS

### *Measure Implementation Eligibility*

All combinations of measure application type, delivery type, and sector that are established for this measure are specified below. Measure application type is a categorization based on the circumstances and timing of the measure installation; each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements. Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

*Note that some of the implementation combinations below may not be allowed for some measure offerings by all program administrators.*

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<sup>1</sup> Code of Federal Regulations at 10 CFR 430, Subpart C – Furnaces and Boilers.

**Implementation Eligibility**

Measure Application Type	Delivery Type	Sector
Normal replacement	DnDeemed	Com
New construction	DnDeemed	Com
Normal replacement	DnDeemed	Ind
New construction	DnDeemed	Ind

Combustion condensate management must meet local codes and demonstrate adequate freeze protection in colder climate rooftop environments. Manufacturer installation instructions must be followed.

Because combustion condensate is acidic and must be neutralized by an approved dilution or neutralizing device before discharging into the plumbing system.

*Eligible Products*

- All eligible products must meet specification in the Measure Case Description
- All installations must replace the previously installed gas furnace.
- The replacement furnace must be a weatherized unit.
- Furnaces that meet or exceed the eligibility requirements are listed on the Furnace Rebate Table <https://www.ahridirectory.org/ahridirectory/pages/home.aspx>.
- Combustion condensate management must meet local codes and demonstrate adequate freeze protection in colder climate rooftop environments. Manufacturer installation instructions must be followed.
- Because combustion condensate is acidic and must be neutralized by an approved dilution or neutralizing device before discharging into the plumbing system.
- Only residential furnaces installed in a small commercial establishment qualify for the rebate.
- A brushless DC motor, also known as an electronically commutated motor (ECM), is also eligible.

*Eligible Building Types and Vintages*

This measure is applicable for the following nonresidential building types, of all vintages:

Eligible Building Types	
Assembly – (Asm)	Manufacturing – Light Industrial (MLI)
Commercial (Com)	Health/Medical - Nursing Home (Nrs)
Education – Community College (ECC)	Office Small (Ofs)
Education – Primary School (Epr)	Restaurant – Fast Food (RFF)
Education – Relocatable Classroom (ERC)	Restaurant – Sit-Down (RSD)
Education – Secondary School (ESe)	Retail – Single-story Large (RSL)
Grocery (Gro)	Retail – Single-story Small (RSS)
Health/Medical – Hospital (Hsp)	Storage – Conditioned (SCn)
Lodging – Hotel (Htl)	Warehouse – Refrigerated (WRf)
Manufacturing – Biotech (MBT)	

*Eligible Climate Zones*

This measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

None.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

HVAC

ELECTRIC SAVINGS (kWh)

Not applicable.

PEAK ELECTRIC DEMAND REDUCTION (kW)

Not applicable.

GAS SAVINGS (Therms)

The gas unit energy savings (UES) from the high efficiency central gas furnace were drawn directly from the Database of Energy Efficient Resources (DEER). The version used to calculate savings for these measures is DEER 2020 (v2.5.1). The results were reported in the Remote Ex-Ante Database Interface (READI) tool. Savings values vary by building type and climate zone.

The DEER 2020 provides UES values in Cap-kBTUh.

**Statewide Measure Offering IDs and DEER Energy Impact IDs**

Statewide Measure Offering ID	DEER Energy Impact ID	Measure Offering Description
SWHC011A	Furnace-Pkg-AFUE95-ECM-It65kBtuh	High Efficiency Furnace, Commercial, 95% AFUE, With VSM

LIFE CYCLE

Effective useful life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. Remaining useful life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would



have remained in service and operational had the program intervention not caused the replacement or alteration.

The EUL and RUL specified for the High Efficiency Gas Furnace are presented below. This EUL, documented in 2008, is set equal to the maximum value as per the *Energy Efficiency Policy Manual*. The RUL value is only applicable to the first baseline period for an add-on equipment or accelerated replacement measure with an applicable code baseline and is not applicable for this measure.

#### Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs)	20.0	California Public Utilities Commission (CPUC), Energy Division. 2003. <i>Energy Efficiency Policy Manual v 2.0</i> . Page. 16.
RUL (yrs)	n/a	

#### BASE CASE MATERIAL COST (\$/UNIT)

The base case material cost for this measure was derived as the average of data collected in 2018 from manufacturers of roof top units and the 2016 RSMeans Mechanical Cost Data (for both equipment and labor). Data covered four units of 95 kBtuh to 200 KBtuh furnace for the standard efficiency 81% AFUE.<sup>2</sup>

#### MEASURE CASE MATERIAL COST (\$/UNIT)

The measure case material cost for this measure was derived as the average of data collected in 2018 from manufacturers of roof top units and the 2016 RSMeans Mechanical Cost Data (for both equipment and labor). Data covered two units of 95 KBtuh and 110 KBtuh of 95% AFUE.<sup>3</sup>

#### BASE CASE LABOR COST (\$/UNIT)

See Base Case Material Cost.

#### MEASURE CASE LABOR COST (\$/UNIT)

See Measure Case Material Cost.

#### NET-TO-GROSS (NTG)

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. This NTG value is based upon the average of all NTG ratios for all evaluated 2006 – 2008 commercial sector programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. This sector average NTG (“default NTG”) is applicable to all energy

<sup>2</sup> Southern California Gas Company (SCG). 2019. “SWHC011-01 Costs.xlsx.”

<sup>3</sup> Southern California Gas Company (SCG). 2019. “SWHC011-01 Costs.xlsx.”

efficiency measures that have been offered through commercial sector programs for more than two years and for which impact evaluation results are not available.

#### Net-to-Gross Ratios

Parameter	Value	Source
NTG - Commercial	0.60	Itron, Inc. 2011. <i>DEER Database 2011 Update Documentation</i> . Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3.

#### GROSS SAVINGS INSTALLATION ADJUSTMENT (GSIA)

The gross savings installation adjustment (GSIA) rate represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. The GSIA rate for this measure is the current “default” rate specified for measures for which an alternative GSIA has not been estimated and approved.

#### Gross Savings Installation Adjustment Rates

Parameter	Value	Source
GSIA	1.0	California Public Utilities Commission (CPUC), Energy Division. 2013. <i>Energy Efficiency Policy Manual Version 5</i> . Page 31.

#### NON-ENERGY IMPACTS

Non-energy benefits for this measure have not been quantified.

#### DEER DIFFERENCES ANALYSIS

This section provides a summary of DEER-based inputs and methods, and the rationale for inputs and methods that are not DEER-based.

#### DEER Difference Summary

DEER Item	Comment / Used for Workpaper
DEER Operating Hours	Yes
DEER eQUEST Prototypes	Yes
DEER Version	DEER 2020 (v2.5.1)
Reason for Deviation from DEER	None
DEER Measure IDs Used	Furnace-Pkg-AFUE95-ECM-lt65kBtuh
NTG	Source: DEER. The NTG of 0.60 is associated with NTG ID: <i>Com-Def&gt;2yrs</i>
GSIA	Source: DEER. The GSIA of 1.0 is associated with GSIA ID: <i>Def-GSIA</i>
EUL/RUL	Source: DEER2013. The value of 20 years is associated with EUL ID: <i>HVAC-Frnc</i> .

## REVISION HISTORY

## Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision
01	09/30/2018	Jennifer Holmes Cal TF Staff	Draft of consolidated text for this statewide measure is based upon: WPSCGNRHC180524A, Revision 0 (DRAFT) – short form based upon PGECOHC146 v.4 Consensus reached among Cal TF members.
	06/11/2019	Raad Bashar, SCG  Jennifer Holmes, Cal TF Staff	Revisions for submittal of version 01.