

## Residential HVAC – Thermostats with Gas Heating

Version No. 2.0

### Measure Overview

**Description:** This measure includes installation of a programmable (Tier I), communicating (Tier II), or analytics capable (Tier III) thermostat in existing homes, or a communicating or analytics capable thermostat in new homes.

Each tier is defined by the following characteristics:

Tier I: Programmable

- Customer programmed set points schedule

Tier II: Communicating

- Customer access to set points and schedule from anywhere using a smart device (phone, tablet or computer)

Tier III: Analytics Capable

- Additional energy savings features, including coaching, HVAC diagnostics, geofencing, comparative information, etc.
- Demand response capabilities
- Customer engagement features including customer-specific data and recommendations

Caution is advised in using this measure as few large scale pilots have been completed to date and results have varied significantly.

**Actions:** Replace on Fail, Replace Working, New Construction

**Target Market Segments:** Residential

**Target End Uses:** HVAC

**Applicable to:** Residential customers in single-family homes, duplexes, townhomes, and multi-family homes (including 3- and 4- family homes).

### Algorithms:

Unit kWh Savings per Year = (CSF x Cooling kWh)

Unit Peak kW Savings = 0 unless Tier III device with demand response program. See Notes.

Unit Dth Savings per Year = (HSF x Heating Dth)

Unit Gallons Fuel Oil Savings per Year = 0

Unit Gallons Propane Savings per Year = 0

Measure Lifetime (years) = 10 (Ref. 1, 2)

Unit Participant Cost = See Table 2 or use actual device costs plus installation cost if available.

Where:

Heating Dth = Baseline heating energy for natural gas-heated residences in pilot area. Default = 69 Dth/yr (Ref. 9)

Cooling kWh = Baseline cooling energy for residences in pilot area. Default = 760 kWh/yr (Ref. 9)

HSF = Heating savings factor, assumed fraction of heating energy saved by thermostat, see Table 1.

CSF = Cooling savings factor, assumed fraction of cooling energy saved by thermostat, see Table 1.

**Required from Customer/Contractor:** Confirmation of heating type, existing or new home

*Example:*

150 Tier III thermostats are installed in natural gas-heated homes with air-conditioning as part of a pilot program. The pilot does not include demand response.

Unit kWh Savings per Year =  $0.089 \times 760 = 67.6$

Unit kW Savings = 0

Unit Dth Savings =  $0.089 \times 69 = 6.1$

**Deemed Input Tables:**

Table 1: Heating and cooling savings factors (Ref. 2, 3), incremental costs (Ref. 2, 8)

	Tier I	Tier II	Tier III
Heating (HSF)	3.6%/0% <sup>3</sup>	5.4%	8.9%
Cooling (CSF)	0.0%	5.4%	8.9%
Incremental Cost <sup>1,2</sup>	\$30	\$110	\$200

<sup>1</sup>Tier III devices often require a monthly fee for software updates and data management. These fees should be factored into cost-benefit analyses. A typical fee is \$3 per month (Ref. )

<sup>2</sup>Does not include installation costs.

<sup>3</sup>No savings may be claimed for Tier I thermostats in new homes with gas furnaces because they are required by MN Residential Energy Code.

### Methodology and Assumptions:

A Tier I (programmable) thermostat is assumed to replace a manual thermostat. Programmable thermostats are required by the 2015 Minnesota Residential Energy Code for new homes with gas furnaces.

As savings is dependent on household consumption, households with multiple thermostats shall not attain savings beyond that of the installation of one thermostat.

As a result, the savings factors may require adjustment as more pilot programs are completed.

### Notes:

Few large scale pilot programs have been completed as of the drafting of this measure and results vary significantly.

There is little information on demand response impacts from smart thermostat programs at this time. kW savings could be updated as more pilot programs are completed.

ENERGY STAR proposed a new specification for connected (Tier II) thermostats on June 17, 2015.

The specification will be based on demonstrated savings with aggregate data.

This measure could be modified to reference the new ENERGY STAR specification when finalized.

### References:

1. Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, GDS Associates, Inc. June 2007.
2. DTE Residential Thermostats, Market Assessment of Advanced Residential Programmable Thermostats, Navigant. December 2014.

Midpoint of device cost ranges used for Tier II, Tier III incremental costs.

3. Tier I savings factor of 3.6% is based on the following sources: Ref. 2, 2.0%; Ref. 4, 6.6%, Ref. 5, 3.9%; Ref 6., 3.6%. If ISR of 56% is assumed for non-direct installs (Ref. 7), Ref. 4 savings are 3.7%.
4. Validating the Impacts of Programmable Thermostats, Final Report, RWL Analytics. 2007
5. CenterPoint Energy 2013-2015 Triennial CIP Plan, Docket No. G008/CIP-12-564. CPE estimated a reduction of 2.8 Dth for programmable thermostats, equivalent to 3.9% of the average heating load in its territory based on a 1.4F/18 hour average setback.

The 1.4F average setback accounts for customers that do not program a schedule or manually override the schedule.

6. Xcel Energy 2013-2015 Triennial CIP Plan, Docket No. E,G002/CIP-12-447. Energy savings for the thermostat setback were calculated in RemRate modeling using a baseline model

home calibrated to typical home size and characteristics for the Minneapolis/St.Paul area. Natural gas savings = 74.4 - 71.8 = 2.6 Dth/yr, equivalent to about 3.6% savings.

7. Programmable Thermostats. Report to KeySpan Energy Delivery on Energy and Cost Effectiveness, GDS Associates, Marietta, GA. 2002
8. Market price vary significantly for this product, the basic functions required are available on units readily available in the market for the listed price. (Illinois Statewide Technical Reference Manual for Energy Efficiency Version 3.0, 2014)
9. Baseline heating and cooling energy are derived from monthly sales information included in the 2015 jurisdictional annual reports filed by CenterPoint Energy and Xcel Energy (docket no. E,G999/PR-15-4) for calendar year 2014.

The gas heating figure is based on weather-normalized sales. The cooling figure is based on non-weather normalized sales. The gas heating figure was converted to kWh for electric resistance heating assuming an average gas efficiency of 0.8 and electric efficiency of 100%.

The electric resistance heating figure was used to derive average heating kWh for air source and ground source heat pumps assuming efficiencies of 7.7 HSPF and 3.3 COP, respectively.

**Document Revision History:**

Version / Description	Author	Date
1.0 Measure Created	Franklin Energy	2/28/2014
1.1 Added duplex to multifamily category	JP	3/11/2014
1.2 Added IECC 2012 note	Franklin Energy	7/31/2014
1.3 In Methodology and Assumption, changed "solely" to "primarily" regarding gas heating for consistency with Description.	JP	7/31/2014
2.0 Expanded measure to three Tiers of Thermostats,	FES	11/12/2015