**Work Paper PGE3PHVC153**

**Programmable Thermostat - Nonres**

**Revision # 3**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**Programmable Thermostat - Nonres**

**Measure Codes: T314**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Solution and Measure Codes:** | T314 |
| **Measure Description:** | Replace non-programmable thermostat and set supply fan to Auto in unoccupied periods for split and packaged dx cooling units with and without economizers |
| **Base Case Description:** | Existing non-programmable thermostat installed on split and packaged dx cooling systems with or without an economizer. |
| **Units:** | Per Cap-Tons |
| **Energy Savings:** | Refer to Excel Calculation Attachment |
| **Gross Measure Cost ($/unit):** | Refer to Excel Calculation Attachment |
| **Measure Incremental Cost ($/unit):** | Refer to Excel Calculation Attachment |
| **Effective Useful Life:** | 5 years (RUL = 1/3 of EUL of a rooftop air conditioner or heat pump unit) |
| **Measure Application Type:** | Retro-Commissioning (RC) |
| **Net-to-Gross Ratio:** | 0.70, from May 16, 2013 ED disposition. |
| **Important Comments:** |  |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Revision # | Revision Date | Author (Affiliation) | Summary of Changes |
| Revision 0 | 06/25/2012 | Janice Peterson (PECI)  Tai Voong (PG&E) | * Original work paper |
| Revision 0 | 06/25/2012 | Tai Voong (PG&E) | * At-A-Glance Measure List: Changed Building Vintage from “AV” to “Any” and Unit Definition from “Ton” to “Cap-Tons”. |
| Revision 1 | 6/20/2013 | Christopher Li (PG&E) | * Revised savings, NTG, and ISR to comply with ED’s Disposition on the HVAC Quality Maintenance/AirCare Plus Workpapers dated on the March 2, 2013 and May 16, 2013 disposition. * Only the PG&E executive summary savings template was updated. Workpaper language will be updated later. * For updated Savings values, see file PGE3PHVC152 R1\_EconomizerControl(chl7v3).xlsx |
| Revision 2 | 10/30/2014 | Christopher Li (PG&E) | * With Product Manager’s request, measures will be offered under PG&E’s downstream delivery channel, update workpaper to reflect this change. |
| Revision | 7/27/2015 | Christopher Li (PG&E)  Jia Huang (PG&E) | * Remove downstream delivery channel from workpaper. * Updated material and labor cost with 2014 RS Means Electrical Cost Data |

# Section 1: General Measure & Baseline Data

## 1.1 Measure Description & Background

This measure is to replace an existing non-programmable thermostat which allows the supply fan to change from continuous operation during unoccupied periods to intermittent fan operation.

Table 1: Measures and Codes

|  |  |  |
| --- | --- | --- |
| SCE Solution Code | PG&E Measure Code | Measure Name |
|  | T314 | Programmable Thermostat |

* **Eligibility requirements**: Participants must ensure the facility is physically located within PG&E service territory and receives electricity services from PG&E, via which the customer pays into the PGC fund or the PPP surcharges. Additionally, this policy restricts AirCare Plus (ACP) and Commercial Quality Maintenance (C-QM) Programs participation to only those customers that have not received incentives (not including tax credits available under the Energy Policy Act of 2005), for the same measures or services from another utility, state, or local program for 3 years prior to and following participation in the ACP and C-QM Programs. Participation is conditional upon agreement by the customer to comply with this prohibition.
* **Implementation requirements**: This measure is applicable to non-residential customers with split and packaged dx cooling units with and without economizers. The measure is applicable in all PG&E climate zones, all building types and vintages. The intent of the incentive is to set the supply fan control to run in AUTO mode during unoccupied periods.

## 1.2 Technical Description

This measure replaces existing non-programmable thermostats on split and packaged dx cooling systems with and without economizers. The programmable thermostat allows the supply fan to change from continuous operation during unoccupied periods to intermittent fan operation. There are also electric and gas savings achieved from reducing the amount of outside air brought into the conditioned space during unoccupied hours. The replacement thermostat must be set during unoccupied hours to call for heating at < 55 degrees Fahrenheit and call for cooling at > 85 degrees Fahrenheit. Occupied comfort settings must be in the range of 72 to 75 degrees Fahrenheit for cooling and 65 to 68 degrees Fahrenheit for heating.

## 1.3 Application Types and Delivery Mechanisms

The Delivery Mechanism of these measures is Direct Install. For Direct Install, the program will provide incentive to the program implementer and the install contractor.

The Application Type of this workpaper coversRC (Retro-Commissioning).

This measure is applicable to the AirCare Plus (ACP) and Commercial Quality Maintenance (C-QM) programs only.

See Appendices A and B for definitions of application types and delivery mechanisms.

## 1.4 Measure and Base Case Cost Effectiveness Data

### 1.4.1 DEER Measure and Base Case Analysis

The Database for Energy Efficient Resources (DEER) does contain a measure that’s similar to this product, however, the impact savings does not contain any blower fan savings, and therefore eQUEST modeling was used to determine the overall savings. DEER values are used for Net-to-Gross, EUL, and ISR.

Table 2: DEER Difference Summary

|  |  |
| --- | --- |
| DEER Difference Summary Table | |
| Referenced versions of DEER and READI | None, DEER does not contain this measure |
| Summary of deviation from DEER | DEER does not contain this measure |
| DEER measures scaled? | No |
| DEER eQUEST prototypes used? | Yes |
| DEER operating hours used? | Yes |

**Net-to-Gross Ratio**

The NTG value was obtained from the “DEER2011\_NTGR\_2012-05-16.xls” on the DEER website as required by Version 5 of the California Public Utilities Commission (CPUC) Energy Efficiency Policy Manual [351]. The relevant NTGR for this measure is shown in Table 3 below.

Table 3: Net-to-Gross Ratio

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NTGR ID | Description | Sector | BldgType | ProgDelivID | NTG |
| All-Default<=2yrs | All other EEM with no evaluated NTGR; new technology in program for 2 or fewer years | All | Any | Any | 0.70 |

**Installation Rate**

The IR values were obtained using the DEER READI tool. The relevant IR values for the measures in this work paper are in the table below.

Table 4: Installation Rate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GSIA ID | Description | Sector | BldgType | ProgDelivID | GSIAValue |
| Def-GSIA | Default GSIA values | COM | COM | Any | 1 |

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Technology Fields**

The Technology Fields were obtained from the Ex Ante Database Specification. The relevant Use Category, Use Sub-category, Technology Group, and Technology Type values for the measures in this work paper are in the table below.

Table 5: Technology Fields

|  |  |
| --- | --- |
| Classification | Value |
| Measure Case UseCategory | HVAC |
| Measure Case UseSubCats | HeatCool |
| Measure Case TechGroups | HV\_Tech |
| Measure Case TechTypes | TStat |
| Base Case TechGroups | HV\_Tech |
| Base Case TechTypes | TStat |

**Effective and Remaining Useful Life**

The EUL and RUL values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

Table 6: EUL and RUL

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| EUL ID | Description | Sector | UseCategory | EUL (Years) | RUL (Years) |
| HVAC-ProgTstat | Setback Programmable Thermostats | Com | HVAC | 11 | 3.7 |
| **RUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| HVAC-airAC | Air Conditioners (air-cooled, split and unitary) | Com | HVAC | 15 | 5 |

### 1.4.2 Codes and Standards Analysis

Title 20: This measure does not fall under Title 20 of the California Energy Regulations

Title 24: New thermostats must meet the requirements of Section 112c:

**Thermostats:** All unitary heating and/or cooling systems including heat pumps that are not controlled by a central energy management control system (EMCS) shall have a setback thermostat.

**1. Setback Capabilities**: All thermostats shall have a clock mechanism that allows the building occupant to program the temperature set points for at least four periods within 24

The standard does not address supply fan scheduling.

Federal Standards: This measure does not fall under Federal DOE or EPA Energy Regulations.

### 1.4.3 Non-DEER Study Review

No Non-DEER studies were references in the work paper.

# Section 2: Calculation Methodology

The energy savings for both the economizer adjustment and replacement measures come from the May 16, 2013 Energy Division’s most latest workpaper disposition[A] for the non-residential HVAC Rooftop Quality Maintenance program. The tab “ED-Overall Tstat Savings” includes savings impacts for varying HVAC system types, whether an economizer is present, and whether the measure is replace or reprogram a thermostat. PG&E’s program is only concerned with thermostat replacement. Final savings values are weighted by HVAC type and whether the system has an economizer. The assumed weightings for systems in PG&E’s program are 90% DXGF/ 10% PKHP and 67% without economizer/ 33% with economizer. See accompanying savings spreadsheet, tab “Weighted Savings-TstatReplace”, for details on the savings.

Prior to the disposition, previous revision 0 uses the eQUEST simulation tool to simulate the energy savings for this measure. The energy savings for this measure come from allowing the supply fan to change from continuous operation during unoccupied periods to intermittent fan operation.

Weather

Weather files were updated from the CZ2 weather files based on TMY2 data to the CZ2010 weather files and other more recent data. The CZ2010 weather files were developed for the CPUC by Joe Huang of Whitebox Technologies.

Both the “demand reduction” and “gas energy” savings uses the same approach as the energy savings described above.

# Section 3: Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

Table 8: Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| Building Type | Load Shape | E3 Alt. Building Type |
| Asm | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| EPr | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| ESe | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| ECC | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| Nrs | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| MLI | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| OfL | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| OfS | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| RSD | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| RFF | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| Rt3 | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| RtL | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |
| RtS | PGE:COMMERCIAL:3 = Commercial HVAC | NON\_RES |

# Section 4: Base Case & Measure Costs

**Table 1. Measure Cost Summary**

|  |  |  |  |
| --- | --- | --- | --- |
| **Install/Program Type** | **Gross Measure Cost**  **(First Baseline Period)** | **Gross Measure Cost**  **(Second Baseline Period)** | **Incremental Measure Cost** |
| RC | Measure Equipment Cost + Measure Labor Cost | N/A | Measure Equipment Cost + Measure Labor Cost |

\*Note: For a more thorough discussion on the install/program type, see the install type document.

## 4.1 Base Case Cost

There are no base case costs since the base case is the customer’s existing equipment.

## 4.2 Measure Case Cost

2014 RS Means Electrical Cost Data has material and labor cost for programmable thermostats. See spreadsheet tab “Cost – RS Means” for details.

Table 9: RS Means Electrical Cost Data

|  |  |  |  |
| --- | --- | --- | --- |
| Cost Case Description | Section | Material Cost\*  (per cap-tons) | Labor Cost\*  (per cap-tons) |
| Thermostats – 24 hour, automatic clock | 23 09 53.10 | $31.60 | $10.90 |

\*Note: RS Means provides a full unit costs and not a per cap-ton costs as used in the programs. To determine the per cap-ton cost basis, both the RS Means material cost and labor cost was divided by 5 tons (assuming 5 tons is the average tonnage system seen in commercial buildings).

## 4.3 Gross and Incremental Measure Cost

### 4.3.1 Gross Measure Cost (GMC)

Per the E3, the gross measure cost is the cost to install an energy efficient measure. In the case of RC, GMC means the full cost of the measure to purchase and install.

For RC, GMC is represented by the equation below:

GMC = Measure Equipment Cost + Measure Labor Cost

### \*Note: Various complicated price fluctuations are not addressed in these equations, such as future costs due to inflation in labor, future costs due to deflation in material cost, and other variables that cannot be accurately described at this time.

### 4.3.2 Incremental Measure Cost (IMC)

Incremental Measure Cost is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure. While IMC has a straight forward definition, depending on the install type the equation does vary. The incremental cost is only used to help determine program incentives. It is not affected by the first and second baseline periods and may differ from the cost used for cost effectiveness calculations.

For RC there exists no base case to compare the measure to, as this measure is considered as a retro-commissioning product. Because of this, for **RC**, IMC is represented by the equation below:

IMC = Measure Equipment Cost + Measure Labor Cost

# Attachments

[A] - Commercial HVAC QM Energy Division Workpaper Disposition, May 16, 2013.



# References



A. Whitebox Technologies, Moraga,CA .http://www.whiteboxtechnologies.com/weather\_data.html

B. California Utilities Statewide Codes and Standards Team, 2013 California Building Energy Efficiency Standards: Light Commercial Unitary HVAC, draft March 2011

C. Davis, R., Francisco, P., Kennedy, M., Baylon, R., Manclark, B., Enhanced Operations and Maintenance Procedures for Small Packaged Rooftop HVAC Systems, pp. 332-33,April 2002.

D. Price, S., and Rosenow, L., BPA RTU Puget Sound Pilot, 11/25/2009

E. Executive Summary spreadsheet

(See accompanying file) PGE3PHVC152 R2-April-Spec.xlsx

F. Workpaper Disposition for Non-Residential HVAC Rooftop Quality Maintenance, May 16, 2013.

(See reference folder) PGE-CommercialHVAC-QM\_EDDisposition\_16May2013.docx

# Appendix A: Application Types

This table shows the application types in PG&E systems with those in DEER.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Application (Program) Type | DEER Application Type | Savings | | Cost | | Life | |
| **1st Baseline (BL)** | **2nd BL** | **1st BL** | **2nd BL** | **1st BL** | **2nd BL** |
| Retro-Commissioning (RC) | N/A | Above Customer Existing | N/A | Full Cost | N/A | EUL | 0 |

# Appendix B: Delivery Mechanisms

A delivery mechanism is a delivery method paired with an incentive method. PG&E’s delivery methods include:

* Commissioning
* Midstream Programs

The following table describes the incentive methods.

|  |  |
| --- | --- |
| Incentive Method | Description |
| Direct Install | The utility program performs an assessment of the customer’s facility, provides recommendations, and implements energy efficiency measures for free. |