**Work Paper WPSDGENRHC1051**

**Revision 1**

**San Diego Gas & Electric**

**Energy Efficiency Engineering**

**Guest Room PTAC/PTHP Adaptive Climate Controller**

At-a-Glance Summary

|  |  |  |
| --- | --- | --- |
|  | Measure 1 | Measure 2 |
| **Measure description** | Guest Rm PTAC Adaptive Climate Controller | Guest Rm PTHP Adaptive Climate Controller |
| **Program delivery method** | Direct Installation, Downstream | Direct Installation, Downstream |
| **Measure application type** | REA (Retrofit/Add-on) | REA (Retrofit/Add-on) |
| **Base case description** | Source: DEER  PTAC 7.71 EER to 9.41 EER | Source: DEER  PTHP 7.61 EER to 9.31EER |
| **Energy and demand impact common units** | Tons Cooling Capacity | Tons Cooling Capacity |
| **Peak Demand Reduction**  **(kW/unit)** | 0.228 kW/ton average. See “Updated PTAC-PTHP ACC Measure Table.xlsx” for climate zone and base equipment variations. | 0.111 kW/ton average. See “Updated PTAC-PTHP ACC Measure Table.xlsx” for climate zone and base equipment variations. |
| **Energy savings**  **(Base case – Measure)**  **(kWh/unit)** | 624.53 kWh/ton average. See “Updated PTAC-PTHP ACC Measure Table.xlsx” for climate zone and base equipment variations. | 419.78 kWh/ton average. See Updated PTAC-PTHP ACC Measure Table.xlsx for climate zone and base equipment variations. |
| **Gas savings**  **(Base case – Measure)**  **(therms/unit)** | 0 | 0 |
| **Full measure cost**[[1]](#footnote-1)  **($/unit)** | $348.35  Source: Manufacturer estimate, DEER Labor Rates | $348.35  Source: Manufacturer estimate, DEER Labor Rates |
| **Incremental measure cost[[2]](#footnote-2)**  **($/unit)** | $348.35  Source: Manufacturer retail price and DEER Labor Rate | $348.35  Source: Manufacturer retail price and DEER Labor Rate |
| **Effective useful life**  **(years)** | 15 years  Source: DEER Ex Ante Database Support Table Export (EUL), READI. EUL ID: HVAC-PTACCtrl, ExAnte 2010 | 15 years  Source: DEER Ex Ante Database Support Table Export (EUL), READI. EUL ID: HVAC-PTACCtrl, ExAnte 2010 |
| **Net-to-gross ratio(s)** | 0.6  Source: DEER NTG Support Table (READI v.2.4.5) | 0.6  Source: DEER NTG Support Table (READI v.2.4.5) |
| **Important comments** |  |  |

Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Revision # | Revision Date | Section-by-Section Description of Revisions | Author (Name, PA) |
| 0 | 1/19/2010 | Original work paper (short form) | Liz DeSouza/CSG |
| 2010-2012 | 9/28/2012 | Adopted from WorkPaper WPSDNRHC\_PTACACCfinal.doc, updated January 19, 2010. | Charles Harmstead/SDGE |
| 2016 | 7/20/2016 | Updated savings for 2013 Weather data, measure costs, EUL and NTG data values. | Liz DeSouza/Clear Result |
| 1 | 9/6/2016 | Format corrections, EUL corrections, and NTG corrections. Eliminated hard-to-reach. Deleted unnecessary data and embedded files. | Peter Ford/SDG&E |

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General Measure & Baseline Data

* 1. Product Measures

**General Description**

The Adaptive Climate Controller (ACC) is a variable fan speed control installed in hotel or motel guest rooms with existing PTAC or PTHP units.

Table 1. Measure Names

|  |  |
| --- | --- |
| Product Code | Measure Name |
| NA | Adaptive Climate Controller (ACC) for Hotel/Motel Package Terminal Air-Conditioning Unit |
| NA | Adaptive Climate Controller (ACC) for Hotel/Motel Package Terminal Heat-Pump Unit |

**Technical Description**

Each installation includes an Optically Programmable (OP) controller combination which continually monitors, controls, powers and regulates the speed of fractional horsepower AC motors. This technology is applicable to most single phase AC induction motors up to 240 VAC and 10 amps, and can be used to upgrade unit ventilators, fan coils, PTACs and exhaust fans. Developed in conjunction with the Department of Energy’s EERE Industrial Technologies Program, this technology can reduce fan electrical energy use by over 30%.

* 1. Program Implementation Overview

**Implementation Methods**

Delivery will be a combination of Direct Install, On Bill Financing, and Customer Prescriptive Rebates.

**Program Restrictions and Guidelines**

Installation will be limited to hotels or motels built before 2016 (not new construction).

**Measure Application Type**

REA, Retrofit/Add-on, is the measure application type. The unit is associated with the PTAC and since there are no differences between the 2005 Title 24 PTAC/PTHP codeefficiency and the replacement 2013 Title 24 PTAC/PTHP code efficiency, then the full EUL of the measure applies.

* 1. Product Parameter Data
     1. DEER Data

DEER D03-073 (Run ID CHTl077PrTSt) provides savings and cost data for “installing programmable thermostats in older buildings,” accounting for Energy Impacts of 454.522 kWh/1000 square feet, therm savings based on a gas/electric HVAC system, and negative kW savings. DEER D03-072 (Run ID CHtl0775HCEMS) provides data for “Suite of EMS measures” with respect to installations at hotels where a central plant system is used. This measure differs from the first two measures in that the savings unit is per ton of cooling, the building type is limited to Hotel and Motel Guest Rooms, and the heating/cooling system is packaged terminal air conditioning or heat pumps (PTAC/PTHP). PTAC and PTHP units are all-electric, with no gas component for heating. The Controller in this work paper continually monitors power and fan motor speed in order to achieve savings when the unit is running. Run-time reductions are expected year-round, with the potential for summer peak demand reductions.

Table 2. DEER Difference Summary

|  |  |
| --- | --- |
| DEER | Used in Workpaper Approach? |
| Modified DEER methodology | No |
| Scaled DEER measure | Yes |
| DEER base case used | Yes |
| DEER measure case used | No |
| DEER building types used | Yes (Htl/Mtl/Gst) |
| DEER operating hours used | Yes |
| Reason for Deviation from DEER | DEER does not contain this type of measure. |
| DEER Version | DEER2014 |
| DEER ID and Measure Name | N/A |

**Net-to-Gross**

The default Net-to-Gross “Com-Default>2yrs” applies to this measure. This includes “All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years”. The PTAC-ACC technology does not have an evaluated NTGR.

**Table 3.** DEER Net-to-Gross Ratios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| From DEER Tables | | | | | |
| NTGR\_ID | Description | Sector | Building Type | NTG | Program Delivery |
| Com-Default>2yrs | All other EEM with no evaluated NTGR; new technology in program for 2 or fewer years | Com | Customer Prescriptive Rebates | 0.6 | Direct Install |

**Effective Useful Life / Remaining Useful Life**

Value: 15 years, based on DEER value for Package Terminal AC. HVAC-PTACCtrl Package Terminal AC – Controller. IOU Workpaper HV\_Tech

**Table 4.** DEER EUL Values/Methodology

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| READi EUL ID | Market | End Use | Measure | EUL (Years) | RUL (Years) |
| HVAC-PTACCtrl | Non-Residential | HVAC | Package Terminal AC - Controller | 15 | 5 |

**In-Service Rate / First Year Installation Rate:**

1.0 based on Direct Installation.

**Table 5.** Installation Rate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| From DEER Tables | | | | | |
| GSIA\_ID | Description | Sector | Building Type | GSIA Value | Program Delivery |
| Def-GSIA | Default GSIA values | Com | Htl | 1.0 | (Direct Install) |

**READi Technology Fields**

Table 6. READi Tech IDs

|  |  |  |
| --- | --- | --- |
| READi Field Name | Values included in this workpaper | |
| **PTAC** | **PTHP** |
| Measue Case UseCategory | HVAC | HVAC |
| Measure Case UseSubCats | SpaceCool | SpaceCool |
| Measure Case TechGroups | HV\_Tech | HV\_Tech |
| Measure Case TechTypes | TStat | TStat |
| Base Case TechGroups | dxAC\_equip | dxHP\_equip |
| Base Case TechTypes | spltEER | spltEER |

* + 1. Codes & Standards Requirements Base Case and Measure Information

**Title 24:**

The code effects on EMS Controller savings is insignificant because direct installations and customer incentives will be targeted specifically at existing building stock and existing or replacement PTAC/PTHP units installed prior to 2016.

According to 2013 Building Energy Efficiency Standards (Title 24), setpoint setup/setback requirements for guest rooms are described in Section 120.2.(e).4, p 116, as follows:

*Hotel and motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, setpoints are setup at least +5°F (+3°C) in cooling mode and set-down at least -5°F (-3°C) in heating mode.*

The PTAC-ACC Controller is not an occupancy sensing control and is not required by Title 24 code.

**Federal Standards:** None identified

* + 1. Relevant EM&V Studies

None identified

* + 1. Relevant Workpaper Dispositions

None identified

* + 1. Other Sources for non-DEER Methods

Manufacturer calculations and laboratory testing data place ex-ante efficiency improvements at over 30%. See attachment ETL\_Summary\_Tests\_7819.pdf. This summary identifies savings under laboratory conditions as performed by the manufacturer.

1. Calculation Methods
   1. Program Implementation Analysis

The measures are considered REA measures that are dependent on the RUL of the host equipment. Evaluation of the 2013 Title 24 code indicates that for replacement PTACs and PTHPs there is no difference in the code between 2005 and 2013. As a result, there is no difference in the host equipment efficiency upon replacement so the measure is considered valid for the entire EUL of the controller.

Table 7. Baseline by Measure Application Type

|  |  |  |  |
| --- | --- | --- | --- |
| Measure Application Type | Baseline | Baseline Technology | Duration |
| **REA** | First | Existing Technology | EUL |
| Second | N/A | N/A |

* 1. Electric Energy Savings Estimation Methodologies

Table 8 summarizes Weather File Update adjustment factors

Revision 2010-2012 methodology:

Deemed Savings based on DEER 2008 Commercial Results Review-NonUpdated Measures.xls for PTHP2 and PTAC2 equipment, Primary End-Use kWh/unit and manufacturer data.

Energy savings (kWh/tons served) = .30 efficiency improvement x Customer Base

(Deemed Customer Base from DEER 2008 Commercial Results Review-NonUpdated Measures.xls)

Assumptions:

Manufacturer calculations and laboratory testing data place ex-ante efficiency improvements at over 30%. See attachment ETL\_Summary\_Tests\_7819.pdf. This summary identifies savings under laboratory conditions as performed by the manufacturer.

Please see attached worksheet for DEER 2008 Baseline information (from NonUpdated Measures file) and associated calculations.

Revision 2016 Savings Update Methodology:

The savings have been updated to account for 2013 weather file updates and weighted building vintages and IOU-area climate zones to align with DEER 2014 (READI v.2.4.3).

To account for the weather data update, similar DEER 2011 and 2014 measure above-code savings were compared to obtain a percent scaling factor. For PTAC weather scaling, the energy impact IDs for small commercial packaged DX units, NE-HVAC-airAC-Pkg-lt65kBtuh-14p0seer (DEER 2011) and NE-HVAC-airAC-Pkg-lt55kBtuh-14p0seer (DEER 2014) were used. Deemed savings are based on Climate Zone = IOU (weighted average), Vintage = Existing, and Building Type = Htl. Table 8 summarizes these results. These scaling factors were then applied to the Revision 2010-2012 savings values as shown in the ‘Updated Template’ worksheet of workbook Updated PTAC-ACC Measure Table.xlsx. For calculations see ‘Calculations’ worksheet. The ‘Conversion’ worksheet includes READI screenshots of the DEER runs used for this scaling.

Table 8. Weather File Update kW and kWh Adjustment Factors

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit type | EnergyImpactID | DEER | kWh | Weather  | kW | Weather  |
| Air AC | NE-HVAC-airAC-Pkg-lt65kBtuh-14p0seer | 2011 | 436 | 97.5% | 0.0584 | 92.5% |
| NE-HVAC-airAC-Pkg-lt55kBtuh-14p0seer | 2014 | 425 | 0.054 |
| Air HP | NE-HVAC-airHP-Pkg-lt65kBtuh-14p0seer-8p6hspf | 2011 | 329 | 62.0% | 0.102 | 42.5% |
| NE-HVAC-airHP-Pkg-lt55kBtuh-14p0seer-8p0hspf | 2014 | 204 | 0.0434 |

Revision 1 Savings Update Methodology:

No change in fundamental savings methodology, but changes in applicable NTG and READI IDs have been included.

* 1. Demand Reduction Estimation Methodologies

Revision 2010-2012 methodology:

Demand Reduction based on PCimpact/ECImpact x Energy Savings (from above).

Average kW reduction (all vintages, based on climate zone 7) = .24816

Revision 2016 Savings Update Methodology

The savings have been updated to account for 2013 weather file updates.

To account for the weather data update, similar DEER 2011 and 2014 measure above-code savings were compared to obtain a percent scaling factor. For PTAC weather scaling, the energy impact IDs NE-HVAC-airAC-Pkg-lt65kBtuh-14p0seer (DEER 2011) and NE-HVAC-airAC-Pkg-lt55kBtuh-14p0seer (DEER 2014) were used (Building Type: HTL, Climate Zone IOU, Building Vintage: Existing). Table 8 (above) summarizes these results. These scaling factors were then applied to the Revision 2010-2012 savings values as shown in in the ‘Calculations’ worksheet of workbook Updated PTAC-ACC Measure Table.xlsx.

* 1. Gas Energy Savings Estimation Methodologies

No gas savings are associated with this measure.

1. Load Shapes

Table 9. Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| Building Type | E3 Alternate Building Type | Load Shape |
| Lodging – Hotel (Guest Rooms) | NON\_RES | SDG:NON\_res:DEER:HVAC\_Split-Package\_AC |

1. Base Case, Measure, and Installation Costs

For Direct Install measures, the cost is obtained through manufacturer retail price and READI Labor Rate. Ex Ante Database Support Table (READI) Labor Rate NR-HVAC-PT (HVAC-Programmable Thermostats).

**Table 10**. Measure cost summary by application type

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Measure Application Type | Base Case  Equipment Cost  ($/unit) | Measure  Equipment Cost  ($/unit) | Installation Cost  ($/Unit) | Incremental Measure Cost  ($/unit) | Full Measure Cost  (1st Baseline period)[[3]](#footnote-3)  ($/unit) | Full Base Cost  (2nd baseline period)[[4]](#footnote-4)  ($/unit) |
| REA | $0.00 | $300.00 | $48.35 | N/A\* | $348.35 |  |

\* IMC may be useful for determining program incentive.

Base case cost is zero since the base case unit does not include this measure, nor do current codes require it. It is a retrofit-add-on measure.

* 1. Measure Case Costs

DEER Measure costs are available for VSD Supply Fan and Programmable Thermostats, but neither measure adequately captures the cost of the PTAC-ACC unit. Further research in the 2010-2012 ITRON study did not yield a comparable measure. Costs provided are manufacturer’s retail costs plus labor costs taken from DEER Support Tables (READI v. 2.4.3 (Current Ex Ante data). Labor Rate: NR-HVAC-PT, Sector: Com, Base Labor Rate: $48.35, Application: HVAC - Programmable Thermostats, Downstream Prescriptive Rebates/Incentives.

* 1. Installation/Labor Costs

Labor Installation costs are similar to thermostat installation. These are from DEER Support Tables (READI v. 2.4.3 (Current Ex Ante data). Labor Rate: NR-HVAC-PT,Sector: Com, Base Labor Rate: $48.35, Application: HVAC - Programmable Thermostats, Downstream Prescriptive Rebates/Incentives.

* 1. Incremental & Full Measure Costs

Incremental and Full Measure Costs are equivalent as this is a Retrofit Add-On measure, REA in Table 10 above.

**Table 11.** Incremental and full measure cost calculations

|  |  |  |  |
| --- | --- | --- | --- |
| Measure Application Type | Incremental Measure Cost  ($/unit) | Full Measure Cost  (1st Baseline period)  ($/unit) | Full Base Cost  (2nd baseline period)  ($/unit) |
| REA | N/A | **Full Measure Cost =**  Measure Equipment Cost + Labor Cost | N/A |

Table 12. Incremental and full measure cost values

|  |  |  |  |
| --- | --- | --- | --- |
| Measure Application Type | Incremental Measure Cost  ($/unit) | Full Measure Cost  ($/unit) | Full Base Cost  (2nd Baseline)  ($/unit) |
| REA | N/A | $348.35 | N/A |

# Appendix 1 - Supplemental Files











# Appendix 2 - Measure Application Type Definitions

The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2011 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls*, defines the measure application type terms as follows:

Measure Application Type

|  |  |  |
| --- | --- | --- |
| Code | Description | Comment |
| REA | Retrofit Add-on | Retrofit to existing equipment without replacement |

Baseline Technologies for UES and Cost calculations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Measure Application Type | Baseline | Baseline Technology | Measure Cost Calculation | Duration |
| REA | First | Existing technology | Measure equipment cost + labor cost | EUL |
| Second | N/A | N/A | N/A |

1. Full measure cost = measure equipment cost + measure labor cost [↑](#footnote-ref-1)
2. Incremental measure cost = Measure equipment cost – Baseline equipment cost [↑](#footnote-ref-2)
3. Full measure cost = measure equipment cost + installation cost, for first baseline period [↑](#footnote-ref-3)
4. Full base cost = 2nd baseline equipment cost + installation cost, for the second baseline period [↑](#footnote-ref-4)