Work Paper WPSDGENRHC1051
Product Category
Revision 2016

San Diego Gas & Electric
Energy Efficiency Engineering

Guest Room PTAC/PTHP Adaptive Climate Controller

Product sub-categories if applicable

06/29/2016

At-a-Glance Summary

	Measure 1
Measure description	Guest Rm PTAC/PTHP Adaptive Climate Controller
Program delivery method	Direct Installation, Downstream
Measure application type	REA (Retrofit/Add-on)
Base case description	Source: DEER PTAC/PTHP 6.8 EER to 10.16 EER
Energy and demand impact common units	Tons Cooling Capacity
Peak Demand Reduction (kW/unit)	0.169 kW/ton average. See Updated PTAC-ACC Measure Table.xlsx for climate zone and base equipment variations.
Energy savings (Base case – Measure) (kWh/unit)	522.15 kWh/ton average. See Updated PTAC-ACC Measure Table.xlsx for climate zone and base equipment variations.
Gas savings (Base case – Measure) (therms/unit)	0
Full measure cost[1] ($/unit)	$348.35 Source: Manufacturer estimate, DEER Labor Rates

[1] Full measure cost = measure equipment cost + measure labor cost

Incremental measure cost[2] ($/unit)	$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
Net-to-gross ratio(s)	0.7 Source: DEER NTG Support Table (READI v.2.4.3)
Important comments	

[2] Incremental measure cost = Measure equipment cost – Baseline equipment cost

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	6/28/2016	Updated savings for 2013 Weather data, measure costs and EUL.	

Commission Staff Review and Comment History

Revision #	Date Submitted to Commission Staff	Date Comments Received	Commission Staff Comments

Table of Contents

General Measure & Baseline Data

1.1 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.

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 electrical energy use by over 30%.

1.2 Program Implementation Overview

Implementation Methods

Delivery will be a combination of Direct Install, On Bill Financing, and Customer Prescriptive Rebates aimed at hard-to-reach market segments.

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.

1.3 Product Parameter Data

1.3.1 DEER Data

DEER D03-073 (Run ID CHTl077PrTSt) provides savings and cost data for "installing programmable thermostats in older buildings," accounting for EImpacts 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 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 1. 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
DEER operating hours used	Yes
Reason for Deviation from DEER	DEER does not contain this type of measure.
DEER Version	DEER14
DEER ID and Measure Name	N/A

Net-to-Gross

Error! Reference source not found.The default Net-to-Gross "All-Default<=2yrs" applies to this measure. This includes "other EEM with no evaluated NTGR; new technology in program for 2 or fewer years." The PTAC-ACC technology does not have an evaluated NTGR. This measure is a newer technology, with very low (< 1%) measure market share.

Table 2. DEER Net-to-Gross Ratios

From DEER Tables					
NTGR_ID	Description	Sector	Building Type	NTG	Program Delivery
All-Default<=2yrs	All other EEM with no evaluated NTGR; new technology in program for 2 or fewer years	Com	Any	0.7	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 3. 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 4. Installation Rate

From DEER Tables					
GSIA_ID	Description	Sector	Building Type	GSIA Value	Program Delivery
Def-GSIA	Default GSIA values	Any	Any	1.0	Any (Direct Install)

READi Technology Fields

Table 5. READi Tech IDs

READi Field Name	Values included in this workpaper	
	PTAC	**PTHP**
Measue Case UseCategory	HVAC	HVAC
Measure Case UseSubCats	SpaceCool	HeatCool
Measure Case TechGroups	dxAC_equip	dxHP_equip
Measure Case TechTypes	pkgTerm	pkgTerm
Base Case TechGroups	dxAC_equip	dxHP_equip
Base Case TechTypes	pkgTerm	pkgTerm

1.3.2 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

1.3.3 Relevant EM&V Studies

None identified

1.3.4 Relevant Workpaper Dispositions

None identified

1.3.5 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.

Section 2. Calculation Methods

2.1 Program Implementation Analysis

Table 6. Baseline by Measure Application Type

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

2.2 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 7 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 7. Weather File Update kW and kWh Adjustment Factors

Unit type	EnergyImpactID	DEER	kWh	Weather Δ	kW	Weather Δ
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	

2.3 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 7 (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.

2.4 Gas Energy Savings Estimation Methodologies

No gas savings are associated with this measure.

Section 3. Load Shapes

Table 8. Building Types and Load Shapes

Building Type	E3 Alternate Building Type	Load Shape
Lodging – Hotel (Guest Rooms)	NON_RES	11-HTL-Lodging-Hotel(GuestRooms)-COOL

Section 4. 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 9. **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] ($/unit)	Full Base Cost (2nd baseline period)[4] ($/unit)
REA	$0.00	$300.00	$48.35	N/A*	$348.35	

* IMC may be useful for determining program incentive.

4.1 Base Case(s) Costs

See Ex Ante Database Support Table (READI) Labor Rate NR-HVAC-PT (HVAC-Programmable Thermostats).

Table 9 above.

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

4.2 Measure Case Costs

See Ex Ante Database Support Table (READI) Labor Rate NR-HVAC-PT (HVAC-Programmable Thermostats).

Table 9 above. 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

[3] Full measure cost = measure equipment cost + installation cost, for first baseline period
[4] Full base cost = 2nd baseline equipment cost + installation cost, for the second baseline period

Ex Ante data). Labor Rate: NR-HVAC-PT, Sector: Com, Base Labor Rate: $48.35, Application: HVAC - Programmable Thermostats, Downstream Prescriptive Rebates/Incentives.

4.3 Installation/Labor Costs

See Ex Ante Database Support Table (READI) Labor Rate NR-HVAC-PT (HVAC-Programmable Thermostats).

Table 9 above. 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.

4.4 Incremental & Full Measure Costs

See Ex Ante Database Support Table (READI) Labor Rate NR-HVAC-PT (HVAC-Programmable Thermostats).

Table 9 above. Incremental and Full Measure Costs are equivalent as this is a Retrofit Add-On measure, REA in Table 10 below.

Table 10. 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)
ROB/NEW	**Incremental Measure Cost** = (Measure Equipment Cost + Measure Labor Cost) – (Base Case Equipment Cost + Base Case Labor Cost)	N/A	N/A
ER	N/A	**Full Measure Cost** = Measure Equipment Cost + Labor Cost	**Full Base Cost** = (-1)*(Second Base Case Equipment Cost + Labor Cost)[5]
REA	N/A	**Full Measure Cost =** Measure Equipment Cost + Labor Cost	N/A

[5] The E3 calculator determines the net present value of the second baseline cost and subtracts it from the first baseline cost to determine the measure cost for the early retirement measure. According to the Energy Efficiency Policy Manual v.5 at page 32, the measure cost for an early-retirement case is "the full cost incurred to install the new high-efficiency measure or project, reduced by the net present value of the full cost that would have been incurred to install the standard efficiency second baseline equipment at the end of the [RUL] period".

Table 11. Incremental and full measure cost values

Measure Application Type	Incremental Measure Cost ($/unit)	Full Measure Cost ($/unit)	Full Base Cost (2nd Baseline) ($/unit)
ROB/NEW		N/A	N/A
ER	N/A	N/A	N/A
REA	N/A	$348.35	N/A

Appendix 1 - Supplemental Files

Updated PTAC-ACC Measure Table.xlsx

SupportTables-All.xlsx [1]

2010-2012_WO017_Ex_Ante_Measure_CI [2]

ETL_Summary_Tests_7819.pdf

OGD3ACC_us_doe.pdf [3]

OGD3ACCclarkson.pdf [4]

itp_successes extract.pdf

Appendix 2 – Commission Staff Comments / Review

Include embedded file(s) with Commission staff feedback.

Appendix 3 - Measure Application Type Definitions

The DEER Measure Cost Data Users Guide found on 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
ER	Early retirement	Measure applied while existing equipment still viable, or retrofit of existing equipment
REA	Retrofit Add-on	Retrofit to existing equipment without replacement
ROB	Replace on Burnout	Measure applied when existing equipment fails or maintenance requires replacement
NC	New Construction	Measure applied during construction design phase as an alternative to a code-compliant standard design

Baseline Technologies for UES and Cost calculations[6]

Measure Application Type	Baseline	Baseline Technology	Measure Cost Calculation	Duration
ER	First	Existing technology	Measure equipment cost + labor cost	RUL = 1/3*EUL[7]
	Second	Code or standard	(-1)*(Code/standard equipment cost + labor cost)	EUL - RUL
REA	First	Existing technology	Measure equipment cost + labor cost	EUL
	Second	N/A	N/A	N/A
ROB	First	Code or standard	(Measure equipment cost + labor cost) – (Code/standard cost + labor cost)	Full EUL
	Second	N/A	N/A	N/A
NC	First	Code or standard	(Measure equipment cost + labor cost) – (Code/standard cost + labor cost)	Full EUL

[6] According to the Energy Efficiency Policy Manual v.5 at page 32, the measure cost for an early-retirement case is "the full cost incurred to install the new high-efficiency measure or project, reduced by the net present value of the full cost that would have been incurred to install the standard efficiency second baseline equipment at the end of the [RUL] period". Page 33 elaborates that "the period between the RUL and EUL defines the second baseline calculation period…the measure cost for this period is the full cost of equipment, including installation, for the second baseline equipment measure".

[7] The Energy Efficiency Policy Manual v.5 at page 33 states "the remaining useful life (RUL)…[is established by DEER] as one-third of the expected useful life (EUL) for the equipment type".

	Second	N/A	N/A	N/A

Measure cost overview developed by SCE:

Measure Cost rev9.docx

Appendix 4 – CPUC Quality Metrics

CPUC workpaper development actions to ensure quality are listed below, adapted from ex ante implementation scoring metrics described in Attachment 7 of Decision (D).13-09-023. The corresponding scoring metrics are shown below.

Metric	Workpaper Development Action to Ensure Quality
2	Address all aspects of the Uniform Workpaper Template[8]
3a[9]	Include appropriate program implementation background
3b	Include analysis of how implementation approach influences development of ex ante values
3c	Include all applicable supporting materials
3d	Include an adequate[10] description of assumptions or calculation methods
4	Pursue up-front collaboration on high impact measures with Commission staff prior to formal submission for review
7	Include analysis of recent and relevant existing data and projects that are applicable to workpaper technologies for parameter development that reflects professional care, expertise, and experience
9	Appropriately incorporate DEER assumptions, methods, and values for new or modified existing measures using professional care and expertise
10	Incorporate cumulative experience into workpaper through inclusion of an analysis of previous activities, reviews, and direction. (ED expects IOUs to immediately incorporate disposition guidance into workpapers to be submitted for formal review)

[8] The Uniform Workpaper Template is not posted on the DEER website as of 4/21/14, and is currently in Microsoft Access Database format.
[9] Metric 3 is not split among a – d in Attachment 7, however metric 3 was separated into four subcategories in this document for the purposes of identifying individual workpaper development actions to address quality.
[10] "Adequate" is defined in Attachment 7 such that derivations of underlying assumptions of workpaper are easy to understand by the CPUC reviewer.

Appendix 5 – DEER Resources Flow Chart

Draft DEER
Resources Flow Cha

References

[1] READI Ex Ante Database Support Table Export. Support Table Group: cpCostEff. Support Table: EUL. READI v.2.43 (Current Ex Ante data). Options: Include Non-DEER data: 1/1/2013 – 1/1/2020. Retrieved June 24, 2016.
[2] 2010-2012 WO017 Ex Ante Measure Cost Study Final Report. May 27, 2014. Itron, Inc.
[3] READI Ex Ante Database Support Table Export. Support Table Group: cpCostEff. Support Table: NTG. READI v.2.43 (Current Ex Ante data). Options: Include Non-DEER data: 1/1/2013 – 1/1/2020. Retrieved June 24, 2016.
[4] READI Ex Ante Database Support Table Export. Support Table Group: cpMeasCost. Support Table: LaborRate. READI v.2.43 (Current Ex Ante data). Options: Include Non-DEER data: 1/1/2013 – 1/1/2020. Retrieved June 24, 2016.