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| HVAC  Smart Thermostat, Residential  SWHC039-04 |

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Measure Name

Smart Thermostat, Residential

Statewide Measure ID

SWHC039-04

Technology Summary

A smart thermostatis a device that controls heating, ventilation, and air-conditioning (HVAC) equipment to regulate the temperature of the room or space in which it is installed, has the ability to make automated adjustments to the set point of the HVAC system to drive energy savings (electric and gas), and has the ability to communicate with sources external to the HVAC system. For connection, the smart thermostat may rely on a home area network (e.g., Wi-Fi) and an internet connection that is independent of the smart thermostat.

Measure Case Description

The measure case is defined as the installation of Residential smart thermostatwith two-way communication and automatic scheduling capabilities. Measure offerings are separated based on existing HVAC system types and delivery types because those parameters impact savings, costs, and NTG values.

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Offering ID** | **Description** | **HVAC Type** | **Delivery Type** |
| SWHC039A | Residential Smart Thermostat | Central AC with Gas Heat | DnDeemed, UpDeemed |
| SWHC039B | Central Heat Pump | DnDeemed, UpDeemed |
| SWHC039C | Central AC with Gas Heat | DnDeemDI |
| SWHC039D | Central Heat Pump | DnDeemDI |

Base Case Description

The base case is defined as a setback programmable thermostat per **Program Year 2018 Impact Evaluation Study**.[[1]](#footnote-1)

Code Requirements

Thermostats are covered by the California Building Energy Efficiency Standards (Title 24), but the smart thermostat technology defined for this measure are not a subject to the standards.

This measure is not governed by the California Appliance Efficiency Standards (Title 20) or federal regulations.

Note that the applicable codes and standards for these measures dictate that the thermostats be capable of shutting systems OFF and adjusting temperature setpoints during unoccupied hours. There are no requirements to shut down systems during unoccupied hours, or to make any specific unoccupied temperature setpoint adjustments.

Note that the Standards, under Section 110.2(b), Controls for Heat Pumps with Supplementary Electric Resistance Heaters, requires that heat pumps with supplementary electric resistance heaters shall have controls: 1. That prevent supplementary heater operation when the heating load can be met by the heat pump alone; and 2. In which the cut-on temperature for compression heating is higher than the cut-on temperature for supplementary heating, and the cut-off temperature for compression heating is higher than the cut-off temperature for supplementary heating.

EXCEPTION 1 to Section 110.2(b): The controls may allow supplementary heater operation during: A. Defrost; and B. Transient periods such as start-ups and following room thermostat setpoint advance, if the controls provide preferential rate control, intelligent recovery, staging, ramping or another control mechanism designed to preclude the unnecessary operation of supplementary heating.

EXCEPTION 2 to Section 110.2(b): Room air-conditioner heat pumps.

Applicable State and Federal Codes and Standards

|  |  |  |
| --- | --- | --- |
| **Code** | **Applicable Code Reference** | **Effective Date** |
| CA Appliance Efficiency Regulations – Title 20 (2020) | None | January 1, 2020 |
| CA Building Energy Efficiency Standards – Title 24 (2019) | Section 110.2(b) | January 1, 2020 |
| Federal Standards | None | n/a |

Normalizing Unit

Household

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 (or available) for some measure offerings by all program administrators.*

Implementation Eligibility

|  |  |  |  |
| --- | --- | --- | --- |
| **Applicable Offerings** | **Measure Application Type** | **Delivery Type** | **Sector** |
| SWHC039A, SWHC039B | Normal replacement | DnDeemed, UpDeemed | Res |
| SWHC039C, SWHC039D | Normal replacement | DnDeemDI | Res |

The normal replacement measure application type is determined appropriate given baseline characterization determined by the Smart Thermostat Process Evaluation.[[2]](#footnote-2)

Eligible Products

**General Eligibility Requirements:[[3]](#footnote-3)**

The program administrator (PA) shall employ QA/QC procedures to ensure that the thermostat is installed in an eligible home and is attached to the type of HVAC equipment that is being incentivized, whether it is for natural gas or electricity savings.

The PA shall confirm that the customer has a newly purchased smart thermostat. At minimum, the PA shall obtain a copy of the thermostat sales receipt and the PA shall confirm the purchase date is on or after the program start date.

The PA shall determine customer eligibility prior to rebate payment. Upon request, all data associated with determining eligibility shall be provided to Energy Division of the California Public Utilities Commission (CPUC). All PAs shall extend this requirement to all third-party vendors that assist PAs with determining customer eligibility. To the extent that they are used to determine eligibility, data regarding dates of purchase, location of home, customer HVAC equipment type, pre-installation HVAC energy use, etc. shall be made available.

Per Program Year 2019 Impact Evaluation,[[4]](#footnote-4) PA’s and 3P program implementers are recommended to “support Direct Install programs to include or strengthen contractor training and customer education about settings (auto-away) and device use (pre-heating/pre-cooling) that will help save energy.”

**Device Eligibility Requirements:**

The smart thermostat must be in full compliance with the ENERGYSTAR® Program Requirements and Product Specification for Connected Thermostats products Version 1.0 or later.[[5]](#footnote-5)

The customer must use the thermostat to control heating and/or cooling equipment supplied by fuels provided by the program administrator:

* For single-fuel utilities (or dual-fuel utilities in a portion of their service area where they only supply one fuel), only savings for the applicable delivered fuel may be claimed
* Eligible heating equipment: gas forced-air furnace, electric forced-air furnace, heat pump
* Eligible cooling equipment: central air conditioning

Eligible Building Types and Vintages

This measure is applicable for all residential building types (single family, multifamily, and mobile homes) of any vintage.

Eligible Climate Zones

This measure is applicable in all California Climate Zones with allowable measure savings claims as reported in corresponding energy savings tables. For some Climate Zones and building type combinations the energy use is increased and/or there are no energy savings attributed to the measure. For these cases, measure savings are zero out.

Program Exclusions

Per Program Year 2019 Impact Evaluation[[6]](#footnote-6) guidance, Direct Install projects already equipped with smart thermostat technology and/or including the installation of smart thermostat technology shall not be bundled with (or include the installation of) fan control technology to avoid potential double counting of energy savings attributions from both technologies. Referenced Program Exclusion is expected to be re-evaluated with future Impact Evaluations including savings attributions for bundled measures.

Data Collection Requirements

To ensure that the appropriate incentives, savings, and cost effectiveness values are applied for each application, the following data must be collected for each application:

* Building type. For upstream or midstream measures where building type is not available, the “Res” sector shall be assumed.
* Climate Zone
* Existing HVAC system type

In any event, data collection shall fully comply with both general and device eligibility requirements.

**Data Collection Recommendations**

Per Impact Evaluation[[7]](#footnote-7) recommendations, data collection requirements and additional work (to be supported by program evaluators) specifically needed to support further validation and/or evaluation of energy savings estimates from 2018PY Impact Evaluation, to include the following:

* “Differences between participants and comparison group households point to potential increasing trends in baseload consumption among participants. The next smart thermostat evaluation should develop methods for identifying trends in pre-installation consumption to include as a matching variable as well as other methods to minimize potential self-selection bias. Also, the current study could be updated with a new matched comparison group comprised of more recent program participants who were not available for inclusion within the existing evaluation timeframe.”
* “Load savings shapes are an increasingly important outcome from studies like this and further research is required to move them beyond the exploratory phase. This should not only provide better estimates of load savings shapes but also provide annual savings estimates that are consistent with those obtained from other methods, including the two-stage method used in this study.”

Use Category

HVAC

Electric Savings (kWh)

The electric unit energy savings (UES) represents the per household heating and cooling energy savings from the installation of a smart thermostatin a residential household. The calculation approach accounts for the range in energy savings change associated with smart thermostat installations, and the results represent an average savings of the technology by the climate zone and building type based on referenced studies and/or evaluations.

**Direct Install Programs**

Measure savings for Direct Install programs are based on the PY2019 Impact Evaluation Study.[[8]](#footnote-8) Since Direct Install customers generally have multiple measures installed at once, the analysis used site energy consumption analysis and engineering estimates based on previous impact evaluations and the 2019 Residential Appliance Saturation Study (RASS 2019)[[9]](#footnote-9) to disaggregate smart thermostat savings from whole building savings. To avoid potential data disruptions due to COVID-19, the analysis used 2018 program participant data.

Savings estimates were further adjusted based on analysis supported by smart thermostat vendors in collaboration with IOUs and approved by the CPUC in the third quarter of 2021.[[10]](#footnote-10) Under this analysis, there were three proposed update strategies to the savings including: (a) the addition of temperature optimization (TO) controls; (b) adjustment for selection bias, and (c) unbundling fan control savings. The CPUC approved the proposed TO control and (with revisions) the unbundled fan control savings strategies. CPUC provided new approved savings including these two adjustments which are adopted for the Direct Install measures.[[11]](#footnote-11) Additional details of the adjustments are included below.

Temperature Optimization Controls

The smart thermostat market in California has progressed since the PY2019 Impact Evaluation treatment period. Currently, two of largest smart thermostat manufacturers for California efficiency measures offer TO programs at no cost to all customers. These programs resulted in increased energy savings for smart thermostats (particularly for cooling) that were not captured in the evaluation because it relied on PY 2018 installations with a 2019 post-period to avoid using data from 2020, due to the pandemic. For participating customers, the smart thermostat incrementally relaxes temperature setpoints of the HVAC system by fractions of a degree over time. Using machine learning, the thermostats find the optimal temperature setpoints for each customer based on both their thermal comfort and energy saving preferences. These programs are provided annually, so participation in multiple years of results in “stacked” savings as the thermostat further relaxes setpoints in subsequent years.

The adjusted DI Savings reflect 2.36% additional cooling savings (as a function of the annual cooling) per climate zone, is based on California-specific participation provided by the leading manufacturer, a previous PG&E Seasonal Savings study,[[12]](#footnote-12) prior studies of smart thermostat deployments for SCE and Marin Clean Energy, and evaluated persistence of TO savings from out of state IOU programs.[[13]](#footnote-13) A separate national study for one of the leading manufacturers showed higher opt-in rates for the program resulting in higher savings than assumed in this analysis,[[14]](#footnote-14) but 2.36% was selected to be conservative.

The percent cooling savings was applied to the electric cooling load per building type and climate zone from the PY 2019 Impact Evaluation[[15]](#footnote-15) to find the additional electric energy savings attributions for temperature optimization. [[16]](#footnote-16)

Unbundled Fan Control Savings

Smart thermostats from leading manufacturers include features that run the HVAC fan at the end of cooling cycles to harvest sensible and evaporative cooling from the evaporator. Some Direct Install programs also include a fan control device as a separate measure that includes similar fan control feature (with similar savings attributions). For participants that received multiple (bundled) measures, the Impact Evaluation report allocated whole home kWh savings proportionally to measures based on engineering estimates of the savings from each measure. This approach results in a distribution of proportional savings between the smart thermostat and the fan control when both measures were installed. In installations where the smart thermostats are installed without a separate fan controller these savings proportionally reallocated to the thermostat based on the remaining model savings. In their final approved savings analysis, CPUC provided updated savings values from modeled direct install thermostat installations without the fan control included.[[17]](#footnote-17)

**Downstream and Upstream Rebate Programs**

Measure savings for Downstream programs are adopted from the PY2018 Impact Evaluation study.[[18]](#footnote-18) The evaluation takes a two-stage modeling approach to estimate the effect of smart thermostats on energy consumption. The approach uses variable degree-day PRISM,[[19]](#footnote-19) site-level models with a matched comparison group in a difference-in-difference (DID) framework. For details on measure savings estimates methods refer to referenced study.[[20]](#footnote-20)

The Impact Evaluation included IOU-specific savings potentials. However, the study (originally) did not include IOU-weighted savings for overlapping Climate Zones and savings for Climate Zone 1. Further, the study did not delineate measure savings between central systems with electric heating (or heat pump heating) versus gas heating. After collaboration between IOUs and CPUC, measure savings were adjusted, and clarifications were provided by the CPUC to address these data gaps.[[21]](#footnote-21) Adjusted measure savings estimates were provided by commission staff consultant to IOUs via email.[[22]](#footnote-22)

In the CPUC’s approval of the adjusted Direct Install measures they also approved the inclusion of the temperature optimization program savings for Downstream Rebate measures. The same 2.36% of cooling load savings was assumed to be consistent with the Direct Install calculations. The electric cooling load from the PY 2018 Impact Evaluation Table 5-4[[23]](#footnote-23) was used to calculate the additional TO savings attributions per climate zone, in order to be consistent with the source of savings for the Downstream Rebate measures.[[24]](#footnote-24) Since the current Downstream Rebate savings only vary by climate zone, the use of climate zone only adjustment is consistent with the previous measure analysis.

The downstream rebate savings are also being used for upstream savings. Since the savings for the downstream measures do not vary by building type, the sector-wide “Res” building type has been enabled for downstream and upstream rebate measures.

Peak Electric Demand Reduction (kW)

No peak demand reductions are included within this workpaper (for any of the supported programs) given that methodology supporting evaluation of measure savings (including AMI data) is not “granular” enough to adequately support evaluation of peak demand savings.

Gas Savings (therms)

The gas unit energy savings (UES) represents the per household heating energy savings from the installation of a smart thermostatin a residential household. The calculation approach accounts for the range in energy savings change associated with smart thermostat installations, and the results represent an average savings of the technology by the climate zone and building type based on referenced studies and/or evaluations.

**Direct Install Programs**

Measure savings for Direct Install programs are based on the PY2019 Impact Evaluation Study.[[25]](#footnote-25) Since Direct Install customers generally have multiple measures installed at once, the analysis used site energy consumption analysis and engineering estimates based on previous impact evaluations and the 2019 Residential Appliance Saturation Study (RASS 2019)[[26]](#footnote-26) to disaggregate smart thermostat savings from whole building savings. To avoid potential data disruptions due to COVID-19, the analysis used 2018 program participant data.

Savings estimates were further adjusted based on analysis supported by smart thermostat vendors in collaboration with IOUs and approved by the CPUC in the third quarter of 2021.[[27]](#footnote-27) Under this analysis, there was one proposed update strategy to the savings: the addition of temperature optimization (TO) controls. The CPUC approved the proposed TO control savings. Additional details of the adjustments are included below.

Temperature Optimization Controls

The smart thermostat market in California has progressed since the PY2019 Impact Evaluation treatment period. Currently, two of largest smart thermostat manufacturers for California efficiency measures offer TO programs at no cost to all customers. These programs resulted in increased energy savings for smart thermostats that were not captured in the evaluation because it relied on PY 2018 installations with a 2019 post-period to avoid using data from 2020, due to the pandemic.

For participating customers, the smart thermostat incrementally relaxes temperature setpoints of the HVAC system by fractions of a degree over time. Using machine learning, the thermostats find the optimal temperature setpoints for each customer based on both their thermal comfort and energy saving preferences. These programs are provided annually, so participation in multiple years of results in “stacked” savings as the thermostat further relaxes setpoints in subsequent years.

The adjusted DI Savings reflect 2.62% additional heating savings (as a function of the annual heating load) per climate zone, is based on California-specific participation provided by the leading manufacturer, a previous SCG Seasonal Savings study,[[28]](#footnote-28) prior studies of smart thermostat deployments for Marin Clean Energy, and evaluated persistence of TO savings from out of state IOU programs.[[29]](#footnote-29) A separate national study for one of the leading manufacturers showed higher opt-in rates for the program resulting in higher savings than assumed in this analysis,[[30]](#footnote-30) but 2.62% was selected to be conservative.

The final percent heating savings was applied to the gas heating load per building type and climate zone from the DEER building prototype data to find the additional gas energy savings attributions for temperature optimization.[[31]](#footnote-31)

There were also winter TO programs being run concurrent to the Impact evaluation in Winter 2018-2019 in SCG[[32]](#footnote-32) and MCE[[33]](#footnote-33) service territories. To calculate the thermostat optimization savings that had already been captured as part of the 2019 impact evaluation, the percent of participating thermostats was calculated by climate zone using data collected by the leading smart thermostat for both SCE and MCE. These percentages were multiplied by the average therms savings per deployment for customers who opted into the TO programs for each utility. The TO savings were then adjusted down by the amount above to take into account the overlap from the program.

**Downstream and Upstream Rebate Programs**

Measure savings for Downstream programs are adopted from the PY2018 Impact Evaluation study.[[34]](#footnote-34) The evaluation takes a two-stage modeling approach to estimate the effect of smart thermostats on energy consumption. The approach uses variable degree-day PRISM,[[35]](#footnote-35) site-level models with a matched comparison group in a difference-in-difference (DID) framework. For details on measure savings estimates methods refer to referenced study.[[36]](#footnote-36)

The Impact Evaluation included IOU-specific savings potentials. However, the study (originally) did not include IOU-weighted savings for overlapping Climate Zones and savings for Climate Zone 1. Further, the study did not delineate measure savings between central systems with electric heating (or heat pump heating) versus gas heating. After collaboration between IOUs and CPUC, measure savings were adjusted, and clarifications were provided by the CPUC to address these data gaps.[[37]](#footnote-37) Adjusted measure savings estimates were provided by commission staff consultant to IOUs via email.[[38]](#footnote-38)

In the CPUC’s approval of the adjusted Direct Install measures they also approved the inclusion of the temperature optimization program savings for Downstream Rebate measures. The same 2.62% of heating load savings was assumed to be consistent with the Direct Install calculations. The gas heating load from the PY 2018 Impact Evaluation Table 5-7[[39]](#footnote-39) was used to calculate the additional TO savings attributions per climate zone, in order to be consistent with the source of savings for the Downstream Rebate measures.[[40]](#footnote-40) Since the current Downstream Rebate savings only vary by climate zone, the use of climate zone only adjustment is consistent with the previous measure analysis.

The downstream rebate savings are also being used for upstream savings. Since the savings for the downstream measures do not vary by building type, the sector-wide “Res” building type has been enabled for downstream and upstream rebate measures.

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. EUL values are employed with CPUC authorized annual avoided costs and measure‐specific energy savings to determine lifecycle dollar benefits associated with a measure.

**Effective Useful Life Evaluation Protocol.** Per the California Energy Efficiency Evaluation Protocols,[[41]](#footnote-41) there are two allowable methods for EUL analysis: basic rigor and enhanced rigor. Both methods require survival analysis or other analysis methods that specifically control for right-censored data. Right-censored data are failures that might take place after data collection.

**Effective Useful Life Analysis and Results.[[42]](#footnote-42)** Using non-parametric Kaplan-Meier estimation methodology in the R statistical software, a survival analysis was used on data provided by two main smart thermostat vendors. Specifically, a survival analysis method was used on the thermostat connectivity data to account for right censorship in the data and to provide unbiased estimates of survival functions and rates.

The EUL analysis combined non-linear and linear results to quantify the uncertainty around the EUL estimates, which assisted with program implementation data, results on a weighted average value of 9.1 years.

The EUL specified for the smart communicating thermostat measure are specified below. The EUL ID is currently included in the PEAR database[[43]](#footnote-43).

Effective Useful Life and Remaining Useful Life

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **EUL ID** | **Value** | **Source** |
| EUL (yrs) | HV-SmartTstat | 9.1 | Original Source: Cadmus Group. 2019. “EUL analysis of Residential Smart Communicating Thermostat – Vendor A and B.” Memorandum to Andres Fergadiotti and Cassie Cuaresma, Southern California Edison. February 1.  California Public Utilities Commission (CPUC). 2020. “SupportTable\_EUL.CSV.” Obtained from PEAR database. |
| RUL (yrs) | n/a | n/a |  |

Base Case Material Cost ($/unit)

The base case programmable thermostat material cost was obtained through online price research from various retailer websites in the third quarter of 2021.[[44]](#footnote-44) The total equipment cost includes 8.75% tax. Shipping cost has not been included in the material price as majority of the retailers offer free shipping. The baseline material cost was found to be $58.43.

Measure Case Material Cost ($/unit)

The measure case cost for the smart thermostats was obtained through online price research from various retailer websites in the third quarter of 2021. All the smart thermostat models are ENERGYSTAR certified and meet the workpaper eligibility requirements. The total equipment cost includes 8.75% tax. Shipping cost has not been included in the material price as majority of the retailers offer free shipping. Until more updated studies are done, the online retail point of sales pricing is the best available data to support the measure equipment cost.

The measure costs are adjusted based on smart thermostat adoption of certain manufacturers for both downstream rebate and direct install utility programs in 2018 and 2019, as described in the 2019 PY Impact Evaluation of Smart Thermostat table 2-6.[[45]](#footnote-45) Program tracking data from 2020 identified the dominant models from each of the manufactures from the Impact Evaluation. In cases where the 2020 models had been discontinued, pricing for the newer available models were used instead. Online retailer cost data was weighted based on program participation percentages to establish the measure material costs. As with the savings, the downstream rebate costs are adopted for the upstream programs as well.

The final (weighted) measure material costs were estimated at $148.07 for downstream and upstream rebate programs and $143.06 for direct install programs.[[46]](#footnote-46)

**Cost Methodology/Approach.**

The incremental measure cost is the cost differential of the efficient option over the standard option attributable to features related to energy efficiency performance.[[47]](#footnote-47) A robust analysis would involve developing a taxonomy of features and determining the cost of each feature or component. This is generally done through such methods as product teardowns or hedonic price modeling. However, for thermostats, these methods become unwieldy because it is difficult to develop a standardized set of features due to various possible implementations of the technology and we may not find a reliable correlation between features and price.

Base Case Labor Cost ($/unit)

The base case labor cost was obtained from the RSMeans Online database in 2021. The bare labor hours (0.40 hours)[[48]](#footnote-48) of residential electrician time ($69.45)[[49]](#footnote-49) was used to estimate the labor cost. The average RSMeans regional cost index[[50]](#footnote-50) value for California (of 1.15) was used to adjust the national average hourly labor rate to the California region. The final labor cost for this measure was estimated at $31.85.

Measure Case Labor Cost ($/unit)

The labor costs for both the measure and base case are assumed to be the same. See Base Case Labor 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. The relevant NTG values for this measure are specified below. These values are based on the free ridership survey results published in the Program Year 2019 Impact Evaluation.[[51]](#footnote-51) This information was used to estimate weighted NTG values for both Downstream and Direct Install statewide programs and approved by the CPUC in the workpaper plan[[52]](#footnote-52) and DEER.

Net-to-Gross Ratios

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **NTG ID** | **Value** | **Source** |
| Downstream Deemed and Upstream Deemed | Res-sAll-mHVAC-SCT-dn | 0.60 | Weighted NTG values for Direct Installed and Downstream programs as informed by "Impact Evaluation of Smart Thermostats, Residential Sector - Program Year 2019."  DNV GL. 2021. Draft Response to SWHC039-04 Res SCT WPP. “CPUCComm\_SWHC039-04 Res SCT WPP 7-20-2021.docx.” Prepared for the California Public Utilities Commission. June 20, 2021. |
| Direct Install | Res-sAll-mHVAC-SCT-di | 0.95 |

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.

Gross Savings Installation Adjustment Rates

|  |  |  |
| --- | --- | --- |
| **Parameter** | **GSIA** | **Source** |
| GSIA | 1.0 | California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. 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** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | No |
| DEER Measure Case | No |
| DEER Building Types | Yes |
| DEER Operating Hours | No |
| DEER eQUEST Prototypes | No |
| DEER Version | n/a |
| Reason for Deviation from DEER | The DEER 2022 database does not support measure evaluation on Smart Thermostat technology. |
| DEER Measure IDs Used | n/a |
| NTG | Source: DEER IDs: Res-sAll-mHVAC-SCT-dn, Res-sAll-mHVAC-SCT-di |
| GSIA | Source: DEER. The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA* |
| EUL/RUL | Source: DEER ID: HV-SmartTstat |

Revision History

Measure Characterization Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision Number** | **Revision Complete Date** | **Primary Author, Title, Organization** | **Revision Summary and Rationale for Revision** |
| 01 | 6/24/2019 | Kara Vega, TRC | Draft of consolidated text for this statewide measure is based upon: SCE17HC054, Revision 1 (May 31, 2019)  Measure costs were reassessed based on review of online retailers in 2019 Q2. |
|  | 06/28/2019 | Jennifer Holmes, Cal TF Staff | Revisions for submittal of version 01. |
| 02 | 8/1/2019 | Matthew Mendoza, SoCalGas | Addition of the research/analysis performed by Nexant to update the gas savings estimates. |
| 03 | 6/8/2020 | Lake Casco, TRC | Updated savings values and NTG based on PY2018 Impact Evaluation.  Added newest EUL ID for Smart Thermostat  Updated pricing based on 2020 online retailer data  Split measures between Downstream Direct Install and Downstream Deemed. Direct install measures maintain savings from the previous workpaper.  Downstream Deemed measures use new PY2018 Impact evaluation savings. |
| 04 | 9/20/2021 | Lake Casco, TRC | Updated NTG based on PY2019 Impact Evaluation.  Added exclusion of fan control technology for direct install measures.  Updated direct install savings based on PY2019 Impact Evaluation adjusted by vendors and CPUC.  Updated downstream savings to include temperature optimization and exclusion of fan control coincident savings.  Added upstream program eligibility for rebate measures.  Added Res building type for rebate measures.  Updated measure and baseline costs based on newest online retailer cost and PY2019 Evaluation weighting.  Collaborated with SCG on Gas TO savings and updated measure package accordingly. |

1. DNV GL. 2020. *Impact Evaluation of Smart Thermostats Residential Sector - Program Year 2018.* Prepared for the California Public Utilities Commission. April 16, 2020. [↑](#footnote-ref-1)
2. Opinion Dynamics (ODC). 2018. *PG&E Smart Thermostat Program Process Evaluation. Draft Final Report.* Prepared for Pacific Gas and Electric Company. July 19. [↑](#footnote-ref-2)
3. California Public Utilities Commission (CPUC), Energy Division. 2016. "Disposition for Residential Smart Thermostat Workpapers.” November 8. [↑](#footnote-ref-3)
4. DNV GL. 2021. *Impact Evaluation of Smart Thermostats Residential Sector - Program Year 2019, Table 1-4.* Prepared for the California Public Utilities Commission. June 16, 2021. [↑](#footnote-ref-4)
5. ENERGY STAR. 2017. "ENERGY STAR® Program Requirements for Connected Thermostat Products: Version 1.0 (Rev. Jan 2017)." January. [↑](#footnote-ref-5)
6. DNV GL. 2021. *Impact Evaluation of Smart Thermostats Residential Sector - Program Year 2019, Table 6-1.* Prepared for the California Public Utilities Commission. June 16, 2021. [↑](#footnote-ref-6)
7. DNV GL. 2020. *Impact Evaluation of Smart Thermostats Residential Sector - Program Year 2018.* Prepared for the California Public Utilities Commission. April 16, 2020. [↑](#footnote-ref-7)
8. DNV GL. 2021. *Impact Evaluation of Smart Thermostats Residential Sector - Program Year 2019.* Prepared for the California Public Utilities Commission. June 16, 2021. [↑](#footnote-ref-8)
9. DNV GL Energy Insights USA, Inc. 2020. 2019 California Residential Appliance Saturation Study. California Energy Commission (CEC). Final statewide survey dataset obtained from the California Energy Commission (CEC). [↑](#footnote-ref-9)
10. DNV GL. 2021. *Draft Response to SWHC039-04 Res SCT WPP*. “CPUCComm\_SWHC039-04 Res SCT WPP 7-20-2021.docx.” Prepared for the California Public Utilities Commission. June 20, 2021. [↑](#footnote-ref-10)
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