

**A P P L I A N C E & P L U G L O A D S**

S M A R T C O N N E C T E D P O W E R S T R I P

SWAP010-01

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# MEASURE NAME

Smart Connected Power Strip

# STATEWIDE MEASURE ID

SWAP010-01

# TECHNOLOGY SUMMARY

This measure describes the replacement of a standard power strip with a Tier 2 smart connected advanced power strip (APS) in a home office or home entertainment center.

The power consumed by an electronic device in *standby* or *off* mode is referred to as “phantom” power drain, or “vampire load.” According to a 2008 technical brief conducted by the California Energy Commission (CEC) Public Interest Energy Research (PIER) program, vampire loads account for roughly 4% of the total household electricity used in California.1 Vampire load can be eliminated by manually shutting off a standard power strip or by unplugging the device(s). However, users typically leave electronic devices plugged into power sources (walls or power strips) and never unplug the devices or turn the power off. Households that do not turn off their power strips consume more power due to vampire loads than households that do turn off their power strips. The percentage of households that can benefit from using smart power strips (they currently use wall outlets or power strips and leave power strips on) is 86% for home offices and 95% for home entertainment centers.2

Smart Connected Power Strips (Tier 2)

A Tier 2 smart connected APS uses sensors paired with a configurable countdown timer to manage both active and standby power loads for controlled devices in a complete system. This wireless communicating device operates by sensing the power of all devices connected to the controlled sockets.

Smart connected Tier 2 APS are differentiated from non-communicating Tier 2 APS by their external communication capability which includes the incorporation of wireless network communication elements, such as WiFi or Bluetooth/BLE. This capability allows a customer to better understand and manage electricity use. Thewireless communicating enabledfeature within thisdevice provides several consumer and utility programimplementation benefitsaboveandbeyondnon-communicating Tier 2 APSdevices, which promote a greater focus on the connected home.

1 California Energy Commission (CEC), Public Interest Energy Research Program. 2008 “Energy Use of Household Electronics: Taming the Wild Growth.” September.

2 Hiner and Partners. 2008. *Statewide Home Electronics Assessment Survey*. October.

# MEASURE CASE DESCRIPTION

The measure case is defined as an advanced power strip with one or more outlets that are controlled by an operational occupancy sensor and external communication capabilities (e.g., WiFi, Bluetooth connectivity). The measure offerings include all SMART Tier 2 products that meet the minimum product specifications shown below.

Measure Case Specification

|  |  |  |
| --- | --- | --- |
| Statewide Measure Offering ID | Measure Application Type | Measure Description |
| A | AOE | Tier 2 smart connected APS |

# BASE CASE DESCRIPTION

The base case for all measure offerings is defined as no power strip or standard power strip where all the outlets are controlled with one manual switch.

# CODE REQUIREMENTS

There no state or federal codes or standards that are applicable to the smart power strip measure for existing buildings. However, for new construction buildings, the (2019) California Building Energy Efficiency Standards (Title 24)3 Section 130.5(d), requires circuit controls for 120-volt receptacles in private offices, open office areas, reception lobby, conference rooms, kitchenettes, and copy rooms. Insofar as this measure is classified as add-on equipment, Title 24 is not applicable.

Applicable State and Federal Codes and Standards

|  |  |  |
| --- | --- | --- |
| Code | Applicable Code Reference | Effective Date |
| CA Appliance Efficiency Regulations – Title 20 | None. | n/a |
| CA Building Energy Efficiency Standards – Title 24 (2019) | Section 130.5(d) | Jan 1, 2020 |
| Federal Standards | None. | n/a |

# NORMALIZING UNIT

The normalizing unit is per power strip.

3 California Energy Commission (CEC). 2019. *2019 Nonresidential Compliance Manual for the Building Energy Efficiency Standards for Residential and Nonresidential Buildings*.

# 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 for some measure offerings by all program administrators.*

Implementation Eligibility

|  |  |  |
| --- | --- | --- |
| Measure Application Type | Delivery Type | Sector |
| Add-on equipment | DnDeemDI | Res |
| Add-on equipment | UpDeemed | Res |
| Add-on equipment | DnDeemed | Res |

*Eligible Products*

Tier 2 smart connected APS minimum product specifications include:

* Must provide the option to stream real-time power data directly to the smart device (i.e. directly from the APS device to smart phone or tablet) to ensure power data privacy.
* Feature a resettable circuit breaker.
* Sense and transmit total power being consumed by all devices connected to controlled outlets on the APS device.
* Must comply with the current California Fire Code (605.4).
* All smart/connected iterations of APS are eligible to be offered in this workpaper. But, any manufacturer/s or third party program administrators (PA) who wish to offer their product/s are required to complete and submit a data collection plan to be reviewed and approved by SCE, which is the lead utility of this workpaper. These data collection plans are to be filled out in pre- determined template4 as developed by SCE and the product/s can only be offered after the plan is approved by SCE and California Public Utilities Commission (CPUC). The manufacturer/s or PA is required to follow the approved plan and must submit the data collected to SCE. The raw data shall be made available to the CPUC upon request.
* Average active/ON mode power consumption must not exceed 2.0 watts for devices with external communication capability via a wireless networked connectivity system when controlled devices are active. External communication capability includes the incorporation of wireless network communication elements into the Tier 2 APS, including, but not limited to WiFi, IrDA,

4 A8 - TIER 2 Advance Power Strip Data Collection Plan.docx

GPRS/cell modem, Z-wave, Zigbee, and Bluetooth/BLE communication interface capabilities which are provided to the end user and intended for typical Smart APS device usage.

*Eligible Building Types*

Tier 2 smart connected APS are eligible in all residential buildings: single-family, multifamily, and mobile homes.

*Eligible Climate Zones*

The measure is applicable in all California climate zones.

# PROGRAM EXCLUSIONS

None.

# DATA COLLECTION REQUIREMENTS

Prior to program implementation by a Third Party, a data collection plan must be submitted to and approved by the Program Administrator SCE. CPUC approval of the data collection plan may also be required prior to program implementation. Data collected as per the approved data collection plan shall be provided to SCE. The raw data shall be made available to the CPUC upon request. Please see section “Program Requirements” section for more details on this requirement.

# USE CATEGORY

AppPlug

# ELECTRIC SAVINGS (KWH)

The energy savings in this workpaper is calculated using the baseline kWh value of 432 kWh from the (PG&E) study5 to addresses concerns regarding baseline usage reflecting the effects of demographics, connected equipment, and hours of usage on the baseline energy usage as metered in the SCE study6. To elaborate, the energy savings in this workpaper is calculated by multiplying the baseline energy usage value of 432 kWh with the 49.6% Energy Reduction Percentage (ERP) value as demonstrated in the SCE 2016 data collection study5 , which is the same ERP performance as observed for IR Masterless control method in the PG&E4 and SDG&E7 using simulation field trial methods, delivering 50% (page 30 ET13PGE1441) and 50% (page 35 ET14SDG8031) respectively. In addition, to adjust the baseline kWh

5 Energy Savings of TIER 2 Advance Power Strips in residential AV Systems, ET13PGE1441, February 2016.

6 TIER 2 Advance Power Strips with Bluetooth in Multifamily Residential Applications, April 2017.

7 TIER 2 Advance Power Strips in Residential and Commercial Applications, ET14SDG8021 and ET14SDG8031, April 2015.

savings using the 49.6% ERP, this methodology also accounts for concerns of persistence of savings for these products over a period of time. An 84% persistence factor is applied to further adjust the energy savings for persistence, aligning with studies such as Advance Power Strip Metering Study8 and the PG&E4 study, which demonstrated an average of 84% persistence factor for these APS products.

Electric Energy Interactive Effects

Tier 2 Advanced Smart Connected Power Strip devices have HVAC interactive effects. However, DEER does not include energy interactive effects specifically for this measure. Thus, this measure will apply the DEER 2020 HVAC interactive effects values used in residential indoor lighting power applications.

The calculation of Energy Savings (kWh) for the Tier 2 smart connected APS is shown in [Equation 1](#_bookmark0)

Equation 1.

����𝑔𝑦 �𝑎�𝑖�𝑔� = ∆𝑊×𝐼 𝑒𝑙𝑒𝑐

1,000 𝑊/𝑘𝑊

x Persistence Factor

*where:*

*∆Watts/unit = (Base Case Average Watts per strip) – (Measure Case Average Watts per strip IEelec = Interactive Effects, by building type/space*

# PEAK ELECTRIC DEMAND REDUCTION (KW)

Tier 2 Advanced and Smart Connected Power Strips

Baseline on-peak demand usage from (PG&E) study4 was used to calculate the peak demand savings. The ERP of 49.6% and a persistence factor of 84% was applied for actual peak demand savings. To adjust for the CPUC approved 4-9 PM peak savings, the DEER 2020 Coincident Demand Factors (CDF) and Interactive Effects (IE) was multiplied with the gross demand savings to calculate the peak demand savings. Please refer to “calculations” tab in DataSpec workbook for further details on peak demand savings calculations.

The calculation of demand reduction impacts (kW) for the Tier 2 smart connected APS is shown in [Equation 2](#_bookmark1)

Equation 2.

𝑃�𝑎𝑘 ���𝑎�� ������𝑖�� = ∆𝑊×���×𝐼 𝑒𝑙𝑒𝑐 x Persistence Factor

1,000 𝑊/𝑘𝑊

*where:*

8 Advanced Power Strip Metering Study, NMR Group Inc, August 2, 2018

*∆Watts/unit = (Base Case Average Watts per strip) – (Measure Case Average Watts per strip) CDF = Coincident demand factor*

*IEelec = Interactive Effects, by building type/space*

GAS PENALTY (THERMS)

The estimated gas unit energy savings (UES) of smart power strips are based solely on the estimated change of gas consumption as reflected by the DEER HVAC interactive effects multiplier, which result in an energy penalty.

The calculation of Gas penalty (Therms) for the Tier 2 smart connected APS is shown in [Equation 3](#_bookmark2)

Equation 3.

𝐺𝑎� �𝑎�𝑖�𝑔� =

∆𝑊×𝐼 𝑔𝑎𝑠

1,000 𝑊/𝑘𝑊ℎ

x Persistence Factor

*where:*

*∆Watts/unit = (Base Case Average Watts per strip) – (Measure Case Average Watts per strip) IEgas = Interactive Effects, by building type/space for gas*

# 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 is often, but not always, derived from measure persistence or retention studies. Remaining Useful Life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational had the program intervention not caused the replacement or alteration. The RUL is only applicable to the first baseline period for a retrofit measure with an applicable code baseline.

The methodology to calculate the RUL conforms with Version 5 of the Energy Efficiency Policy Manual, which recommends “one-third of the effective useful life in DEER as the remaining useful life until further study results are available to establish more accurate values.”9 This approach provides a reasonable RUL estimate without the requiring any a prior knowledge about the age of the equipment being

replaced.10 For add-on equipment, the RUL of the pre-existing (“host”) equipment cannot exceed the EUL for the add-on equipment measure.

An EUL measure life of 5 years is approved in DEER11 and was calculated as follows:

9 California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 32.

10 KEMA, Inc. 2008. "Summary of EUL-RUL Analysis for the April 2008 Update to DEER." Memorandum submitted to Itron, Inc.

11 California Public Utilities Commission (CPUC). 2020. “SupportTable\_EUL.CSV.” Obtained from PEAR database.

* Since studies that provide a data point to inform a measured effective useful life (EUL) value for this measure were not available, the DEER 2014 EUL Update table was used as the starting point for the best available information to use for the EUL. The Plug-OccSens EUL ID was selected, which has an 8-year measure life in DEER12;
* A literature search for customer persistence was performed by CalTF staff to identify if consumers removed their Tier 2 APS products. A 2014 Australian study comprising of varying manufacturers found that the removal rate was 33%. This removal rate was determined to be a conservative estimate and was deemed reasonable until future studies are made available to capture regionally relevant customer retention rates;
* Based on the measure life and retention rate identified above, the result is a measure life of 5.36 years, which was rounded down to 5 year EUL.
* Subsequently, the CPUC approved this 5 year EUL value via Disposition “Meeting Summary August 6, 2015 Conference Call for WPSDGEREHE0004 Revision 0 Tier 2 Advanced Power Strips”13.

Effective Useful Life and Remaining Useful Life

|  |  |  |
| --- | --- | --- |
| Parameter | Tier 2 smart connected APS | Source |
| EUL (yrs) | 5.00 | Tier 1 Smart/OS Power Strip: WPSDGEREHE0004\_Rev1.1  California Public Utilities Commission (CPUC), Energy Division. 2015. "Workpaper Disposition for WPSDGEREHE0004 Revision 0 Tier 2 Advanced Power Strips." Issued on July 27. Page 1. |

# BASE CASE MATERIAL COST ($/UNIT)

The base case cost is $0 because these measures are voluntary retrofits to existing equipment.

# MEASURE CASE MATERIAL COST ($/UNIT)

Measure case material costs for Tier 2 advanced power strips were derived by averaging costs of these products found via web scraping. For the direct install delivery channel, labor rates may vary across different implementers.

12 California Public Utilities Commission (CPUC). 2014. “DEER2014-EUL-table-update\_2014-02-05.xlsx.”

13 A9 - Meeting Summary August 6, 2015 Conference Call for WPSDGEREHE0004 Revision 0 Tier 2 Advanced Power Strips

# LABOR COST ($/UNIT)

The installation labor cost for all other delivery types is assumed to $0.00 as the installations is being completed by the customer .

# 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. Several of the NTG values are based upon the average of all NTG ratios for all evaluated 2006 – 2008 residential, commercial, industrial, and agriculture programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. These sector-based NTG ratios are the “default” values applicable to measures been offered through a residential, commercial, industrial, or agriculture energy efficiency program for more than two years and for which impact evaluation results are not available.

Net-to-Gross Ratios

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Smart/ Occupancy Power Strip | Advanced Power Strip | Source |
| NTG – residential | 0.55 | 0.55 | Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page 15-4, Table 15-3. |

# 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. The GSIA rate adopted for direct installation delivery is current "default" rate; the GSIA adopted for all other delivery types is also equal to this adjustment rate, as per the July 2015 disposition issued by the Energy Division of the California Public Utilities Commission (CPUC).

Gross Savings Installation Adjustment Rates

|  |  |  |
| --- | --- | --- |
| Parameter | Tier 2 Advanced Power Strip (all types) | Source |
| GSIA – direct installation | 1.0 | California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 31. |
| GSIA – all other delivery | 1.0 | California Public Utilities Commission (CPUC), Energy Division. 2015. "Workpaper Disposition for WPSDGEREHE0004 Revision 0 Tier 2 Advanced Power Strips." Issued on July 27. Page 1. |

# NON-ENERGY IMPACTS

Non-energy impacts for this measure have not been quantified.

# DEER DIFFERENCES ANALYSIS

The table below summarizes the inputs and methods that are and are not based upon the Database for Energy Efficient Resources (DEER).

DEER Difference Summary

|  |  |
| --- | --- |
| DEER Item | Comment |
| 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 | DEER2020 |
| Reason for Deviation from DEER | DEER does not contain this measure |
| DEER Measure IDs Used | n/a |
| NTG | Value of 0.55 is associated with NTG ID: *Res-Default>2* |
| GSIA | GSIA value of 1.0 is based upon *GSIA ID: Def-GSIA.* |
| EUL/RUL | Tier 2 value of 5 years based upon EUL ID: *Res-Plug-AdvPwrStrip* |

# REVISION HISTORY

Measure Characterization Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Revision Number | Date | Primary Author, Title, Organization | Revision Summary and Rationale for Revision Effective Date and Approved By |
| 01 | 03/31/2018 | Jennifer Holmes, Cal TF Staff | Draft of consolidated text for this statewide measure is based upon:   * Workpaper WPSDGEREHE0004 Revision 1.1 (August 10, 2017) * Workpaper SCE17CS014 Revision 0 (October 12, 2017) * Workpaper PGECOALL101 Revision #6 (January 25, 2017) * Workpaper WPSDGEREHE0004 Revision 1 (December 7, 2016) * Consensus reached among Cal TF members. |
| 01 | 11/8/2018 | Jennifer Holmes, Cal TF Staff | Revisions and QC |
| 01 | 5/11/2020 | Ajay Wadhera/ SCE | * Revised calculation methodology for SMART Connected TIER 2 APS per workpaper plan submitted on July 10, 2018. * Revised Data Collection Requirements section language and program requirements language. |
| 01 | 8/24/2020 | Srushti Koli, TRC | - Revised language in the Data Collection Requirements, Program Requirements, and Lifecycle sections based on CPUC comments. |
| 01 | 8/09/2021 | Ajay Wadhera, SCE | Changed E3MeaElecEndUseShape from “DEER:Indoor\_Non-CFL\_Ltg” to “ DEER:Indoor\_CFL\_Ltg” in EAD table. |