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COMMERCIAL REFRIGERATION

LOW-TEMPERATURE COFFIN TO REACH-IN DISPLAY CASE CONVERSION

SWCR019-01

CONTENTS

MEASURE NAME

Low-temperature Coffin to Reach-in Display Case Conversion

STATEWIDE MEASURE ID

SWCR091-01

TECHNOLOGY SUMMARY

This measure replaces an existing standard-efficiency, low-temperature coffin refrigerated display case with a new high-efficiency, low-temperature reach-in refrigerated display case. In addition to adding display capacity volume by 20% or more, the use of doors reduces air infiltration and therefore the required cooling capacity per unit volume of case.

MEASURE CASE DESCRIPTION

The measure case is defined as a high-efficiency, low-temperature reach-in refrigerated display case; measure offerings vary by case width (narrow or wide). If the base case is a wide coffin, the measure offering is ⅓ the original coffin length (e.g., 60-foot coffin case to 20-foot reach-in case). If the base case is a narrow coffin, the measure case is defined as a high-efficiency, low-temperature, reach-in refrigerated display case that is ¼ the original length (e.g., 60-foot coffin case to 15-foot reach-in case).

Measure Case Specification

Statewide Measure Offering ID	Measure Offering Description
SWCR019A	Low temp Wide Coffin to Reach-in Display Case
SWCR019B	Low temp Narrow Coffin to Reach-in Display Case

BASE CASE DESCRIPTION

The base case technology is a low-temperature code coffin (open) refrigerated display case, wide or narrow. The base case energy consumption varies by base case width; either 43 inches or 35 inches.[1] (See Electric Savings section for equipment specifications.)

CODE REQUIREMENTS

This measure is not governed by California state codes and standards. The California Title 20 and Title 24 regulations do not address the end-of-life replacement fixture for a horizontal, open freezer.

[1] Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF."

This measure is governed by federal code; the federal energy conservation standards established for commercial refrigeration equipment are applicable to products manufactured on or after January 1, 2012.[2] For the equipment class analyzed (HZO.RC.L, a horizontal freezer without doors with a remote condensing unit, low temperature) the federal standard limits the maximum daily energy consumption (MDEC) as follows:

$$MDEC = 0.57 \times TD + 6.88 \; kWh/yr.$$

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	None.	n/a
Federal Standards – Code of Federal Regulations	10 CFR Part 431.66	Applicable to products manufactured on or after January 1, 2012

NORMALIZING UNIT

Linear feet (Len-ft)

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
Normal replacement	DnDeemed	Com

[2] U.S. Department of Energy (DOE), Energy Conservation Program. 2014. *Energy Conservation Program: Energy Conservation Standards for Commercial Refrigeration Equipment; Final Rule.* Federal Register Vol. 79, No. 60. March 28.

Eligible Products

All coffin replacements with a reach-in display case must meet the specifications in the Measure Case Description. The measure is applicable to replace any existing coffin that is less than or equal to code:

- If the display width is less than or equal to 3 feet, the coffin must be replaced by a reach-in case that is ¼ of the total length of the coffins or less.
- If the display width is greater than 3 feet, the coffin must be replaced by a reach-in case that is ⅓ of the total length of the coffin or less.

The replacement case must include triple-pane doors with low or no anti-sweat heat or anti-sweat-heat controls.

Eligible Building Types and Vintages

The measure is applicable for all existing nonresidential buildings but is typically installed in grocery and supermarket buildings.

Eligible Climate Zones

This measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

None.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

Commercial refrigeration (Comrefrig)

ELECTRIC SAVINGS (kWh)

The unit energy savings (UES) of this measure was derived as the difference between the base case and measure case annual unit energy consumption (UEC).[3]

Because the measure is implemented per linear foot of reach-in case installed, special attention must be given to the relationship the reach-in volume to length ratio and the coffin volume to length ratio. Depending on coffin width, a grocer can display approximately three or four times more product with a

[3] Pacific Gas & Electric Company (PG&E). 2019. "SWCR019 Low Temp Coffin to Reach-in_v5_Calculations.xlsx."

reach-in display case than with a coffin display case (see "Base and Measure Case Volume, Length, and Door Relationships" table below).

To account for this, the base case and measure case scenarios were compared in equivalent display case *volumes*, as opposed to length. That is, the measure case reach-in cases will only display as much product as the base case coffin cases. *This means that the base case length and measure case length will be different.*

Additionally, the implementation of this measure is limited to the portion of reach-in display case that would provide the equivalent display volume to the base case coffin scenario.

The **base case** is represented by a line-up of low-temperature coffin cases, represented by 60 linear feet of the Hill Phoenix OWZGG case or 80 linear feet of the Hill Phoenix ONZ case.[4]

The **measure case** is represented by a line-up of low-temperature high-efficiency reach-in cases, represented 20 linear feet of Hill Phoenix ONZ 4 Door Glass Door Reach-in Frozen Food display case as the code case and a Hill Phoenix ONRIZ case with Eliminator doors as the measure case.[5] These cases were selected from the retail available cases to represent the code equivalent for their case types.

The following table (based on the dimensions of the two coffin cases and the proposed reach-in case) demonstrates the length of coffin case that is represented by 20 feet (8 doors) of the proposed reach-in.

Display Case Volume, Length, and Door Comparison [6]

	Base Case		Measure Case	
	Code equivalent Wide Base Case	Code equivalent Narrow Base Case	Proposed Code Case	Proposed High-Efficiency Code Case
Description	60 len-ft of Wide Coffin Case	80 len-ft of Wide Coffin Case	20 len-ft (8 doors) of Reach-in Case	20 len-ft (8 doors) of Reach-in Case
Manufacturer/Model	Hill Phoenix OWZGG	Hill Phoenix ONZ	Hill Phoenix ORZ	Hill Phoenix ONRIZ
Line-up Length (in)	720.000	960.000	240.000	240.000
Display Width (in)	43.250	34.688	30.875	29.750
Display Height (in)	16.125	13.375	59.000	62.375
Display Volume (ft^3)	291.000	258.000	253.000	258.000

Base Case Annual Unit Energy Consumption

The base case annual UEC was calculated as the sum of the refrigeration and the auxiliary energy consumption.

The **base case Refrigeration UEC** is a function of the cooling coil capacity per linear foot, the compressor energy efficiency ratio, and the refrigeration system run-time hours, as represented below.

[4] Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1 and Figure 2.

[5] Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 3.

[6] Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF."

Refrigeration UEC, Base Case

$$E_{B,REFRIG} = \frac{Q_B \times H_{B,REFRIG}}{EER_B \times 1000W/kW} \times L_B$$

$E_{B,REFRIG}$ = *Refrigeration energy use for the coffin lineup, base case (kWh/ yr)*
Q_B = *Cooling coil capacity, base case (Btuh-ft)*
$H_{B,REFRIG}$ = *Refrigeration annual hours of operation (hrs/yr)*
L_B = *Case length, base case (len-ft)*
EER_B = *Compressor refrigeration system energy efficiency, base case*

Refrigeration UEC Inputs, Base Case

Parameter	Value	Source
Cooling coil capacity (Btuh-ft)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1 and Figure 2.
Refrigeration annual hours of operation (hrs/yr)	8,578	The Average EER value should be used with a refrigeration system duty load of 100%. However, the refrigeration system will not run during defrost hours (153 hrs/year, see Auxiliary UEC Inputs). 8,760 – 153 = 8,578 hrs/year.
Case length (len-ft)	60 80	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1 and Figure 2.
Compressor refrigeration system energy efficiency (EER, Btu/hr-W)	5.0	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE). 2006. 2006 ASHRAE Handbook – Refrigeration. Atlanta (GA): ASHRAE. "EERs range from 4 to 5 Btu/h per watt for frozen food units to as low as 3.5 to 4.0 Btu/h per watt for ice cream units." (Page 46.14)

The **base case auxiliary equipment UEC** accounts for the energy use of fans, anti-sweat heaters, defrost heaters, and drain heaters. Lighting is not included because this case does not contain display case lighting.

Auxiliary Equipment UEC, Base Case

$$E_{B,AUX} = \frac{\left(P_{B,FAN} \times H_{B,FAN}\right) + \left(P_{B,ASH} \times H_{B,ASH}\right) + \left(P_{B,DEF} \times H_{B,DEF}\right) + \left(P_{B,DRAIN} \times H_{B,DRAIN}\right)}{1000} \times CASES_B$$

$E_{B,AUX}$ = *Annual energy consumption of the auxiliary equipment, base case (kWh/yr)*
$P_{B,FAN}$ = *Fan direct power consumption per case, base case (kWh/yr)*
$H_{B,FAN}$ = *Fan annual hours of operation, base case (hrs/yr)*
$P_{B,ASH}$ = *Anti-sweat-heater direct power consumption per case, base case (kWh/case)*
$H_{B,ASH}$ = *Anti-sweat-heater annual hours of operation, base case (hrs/yr)*
$P_{B,DEF}$ = *Defrost heater direct power consumption per case , base case (kWh/yr)*
$H_{B,DEF}$ = *Defrost heater annual hours of operation, base case (hrs/yr)*
$P_{B,DRAIN}$ = *Drain-heater direct power consumption per case, base case (kWh/yr)*

$H_{B,DRAIN}$ = *Base case drain-heater annual hours of operation, base case (hrs/year)*

$CASES_B$ = *Number of 12' or 8' cases in the case line-up*

Auxiliary UEC Inputs, Base Case

Parameter	Value	Source
Fan direct power use (kWh/case)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1 and Figure 2.
Fan annual hours of operation (hrs/yr)	8,578	Calculated total hours per year less 30 min/day of OFF time during the defrost cycle. Assume 1 defrost cycle/day 8,760 – (0.5 * 1) * 365 = 8,578 hrs/yr. Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 2.
Anti-sweat-heater direct power consumption (kWh/case)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1 and Figure 2.
Anti-sweat heater annual hours of operation (hrs/yr)	8,760	Duty cycle is assumed to be 100% if no controllers are present and 100% ASH w/o control runtime. PWP, Inc. 2006. Final Evaluation, Monitoring, and Verification (EM&V) Report for the EnergySmart Grocer Program 2004-2005. Prepared for the California Public Utilities Commission (CPUC). Study ID PEC0002.01. Value corroborated with PECI Sr. Engineering.
Defrost-heater direct power consumption (kWh/case)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1 and Figure 2.
Defrost-heater operating hours (hrs/yr)	183	Min defrost cycle time is 15 min, max is 45 minutes, typical is 30 minutes. Assume 0.5 hrs/cycle and 1 cycle per day. Calculated as the number of hours ON per cycle multiplied by the number of cycles/day and days/yr. 0.5 * 1 * 365 = 183 hr/yr.
Drain-heater direct power consumption (kWh/case)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1 and Figure 2.
Drain-heater annual hours of operation (hrs/yr)	8,760	The duty cycle is assumed to be 100%.
Number of cases in line-up	Varies by case type	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1 and Figure 2.

The base case annual UEC is calculated as the sum of the refrigeration and the auxiliary equipment UEC:

Annual UEC, Base Case

$$E_B = E_{B,REFRIG} + E_{B,AUX}$$

E_B = *Annual unit energy consumption, base case (kWh/yr)*

$E_{B,REFRIG}$ = *Refrigeration annual energy consumption, base case (kWh/yr)*

$E_{B,AUX}$ = *Auxiliary equipment annual energy consumption, base case (kWh/yr)*

Measure Case Annual Unit Energy Consumption

The measure case (a high-efficiency reach-in display case) has a higher EER for the refrigeration system due to a higher evaporator suction temperature, which reduces the compressor load.

The **measure case refrigeration UEC** is based upon the cooling coil capacity, the assumed run-time hours of the refrigeration system, and the enhanced compressor EER due to the higher evaporator suction temperature.

Refrigeration UEC, Measure Case

$$E_{P,REFRIG} = \frac{Q_P \times H_{P,REFRIG}}{EER_P \times 1000W/kW} \times DOORS_P$$

$E_{P,REFRIG}$ = *Refrigeration energy use for the proposed case reach-in lineup, kWh/ft-yr.*
Q_P = *Cooling coil capacity, measure case (Btuh-ft)*
$H_{P,REFRIG}$ = *Annual hours of refrigeration system operation*
D_P = *Measure case number of doors*
EER_P = *Measure case compressor refrigeration system energy efficiency (Btuh-W).*

The **measure case refrigeration system EER** is calculated with the following equation:

Refrigeration System EER, Measure Case

$$EER_P = EER_B \times EERCoeff^{DegreesF}$$

EER_P = *Measure case energy efficiency ratio of the refrigeration system (Btuh-W)*
EERCoeff = *EER coefficient to create the 2% increase in EER for each °F increase in evaporator suction temperature.*
DegressF = *Degrees Fahrenheit that the energy efficient evaporator suction temperature is increased.*
EER_B = *Compressor refrigeration system energy efficiency, EER (Btuh-W)*

Refrigeration UEC Inputs, Measure Case

Parameter	Value	Source
Cooling coil capacity (Btuh-ft)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 3.
Refrigeration annual hours of operation (hrs/yr)	8,578	The Average EER value should be used with a refrigeration system duty load of 100%. However, the refrigeration system will not run during defrost hours (153 hrs/year, see Auxiliary UEC Inputs). 8,760 – 153 = 8,578 hrs/year.

Parameter	Value	Source
Number of doors	8	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 3.
Compressor refrigeration system energy efficiency, base case (EER, Btuh-W)	5.0	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE). 2006. 2006 ASHRAE Handbook – Refrigeration. Atlanta (GA): ASHRAE. "EERs range from 4 to 5 Btu/h per watt for frozen food units to as low as 3.5 to 4.0 Btu/h per watt for ice cream units." (Page 46.14)
Compressor refrigeration system energy efficiency, measure case (EER, Btuh-W)	6.2	Calculated
EER coefficient	1.02	The efficiency of a compressor in a refrigeration system increases by about 2% per °F increase in suction temperature. Cascade Energy. (n.d.) Industrial Refrigeration Best Practices Guide. 3rd Ed. Page 46.
Evaporator suction temperature, base case (°F)	-22 °F	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 1.
Evaporator suction temperature, measure case (°F)	-11 °F	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 2.
Increase in suction temperature (°F)	11 °F	Calculated

The calculation of the **measure case auxiliary equipment** annual electric energy use is represented as:

Auxiliary Equipment UEC, Measure Case

$$E_{P,AUX} = \frac{\left(P_{P,FAN} \times H_{P,FAN}\right) + \left(P_{P,ASH} \times H_{P,ASH}\right) + \left(P_{P,DEF} \times H_{P,DEF}\right) + \left(P_{P,LIGHT} \times H_{P,LIGHT}\right)}{1000W/kW} \times CASES_P$$

$E_{P,AUX}$ = *Annual energy consumption of the auxiliary equipment, measure case (kWh/case)*

$P_{P,FAN}$ = *Fan direct power consumption per case, measure case (kWh/case)*

$H_{P,FAN}$ = *Fan annual hours of operation, measure case (hrs/yr)*

$P_{P,ASH}$ = *Anti-sweat-heater direct power consumption per case, measure case (kWh/case)*

$H_{P,ASH}$ = *Anti-sweat-heater annual hours of operation, measure case (hrs/yr)*

$P_{P,DEF}$ = *Defrost-heater direct power consumption per case, measure case (kWh/case)*

$H_{P,DEF}$ = *Defrost-heater annual hours of operation, measure case (hrs/yr)*

$P_{P,LIGHT}$ = *Fluorescent display case lighting direct power consumption per case, measure case (kWh/case)*

$H_{P,LIGHT}$ = *Display case lighting annual hours of operation, measure case (hrs/yr)*

$CASES_P$ = *Number of 4-door reach-in cases, measure case*

Auxiliary UEC Inputs, Measure Case

Parameter	Value	Source
Direct fan power use (kWh/case)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 3.
Fan annual hours of operation (hrs/yr)	8,578	Calculated total hours per year less 30 min/day of OFF time during the defrost cycle. Assume 1 defrost cycle/day 8,760 – (0.5 * 1) * 365 = 8,578 hrs/yr. Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 2.
Anti-sweat-heater direct power consumption (kWh/case)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 3.
Anti-sweat heater annual hours of operation (hrs/yr)	2,278	Assumes a 26% run time. ASH operating hours of 8%, reported in: PWP, Inc. 2006. *Final Evaluation, Monitoring, and Verification (EM&V) Report for the EnergySmart Grocer Program 2004-2005.* Prepared for the California Public Utilities Commission (CPUC). Study ID PEC0002.01. June 8. Page 28-29. ASH operating hours of 50% provided by PECI Senior Engineer Scott Moore, formerly Energy Manager for Albertsons.
Defrost-heater direct power consumption (kWh/case)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 3.
Defrost-heater annual hours of operation (hrs/yr)	183	Min defrost cycle time is 15 min, max is 45 minutes, typical is 30 minutes. Assume 0.5 hrs/cycle and 1 cycle per day. Calculated as the number of hours ON per cycle multiplied by the number of cycles/day and days/yr. 0.5 * 1 * 365 = 183 hr/yr. Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 2.
Fluorescent display case lighting direct power consumption per case (kWh/case)	Varies	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 3.
Display case lighting annual hours of operation (hrs/yr)	5,798	Calculated as average hours of operation from survey of 422 stores meeting criteria. The reference “GrocerSmart Survey of Main Lighting Schedule of Large Grocery Stores in PG&E Service Territory” is no longer available.
Number of 4-door reach-in cases in line-up, measure case.	2	Pacific Gas & Electric Company (PG&E). 2016. "SWCR019.01 Manufacturer Specs.PDF." See Figure 3.

Measure Case Annual Energy Consumption

The measure case annual UEC is equal to the sum of the measure case refrigeration system and auxiliary equipment annual energy consumption:

$$E_P = E_{P,REFRIG} + E_{P,AUX}$$

$E_P =$ *Annual unit energy consumption, measure case (kWh/yr)*
$E_{P,REFRIG} =$ *Refrigeration energy consumption, measure case (kWh/yr)*
$E_{P,AUX} =$ *Auxiliary equipment annual energy consumption (kWh.yr)*

Annual Unit Energy Savings

Annual base case and measure case UEC values were calculated to represent (approximate) equivalent refrigerated display case volume. The annual unit energy savings (UES) – presented per linear foot of reach-in display case installed – was calculated as the difference between the base case and measure case annual UEC.

Annual Unit Energy Savings

$$E_{SAVE} = \frac{E_B - E_P}{L_P}$$

$E_{SAVE} =$ *Annual unit energy savings per linear foot of installed reach-in display case (kWh/len-ft-yr)*
$E_B =$ *Annual unit energy consumption, base case (kWh/yr)*
$E_P =$ *Annual unit energy consumption, measure case (kWh/yr)*
$L_P =$ *Length of the reach-in display case line-up (len-ft)*

Annual UES Inputs

Parameter	Value	Source
Length of the reach-in display case line-up (len-ft)	20	This value is 20 linear feet and ensures the energy savings calculated is for replacing the entire existing coffin case line-up with about ⅓ or ¼ (based on the coffin case width) the length of a measure case lineup.

PEAK ELECTRIC DEMAND REDUCTION (kW)

Peak electric demand reduction was calculated as the annual average demand reduction (per linear foot) multiplied by a peak coincident diversity factor (CDF). Average demand reduction is equal to the annual unit energy savings per linear foot divided by the annual hours of operation. Inputs of this calculation are provided below.

Peak Demand Reduction

$$D_{Reduction} = (E_{SAVE} / HOURS) \times CDF$$

$D_{Reduction} =$ *Demand reduction per linear foot of reach-in display case installed (kW/len-ft)*

E_{SAVE} =	*Annual unit energy savings per linear foot of installed reach-in display case (kWh/len-ft)*
HOURS =	*Annual hours of operation (hrs/yr)*
CDF =	*Peak coincident demand factor (CDF)*

Peak Demand Reduction Inputs

Parameter	Value	Source
Annual hours of operation (hrs/yr)	8,760	Professional judgement.
Coincident demand factor	0.81	The source for this data is unknown.

GAS SAVINGS (Therms)

Not applicable.

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. 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 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."[7] This approach provides a reasonable RUL estimate without the requiring any a priori knowledge about the age of the equipment being replaced.[8] Further, as per Resolution E-4807, the California Public Utilities Commission (CPUC) revised add-on measures so that the EUL of the measure is equal to the lower of the RUL of the modified system or equipment or the EUL of the add-on component." [9]

The EUL and RUL are specified below, are based upon the estimated lifetime of a reach-in refrigerator or freezer that was established by the Food Service Technology Center (FSTC). Because this measure is only eligible for normal replacement, RUL is not applicable.

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

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

[9] California Public Utilities Commission (CPUC). 2016. *Resolution E-4807.* December 16. Page 13.

Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs)	12.0	The source for this data is unknown.
RUL (yrs)	n/a	-

BASE CASE MATERIAL COST ($/UNIT)

The base case material costs for were calculated as the average of costs provided by commercial refrigeration equipment vendors in 2012. Costs were converted to 2019 values using the RSMeans Historical Cost Index.[10]

Base Case Material Cost Inputs

Input	Value	Source
LT coffin display case ($/len-ft)	$800	Pacific Gas & Electric Company (PG&E). 2019. "SWCR019-01_Cost Update.xlsx."
2019 cost conversion factor	1.19	

MEASURE CASE MATERIAL COST ($/UNIT)

The measure case material costs for were calculated as the average of costs provided by commercial refrigeration equipment vendors in 2012. Costs were converted to 2019 values using the RSMeans Historical Cost Index.[11]

Measure Case Material Cost Inputs

Input	Value	Source
LT reach-in display case ($/len-ft)	$800	Pacific Gas & Electric Company (PG&E). 2019. "SWCR019-01_Cost Update.xlsx."
2019 cost conversion factor	1.19	

BASE CASE LABOR COST ($/UNIT)

The base case labor costs for were calculated as the average of costs provided by commercial refrigeration equipment vendors in 2012. Costs were converted to 2019 values using the RSMeans Historical Cost Index.[12]

[10] Pacific Gas & Electric Company (PG&E). 2019. "SWCR019-01_Cost Update.xlsx."

[11] Pacific Gas & Electric Company (PG&E). 2019. "SWCR019-01_Cost Update.xlsx."

[12] Pacific Gas & Electric Company (PG&E). 2019. "SWCR019-01_Cost Update.xlsx."

Base Case Labor Cost Inputs

Input	Value	Source
Labor installation cost ($)	$120	Pacific Gas & Electric Company (PG&E). 2019. "SWCR019-01_Cost Update.xlsx."
Maintenance	$0	
2019 cost conversion factor	1.19	

MEASURE CASE LABOR COST ($/UNIT)

The measure case labor costs for were calculated as the average of costs provided by commercial refrigeration equipment vendors in 2012. Costs were converted to 2019 values using the RSMeans Historical Cost Index.[13]

Base Case Labor Cost Inputs

Input	Value	Source
Labor installation cost ($)	$120	Pacific Gas & Electric Company (PG&E). 2019. "SWCR019-01_Cost Update.xlsx."
Maintenance	$36	
2019 cost conversion factor	1.19	

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. These NTG values are based upon the average of all NTG ratios for all evaluated 2006 – 2008 commercial programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. These sector average NTGs ("default NTGs") are applicable to all energy efficiency measures that have been offered through commercial sector programs for more than two years and for which impact evaluation results are not available.

Net-to-Gross Ratios

Parameter	Value	Source
NTG - commercial	0.60	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. This GSIA rate is the current "default" rate specified for measures for which an alternative GSIA has not been estimated and approved.

[13] Pacific Gas & Electric Company (PG&E). 2019. "SWCR019-01_Cost Update.xlsx."

Gross Savings Installation Adjustment

Parameter	GSIA	Source
GSIA - Default	1.00	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 inputs and methods based upon the Database of Energy Efficient Resources (DEER), 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	No
DEER Operating Hours	No
DEER eQUEST Prototypes	No
DEER Version	n/a
Reason for Deviation from DEER	This measure is not in DEER.
DEER Measure IDs Used	n/a
NTG	Source: DEER. The NTG of 0.06 is associated with NTG ID: *Com-Default>2yrs*
GSIA	The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA*
EUL/RUL	Source: DEER2014. The value of 12 years is associated with EUL ID: *Cook-SDRef*

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision
01	05/23/2019	Adan Rosillo, PG&E Jennifer Holmes, Cal TF Staff	Draft of consolidated text for this statewide measure is based upon: PGE3PREF122, Revision 4 (January 1, 2016) Consensus reached among Cal TF members.
	06/08/2019	Adan Rosillo, PG&E Jennifer Holmes, Cal TF Staff	Revisions for submittal of version 01.