



eTRM
best in class

HVAC
REFRIGERANT CHARGE, COMMERCIAL
SWSV002-01

C O N T E N T S

Measure Name.....2
Statewide Measure ID.....2
Technology Summary.....2
Measure Case Description.....2
Base Case Description.....2
Code Requirements.....2
Normalizing Unit.....3
Program Requirements.....3
Program Exclusions.....4
Data Collection Requirements.....4
Use Category.....4
Electric Savings (kWh).....4
Peak Electric Demand Reduction (kW).....6
Gas Savings (Therms).....6
Life Cycle.....6
Base Case Cost (\$/unit).....7
Measure Case Material Cost (\$/unit).....7
Measure Case Labor Cost (\$/unit).....7
Net-to-Gross (NTG).....8
Gross Savings Installation Adjustment (GSIA).....8
Non-Energy Impacts.....8
DEER Differences Analysis.....9
Revision History.....9

MEASURE NAME

Refrigerant charge, commercial

STATEWIDE MEASURE ID

SWSV002-01

TECHNOLOGY SUMMARY

This measure involves refrigerant charge correction to nonresidential direct expansion (DX) air-cooled HVAC units. When the refrigerant charge of an HVAC unit does not meet the manufacturer recommended levels the energy efficiency ratio (EER) of the HVAC unit will decrease.

Some units may be undercharged, which can result in decreased power draw but potentially longer run times. Other units may be overcharged, which can result in increased power draw but potentially shorter run times. In either case, energy savings can be achieved by correcting refrigerant charge to optimum levels based on the manufacturer specifications. This measure is only appropriate for 4-50% undercharged or overcharged units. Systems undercharged or overcharged by <4% are not eligible for claimed savings. For units with multiple circuits, unit energy savings values must be applied to the tonnage of the circuit being recharged, not the tonnage of all circuits.

MEASURE CASE DESCRIPTION

The measure case is defined as adjusting refrigerant charge to meet manufacturer specifications.

Measure Case Specification

Statewide Measure Offering ID	Measure Offering Description
SWSV002A	Small Pkg AC system with No TXV, increase refrigerant charge from Typical under-charge (4 - 50%) to factory specified level
SWSV002B	Small Pkg AC system with TXV, increase refrigerant charge from Typical under-charge (4 - 50%) to factory specified level
SWSV002E	Small Pkg AC no TXV, increase refrigerant charge from High under-charge (10 - 50%) to factory specified level
SWSV002F	Small Pkg AC w/ TXV, increase refrigerant charge from High under-charge (10 - 50%) to factory specified level

BASE CASE DESCRIPTION

The base case is defined as the existing charge on the HVAC unit. The existing refrigerant charge can range from 4% to 50% greater or less than manufacturer specifications

CODE REQUIREMENTS

This measure is not governed by either state or federal codes and standards.

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	None.	n/a

NORMALIZING UNIT

Tons of cooling capacity (Cap-tons).

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
BRO-RCx	DnDeemDI	Com
BRO-RCx	DnDeemed	Com
BRO-RCx	DnDeemDI	Ind
BRO-RCx	DnDeemed	Ind

This measure requires field documentation of the existing conditions that verify the measure was necessary and that the measure was successfully applied. The following measure criteria are per Resolution E-4867:¹

“To be eligible for savings claims all charge adjustments must be performed by technicians with proper training, using a “fault” diagnosis and correction sequence and procedure in a program implementation that includes a continuous verification activity to assure the refrigerant charge adjustment, and related system fault detection and correction work, is being performed properly. The diagnosis and correction must be performed using appropriate methods and tools that allow the identification and correction of all system “fault” conditions that affect the refrigerant system measurements prior to proceeding with a charge state measurement and then any indicated appropriate charge adjustment.

¹ California Public Utilities Commission (CPUC). 2017. Resolution E-4867. Issued August 25.

Technicians performing HVAC system fault diagnosis and correction must have all the proper tools, must follow the appropriate procedures, and have been trained by an experienced and qualified professional on the procedures and use of the tools.”

Eligible Products

Refrigerant used must be appropriate for HVAC system.

This measure is only appropriate for 4% to 50% undercharged or overcharged units.

Eligible Building Types and Vintages

This measure is applicable for existing nonresidential buildings of any vintage.

Eligible Climate Zones

This measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

Systems undercharged or overcharged by < 4% are not eligible for this measure.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

HVAC

ELECTRIC SAVINGS (kWh)

The electric unit energy savings (UES) for refrigerant charge adjustments were retrieved directly from the Database of Energy Efficient Resources (DEER). The version used to calculate savings for these measures is DEER 2020 (version D20 v1). The results were reported for each climate zone and all building types. Resolution E-4952² approved the DEER updates for 2020, which included the electric savings values for this measure.

² California Public Utilities Commission (CPUC). 2018. *Resolution E-4952*. October 11.

Statewide Measure Offering IDs and DEER Energy Impact IDs

Statewide Measure Offering ID	DEER Energy Impact ID
SWSV002-01A	NE-HVAC-RefChg-Inc-Typ-ntxv
SWSV002-01B	NE-HVAC-RefChg-Inc-Typ-txv
SWSV002-01E	NE-HVAC-RefChg-Inc-High-ntxv
SWSV002-01F	NE-HVAC-RefChg-Inc-High-txv

Note that the measure impacts are based on recent DEER2020 updates as of 6/6/19 that affect “APreWBkWh” for energy, “APreWBkW” for peak demand and “APreWBtherm”. As we move forward to true statewide offerings, the “PA” would be “Any”, however there were issues when revising the impacts from MASControl3 and could only produce PA-specific impacts. The IOUs were provided guidance from the EAR Team to help consolidate the PA-specific records to create “Any” for this statewide workpaper submission for all nonresidential building types with the exception to “Com” and removed “IOU” for building location to only include all 16 California climate zones.

BldgLoc	Convert from PA to Any, as shown	Comment
CZ01	PGE	
CZ02	PGE	
CZ03	PGE	
CZ04	PGE	
CZ05	PGE	
CZ06	SCE/SCG	For predominantly electric measure records, delete SCG record; for predominantly gas measure records, delete SCE record.
CZ07	SDG	
CZ08	SCE/SCG	For predominantly electric measure records, delete SCG record; for predominantly gas measure records, delete SCE record.
CZ09	SCE/SCG	For predominantly electric measure records, delete SCG record; for predominantly gas measure records, delete SCE record.
CZ10	SCE/SCG	For predominantly electric measure records, delete SCG record;

		for predominantly gas measure records, delete SCE record.
CZ11	PGE	
CZ12	PGE	
CZ13	PGE	
CZ14	SCE/SCG	For predominantly electric measure records, delete SCG record; for predominantly gas measure records, delete SCE record.
CZ15	SCE/SCG	For predominantly electric measure records, delete SCG record; for predominantly gas measure records, delete SCE record.
CZ16	SCE/SCG	For predominantly electric measure records, delete SCG record; for predominantly gas measure records, delete SCE record.

PEAK ELECTRIC DEMAND REDUCTION (kW)

The peak demand reduction values were drawn directly from the Database for Energy Efficient Resources (DEER), following the same approach as the electric savings. See Electric Savings.

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.”³ This approach provides a reasonable RUL estimate without the requiring any a priori knowledge about the age of the equipment being replaced.⁴ 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.”⁵

The EUL specified below was defined in Resolution E-4818⁶ and subsequently stipulated in Resolution E-4952.⁷

Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs)	3.0	California Public Utilities Commission (CPUC). 2018. <i>Resolution E-4952</i> . October 11. Page A-36.
RUL	n/a	-

BASE CASE MATERIAL COST (\$/UNIT)

The base case is the existing equipment; therefore, the base case cost is \$0.

MEASURE CASE MATERIAL COST (\$/UNIT)

The material cost per ton was derived from the average cost per ton from a cost survey conducted of eight active, program-participating contractors and technicians.

BASE CASE LABOR COST (\$/UNIT)

The base case is the existing equipment; therefore, the base case labor cost is \$0.

MEASURE CASE LABOR COST (\$/UNIT)

The labor cost per ton was derived from the average cost per ton from a cost survey conducted of eight active, program-participating contractors and technicians.

³ California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 32.

⁴ KEMA, Inc. 2008. "Summary of EUL-RUL Analysis for the April 2008 Update to DEER." Memorandum submitted to Itron, Inc.

⁵ California Public Utilities Commission (CPUC). 2016. Resolution E-4807. December 16. Page 13.

⁶ California Public Utilities Commission (CPUC). 2017. *Resolution E-4818*. February 9. Page 9.

⁷ California Public Utilities Commission (CPUC). 2018. *Resolution E-4952*. October 11. Page A-36.

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 commercial refrigerant charge NTG value, stipulated in Resolution E-4952⁸ is based upon results of an impact evaluation study of commercial sector HVAC quality maintenance programs implemented in California.⁹

Net-to-Gross Ratios

Parameter	Value	Source
NTG - Commercial Refrigerant Charge	0.45	DNV GL. 2017. <i>Impact Evaluation of 2015 Commercial Quality Maintenance Programs (HVAC3)</i> . Prepared for the California Public Utilities Commission. April 7. Table 5. Page 7.

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 based on the weighted average of the commercial and industrial refrigerant charge adjustment measure installation rates reported in an impact evaluation study of 2006-2008 HVAC “high impact” measures.¹⁰

Gross Savings Installation Adjustment

Parameter	Value	Source
GSIA - Commercial Refrigerant Charge & Airflow Adjustment	0.638	KEMA, Inc., The Cadmus Group, Inc., and Summit Blue Consulting, LLC. 2010. <i>Evaluation Measurement and Verification of the California Public Utilities Commission HVAC High Impact Measures and Specialized Commercial Contract Group Programs. 2006 – 2008 Program Year. Final Consultant Report. Volume 1</i> . Prepared for the California Public Utilities Commission. February 10. Table 3-1. Page 13.

NON-ENERGY IMPACTS

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

⁸ California Public Utilities Commission (CPUC). 2018. *Resolution E-4952*. October 11. Page A-35.

⁹ DNV GL. 2017. *Impact Evaluation of 2015 Commercial Quality Maintenance Programs (HVAC3)*. Prepared for the California Public Utilities Commission. April 7. Table 5. Page 7.

¹⁰ KEMA, Inc., The Cadmus Group, Inc., and Summit Blue Consulting, LLC. 2010. *Evaluation Measurement and Verification of the California Public Utilities Commission HVAC High Impact Measures and Specialized Commercial Contract Group Programs. 2006 – 2008 Program Year. Final Consultant Report. Volume 1*. Prepared for the California Public Utilities Commission. February 10. Table 3-1. Page 13.

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
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	Yes
DEER Measure Case	Yes
DEER Building Types	Yes
DEER Operating Hours	Yes
DEER eQUEST Prototypes	Yes
DEER Version	DEER 2020, READI v2.5.1
Reason for Deviation from DEER	No deviation from DEER
DEER Measure IDs Used	Yes
NTG	Source: HVAC3. The NTG of 0.45 is associated with NTG ID: <i>NonRes-HVAC-maint</i>
GSIA	Source: Evaluation Measurement and Verification of the California Public Utilities Commission HVAC High Impact Measures and Specialized Commercial Contract Group Programs The GSIA of 0.638 is associated with GSIA ID: <i>Com-RCA-All</i>
EUL/RUL	Source: E-4818. The value of 3 years is associated with EUL ID: <i>HVAC-RefChg</i>

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision
01	06/07/2019	Keith Valenzuela, Engineering Manager, AESC	Draft of consolidated text for this statewide measure is based upon: WPSDGENRHCO022_R2_Refrigerant Charge PGE3PHVC160_R4_Refrigerant Charge Adjustment Consensus reached among Cal TF members.
	06/09/2019	Jennifer Holmes, Cal TF Staff	Revisions for submittal of version 01
	06/27/2019	Kelvin Valenzuela, SDG&E	Accepted Track Changes
	7/22/2019	Kelvin Valenzuela, SDG&E	Removed SWSV002C and SWSV002D to adhere to E-4867, page 64.