

**H V A C**

W A T E R - C O O L E D C H I L L E R

SWHC005-02

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# MEASURE NAME

Water-cooled Chiller

# STATEWIDE MEASURE ID

SWHC005-02

# TECHNOLOGY SUMMARY

Chilled water systems use a central plant chiller(s) to cool and distribute water that is in turn used to cool air to meet building cooling demand. Water-cooled chillers use a condenser water loop and cooling towers to reject heat from the refrigeration cycle, generally achieving higher efficiencies relative to air- cooled systems. Water-cooled chillers are common in commercial and industrial applications and are available in a wide range of capacities, generally from 100 tons to several thousand tons.

Electrically operated water-cooled chillers are categorized by compressor type and tonnage capacity in efficiency standards such as ASHRAE 90.1 2016[1](#_bookmark0) and the California 2019 Building Energy Efficiency Standards (Title 24 2019).[2](#_bookmark1) Compressor technologies include positive displacement (reciprocating and rotary screw or scroll) and centrifugal.

The efficiency ratings for a water-cooled chiller are based on the unit operating under standard test conditions, normally determined by AHRI Standard 550/590 – 2016[3](#_bookmark2). Chillers have two different energy efficiency rated conditions: 1) Full load efficiency (EER, kWh/Ton) and 2) Part load efficiency (Integrated Part Load Value (IPLV)).

# MEASURE CASE DESCRIPTION

The measure case is defined as a variable speed water-cooled chiller for use in nonresidential buildings that exceeds the minimum efficiency requirements set forth by the California 2019 Building Energy Efficiency Standards (Title 24) in both full load and integrated part load conditions. In conformance to Resolution E-4952[4](#_bookmark3) two tiers of measure offerings are defined as follows:

* Tier 1, both the full load efficiency (kW/Ton) AND integrated part load efficiency (IPLV) of the chiller technology should exceed Title 24 minimum requirement by 10%.

1 American Society of Refrigeration and Air-conditioning Engineers (ASHRAE), 2016. *ANSI/ASHRAE/IES Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings*.

2 California Energy Commission (CEC). 2018. *2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings.* CEC-400-2018-020-CMF.

3 Air-Conditioning, Heating, and Refrigeration Institute (AHRI). 2016. *AHRI Standard 550/590 (I-P): Standard for Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle.* Arlington (VA): AHRI. Re- published with Errata Sheet. February.

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

* Tier 2, both the full load efficiency (kW/Ton) AND integrated part load efficiency (IPLV) of the chiller technology should exceed Title 24 minimum requirement by 15%.

Measure offering are required to meet both full load and integrated part load efficiency requirements specified below.

Measure Case Specification

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Statewide Measure Offering ID | Measure Offering | Nominal capacity (tons) | % Exceeds Title 24 | Full load (kW/Ton) | IPLV  (kW/Ton) |
| SWHC005I | Centrifugal w/ Conventional VSD | < 150 | 15% | 0.591 | 0.374 |
| SWHC005J | 10% | 0.626 | 0.396 |
| SWHC005A | Centrifugal w/ Conventional VSD | 150 - 299 | 15% | 0.540 | 0.340 |
| SWHC005B | 10% | 0.572 | 0.360 |
| SWHC005C | Centrifugal w/ Conventional VSD | 300 - 399 | 15% | 0.506 | 0.332 |
| SWHC005D | 10% | 0.536 | 0.351 |
| SWHC005E | Centrifugal w/ Conventional VSD | 400 - 599 | 15% | 0.497 | 0.323 |
| SWHC005F | 10% | 0.527 | 0.342 |
| SWHC005G | Centrifugal w/ Conventional VSD | ≥ 600 | 15% | 0.497 | 0.323 |
| SWHC005H | 10% | 0.527 | 0.342 |
| SWHC005S | Variable Speed Screw | < 75 | 15% | 0.663 | 0.425 |
| SWHC005T | 10% | 0.702 | 0.450 |
| SWHC005O | Variable Speed Screw | 75 - 149 | 15% | 0.638 | 0.417 |
| SWHC005P | 10% | 0.675 | 0.441 |
| SWHC005K | Variable Speed Screw | 150 - 299 | 15% | 0.578 | 0.374 |
| SWHC005L | 10% | 0.612 | 0.396 |
| SWHC005M | Variable Speed Screw | 300 - 599 | 15% | 0.531 | 0.349 |
| SWHC005N | 10% | 0.563 | 0.369 |
| SWHC005Q | Variable Speed Screw | ≥ 600 | 15% | 0.497 | 0.323 |
| SWHC005R | 10% | 0.527 | 0.342 |

# BASE CASE DESCRIPTION

The base case is defined as a variable speed water-cooled chiller for use in a nonresidential building that meets the minimum efficiency requirements set forth by the California Building Energy Efficiency Standards (Title 24) in both full load and integrated part load conditions. (See Code Requirements.)

# CODE REQUIREMENTS

Applicable state and federal codes and standards for water-cooled chillers are specified below.

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 110.2 (a), Table 110.2-D | January 1, 2020 |
| Federal Standards | None | n/a |

The California 2019 Building Energy Efficiency Standards (Title 24)[5](#_bookmark4) requires water chillers to meet minimum full-load efficiency (kW/ton) and minimum integrated part-load efficiency (IPLV) values. The Title 24 2019 base case for this above-code measure is listed in section 110.2 (a) Table 110.2-D.

Title 24 also specifies alternate efficiency compliance paths for chiller technology. Path A requires a high full-load efficiency while Path B sets a lower minimum full-load efficiency than Path A but requires a higher minimum integrated part-load efficiency. The measure offerings specified for this measure are variable speed chillers that fall under Path B compliance.

For a given chiller, there will always be both a rated full-load (kW/Ton) and part-load (IPLV) efficiency. The selection of an efficiency tier level must be based on both of these parameters. If the rated full-load efficiency and the rated IPLV are both greater than or equal to the DEER stablished tier levels, then that tier is valid.

Water-cooled chillers with a leaving evaporator fluid temperature higher than 32°F shall show compliance with Table 110.2-D of Title 24 when tested or certified with water at standard rating conditions. The table below shows the requirements for Path B compliance.

Water Chilling Packages - Minimum Efficiency Requirements: Path B[6](#_bookmark5)

|  |  |  |  |
| --- | --- | --- | --- |
| Equipment Type | Size Category (tons) | Maximum Allowable Full-load  (kW/ton) | Maximum Allowable IPLV  (kW/ton) |
| Centrifugal w/ Conventional VSD | < 150 | 0.695 | 0.440 |
| Centrifugal w/ Conventional VSD | 150 - 299 | 0.635 | 0.400 |
| Centrifugal w/ Conventional VSD | 300 - 399 | 0.595 | 0.390 |
| Centrifugal w/ Conventional VSD | 400 - 599 | 0.585 | 0.380 |
| Centrifugal w/ Conventional VSD | ≥ 600 | 0.585 | 0.380 |
| Variable Speed Screw | < 75 | 0.780 | 0.500 |
| Variable Speed Screw | 75 - 149 | 0.750 | 0.490 |
| Variable Speed Screw | 150 - 299 | 0.680 | 0.440 |
| Variable Speed Screw | 300 - 599 | 0.625 | 0.410 |
| Variable Speed Screw | ≥ 600 | 0.585 | 0.380 |

5 California Energy Commission (CEC). 2018. *2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24).* CEC-400-2018-020-CMF.

6 California Energy Commission (CEC). 2018. *2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24).* CEC-400-2018-020-CMF. Table 110.2-D.

# 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 |
| Normal replacement (NR) | UpDeemed | Com |
| New construction (NC) | UpDeemed | Com |
| Normal replacement (NR) | DnDeemed | Com |
| New construction (NC) | DnDeemed | Com |
| Normal replacement (NR) | DnDeemDI | Com |
| New construction (NC) | DnDeemDI | Com |
| Normal replacement (NR) | UpDeemed | Ind |
| New construction (NC) | UpDeemed | Ind |
| Normal replacement (NR) | DnDeemed | Ind |
| New construction (NC) | DnDeemed | Ind |
| Normal replacement (NR) | DnDeemDI | Ind |
| New construction (NC) | DnDeemDI | Ind |

For midstream and upstream deliveries, when possible, the program administrator (PA) shall claim the “specific building type savings” in which the equipment will be installed and submit that information at claims level on CEDARS website. In cases where there is no “building type” information available for a given project, program administrator shall claim the weighted savings of “Com” building type.

*Eligible Products*

Units are required to meet both full load and integrated part load efficiency requirements specified in the Measure Case Description.

*Eligible Building Types and Vintages*

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

*Eligible Climate Zones*

This measure is applicable in all California climate zones.

# PROGRAM EXCLUSIONS

All measures related to constant speed screw, constant speed centrifugal, and frictionless chillers are excluded due to the stringency of the tiers specified for the 2020 update of the Database of Energy Efficient Resources (DEER) and equipment availability in the market.

# DATA COLLECTION REQUIREMENTS

Data requirements include a market assessment of latest chiller technology including performance characterization to support the update/expansion of measure offerings and to evaluate efficiency tiers to better align with market.

Further, Path B chillers focus primarily on integrated part load value (IPLV) and less on full-load efficiency. Hence, specifying the same efficiency tiers for full-load efficiency and IPLV will not allow Path B chillers to meet the measure requirements. Resolution E-4952[7](#_bookmark6) recognizes that establishing a threshold for efficiency based solely on the IPLV would require a considerable primary research effort.

# USE CATEGORY

HVAC

# ELECTRIC SAVINGS (kWh)

The electric unit energy savings (UES) of a water-cooled chiller were retrieved directly from the Database of Energy Efficient Resources (DEER). The version used to support savings for these measures is DEER 2020 (version D20 v0). The results were reported in the Remote Ex-Ante Database Interface (READI) tool v2.5.1.

7 California Public Utilities Commission (CPUC). 2018. *Resolution E-4952.* October 11. Page A-64.

8 Air-Conditioning, Heating, and Refrigeration Institute (AHRI). 2016. AHRI Standard 550/590 (I-P): *Standard for Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle.* Arlington (VA): AHRI. Re- published with Errata Sheet. February.

9 Values were available for the following building types: education - community college (ECC), education - secondary school (Ese), education - university (EUn), health/medical – hospital (Hsp), lodging – hotel (Htl), manufacturing – biotech (MBT), health/medical – nursing home (Nrs), office – large (OfL), office – small (OfS), retail – multi-story large (Rt3).

The DEER Energy Impact IDs and the associated Measure Offering IDs and description are provided below.

Measure Offering IDs and DEER Measure IDs

|  |  |  |
| --- | --- | --- |
| Statewide Measure  Offering ID | DEER Energy Impact ID | Measure Offering Description |
| SWHC005A | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-150to299tons-0.54kwpton- 0.34IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (150 to 299 tons, 0.54 Max kW/ton, 0.34 Max IPLV) |
| SWHC005B | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-150to299tons-0.572kwpton-  0.36IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (150 to 299 tons, 0.572  Max kW/ton, 0.36 Max IPLV) |
| SWHC005C | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-300to399tons-0.506kwpton-  0.332IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (300 to 399 tons, 0.506  Max kW/ton, 0.332 Max IPLV) |
| SWHC005D | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-300to399tons-0.536kwpton- 0.351IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (300 to 399 tons, 0.536 Max kW/ton, 0.351 Max IPLV) |
| SWHC005E | NE-HVAC-Chlr-WtrCldCentChlr-Conv-  1Cmp-400to599tons-0.497kwpton- 0.323IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD  compressor and condenser relief (400 to 599 tons, 0.497 Max kW/ton, 0.323 Max IPLV) |
| SWHC005F | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-400to599tons-0.527kwpton-  0.342IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (400 to 599 tons, 0.527  Max kW/ton, 0.342 Max IPLV) |
| SWHC005G | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-gte600tons-0.497kwpton- 0.323IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (>= 600 tons, 0.497 Max kW/ton, 0.323 Max IPLV) |
| SWHC005H | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-gte600tons-0.527kwpton-  0.342IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (>= 600 tons, 0.527 Max  kW/ton, 0.342 Max IPLV) |
| SWHC005I | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-lt150tons-0.591kwpton-  0.374IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (< 150 tons, 0.591 Max  kW/ton, 0.374 Max IPLV) |
| SWHC005J | NE-HVAC-Chlr-WtrCldCentChlr-Conv- 1Cmp-lt150tons-0.626kwpton- 0.396IPLV-VarSpd-CndRlf | Water Cooled Centrifugal Chiller w/1 conventional VSD compressor and condenser relief (< 150 tons, 0.626 Max kW/ton, 0.396 Max IPLV) |
| SWHC005K | NE-HVAC-Chlr-WtrCldScrewChlr- 150to299tons-0.578kwpton-  0.374IPLV-VarSpd | Water Cooled Variable Speed Screw Chiller (150 to 299 tons, 0.578 Max kW/ton, 0.374 Max IPLV) |
| SWHC005L | NE-HVAC-Chlr-WtrCldScrewChlr- 150to299tons-0.612kwpton-  0.396IPLV-VarSpd | Water Cooled Variable Speed Screw Chiller (150 to 299 tons, 0.612 Max kW/ton, 0.396 Max IPLV) |
| SWHC005M | NE-HVAC-Chlr-WtrCldScrewChlr- 300to599tons-0.531kwpton- 0.349IPLV-VarSpd | Water Cooled Variable Speed Screw Chiller (300 to 599 tons, 0.531 Max kW/ton, 0.349 Max IPLV) |
| SWHC005N | NE-HVAC-Chlr-WtrCldScrewChlr- 300to599tons-0.563kwpton-  0.369IPLV-VarSpd | Water Cooled Variable Speed Screw Chiller (300 to 599 tons, 0.563 Max kW/ton, 0.369 Max IPLV) |

|  |  |  |
| --- | --- | --- |
| Statewide Measure Offering ID | DEER Energy Impact ID | Measure Offering Description |
| SWHC005Q | NE-HVAC-Chlr-WtrCldScrewChlr- 75to149tons-0.638kwpton-0.417IPLV-  VarSpd | Water Cooled Variable Speed Screw Chiller (75 to 149 tons, 0.638 Max kW/ton, 0.417 Max IPLV) |
| SWHC005R | NE-HVAC-Chlr-WtrCldScrewChlr- 75to149tons-0.675kwpton-0.441IPLV-  VarSpd | Water Cooled Variable Speed Screw Chiller (75 to 149 tons, 0.675 Max kW/ton, 0.441 Max IPLV) |
| SWHC005Q | NE-HVAC-Chlr-WtrCldScrewChlr- gte600tons-0.497kwpton-0.323IPLV- VarSpd | Water Cooled Variable Speed Screw Chiller (>= 600 tons,  0.497 Max kW/ton, 0.323 Max IPLV) |
| SWHC005R | NE-HVAC-Chlr-WtrCldScrewChlr- gte600tons-0.527kwpton-0.342IPLV-  VarSpd | Water Cooled Variable Speed Screw Chiller (>= 600 tons,  0.527 Max kW/ton, 0.342 Max IPLV) |
| SWHC005S | NE-HVAC-Chlr-WtrCldScrewChlr- lt75tons-0.663kwpton-0.425IPLV-  VarSpd | Water Cooled Variable Speed Screw Chiller (< 75 tons, 0.663 Max kW/ton, 0.425 Max IPLV) |
| SWHC005T | NE-HVAC-Chlr-WtrCldScrewChlr- lt75tons-0.702kwpton-0.45IPLV- VarSpd | Water Cooled Variable Speed Screw Chiller (< 75 tons, 0.702 Max kW/ton, 0.45 Max IPLV) |

UES values in READi were available as variables of climate zone, nonresidential building types,[9](#_bookmark8) vintage (old, existing, recent and new) and PA (SCE, PGE and SDGE).

Since certain chiller upstream programs may not be able to track the specific building type where the chiller installation occurs, commercial “Com” building type was created by consolidating the energy impacts of specific building type.

Additionally, for ease of implementation, the old and existing vintages were consolidated into existing “Ex” vintage, recent vintage (2017 to 2020) was eliminated because normal replacement typically do not happen for equipment installed in these years, and the PAs were consolidated to “Any” for climates zones falling in multiple PA territories.

All these consolidations were performed using DEER2020 building weights.[[1]](#footnote-1)

DEER2020 building weights are available as a function of program administrator (PA), building type, building location (climate zone, CZ), and building vintage (by model year). Year-style vintages were mapped to DEER2020 style vintages (old, “ex” representing median existing, recent, and new), according to the DEER 2020 update, page A-22, table 4. Consolidation of building weights and UES was performed as follows to match with the measure offerings.

1. Since the measure offerings distinguish building age at the era-style vintages, the weights table as indexed by year-style vintage needed to be transformed to align with the indexing of the DEER measure UES and measure offerings. Example, weights for model year vintages 2003 to 2015 (representing buildings with actual vintages from 2002 to 2016) were summed to determine the weights of the “ex” era for each combination of PA, building type, and building location.
2. The DEER2020 UES values for “new” are provided for “Any” PA; however, the weights table is indexed by specific PAs. Hence, for “new”, the weights of all the PAs were combined in each climate zone that intersects the service areas of more than one PA.
3. The DEER2020 UES values for “old, ex, recent” are provided for each specific PA (SCE, PGE, SDG), so there are multiple UES entries in each climate zone that intersects more than one PA service area. For example, “ex” vintage UES for CZ15 are provided for SCE, PGE, and SDG. In such cases the corresponding PA specific weights from Step 1 were applied.
4. For ease of implementation the UES values for “old” and “ex” were consolidated using weighted average into “ex”, and “rec” was removed.
5. Finally, using the above steps, weighted average energy and demand UES were calculated and presented as combinations for any PA; commercial (com) building type; ex and new vintages and all 16 CZs. Please refer to the calculation file[11](#_bookmark10) for details.

Note that the measure impacts were based on DEER2020 impact IDs “AStdWBkWh” for energy, “AStdWBkW” for peak demand, and “AstdWBtherm” for fuel consumption; for all nonresidential building types and all 16 California climate zones.

# PEAK ELECTRIC DEMAND REDUCTION (kW)

The peak demand reduction values for a water-cooled chiller were retrieved directly from the Database of Energy Efficient Resources (DEER). See Electric Savings for an explanation of the approach.

# 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 EUL and RUL specified for the water-cooled chiller measure are presented below. The estimated lifetime of a water-cooled chiller was derived as the median of estimates reported in various retention studies conducted in California. (A New England study reported an estimated life of 23 years[12](#_bookmark11) that was not accounted for in the EUL adopted for this measure, due to the 20-year cap imposed by the California Public Utilities Commission.[13](#_bookmark12)) Note that RUL is only applicable for add-on equipment and is not applicable for this measure.

11 Southern California Edison (SCE). 2019. “SHWC005-02 Water-cooled chiller analysis.xlsx.”

12 GDS Associates, Inc. 2007. *Measure Life Report Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for the New England State Program Working Group (SPWG).*

13 California Public Utilities Commission (CPUC), Energy Division. 2003. *Energy Efficiency Policy Manual v 2.0.* Page 16.

Effective Useful Life and Remaining Useful Life

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Source |
| EUL (yrs) – measure | 20.0 | San Diego Gas & Electric (SDG&E), Marketing Programs & Planning. 2004. *1994 & 1995 Commercial Energy Efficiency Incentives Ninth Year Retention Evaluation*. Study ID Nos. 925 & 961.  Southern California Edison Company. 2006. *Southern California Edison Commercial/ Industrial/ Agricultural Energy Efficiency Incentives Program Ninth Year Retention Study.* CEC Study ID #558 Calmac Study ID: SCE 0243.01.  ADM Associates, Inc. 2003. *Southern California Edison Commercial/Industrial/Agricultural Energy Efficiency Incentives Program Retention Study*. Prepared for Southern California Edison Company.  San Diego Gas & Electric. 2006. *1996 & 1997 Nonresidential New Construction Program Ninth Year Retention Evaluation*. Study ID No. 1006. |
| RUL (yrs) | n/a | - |

# BASE CASE MATERIAL COST ($/UNIT)

The material cost data for baseline and measure case water -cooled chillers was gathered from two equipment manufacturers who also participate in Upstream HVAC program. This data was collected in October - November 2020 and includes the average equipment cost per ton for the two capacity ranges and three efficiency tiers (baseline, Tier 1 and Tier 2). The average of the two manufactures cost was used as the average equipment cost. See the cost calculation[[2]](#footnote-2) for details.

The manufacturers were not able to provide a full set of data for water-cooled chiller offerings due to transaction of equipment gaps at some high efficiency levels. To support a full map of cost information, a mixture of extrapolation and a reliance on the previous versions of the workpapers’ costing (from 2016-2017) were used.

# MEASURE CASE MATERIAL COST ($/UNIT)

Same methodology as base case material cost.

# BASE CASE LABOR COST ($/UNIT)

The labor cost is expected to be the same for the installations of base case and measure case equipment. Because the labor cost cancels out in the incremental measure cost calculation, the labor cost was not determined.

# MEASURE CASE LABOR COST ($/UNIT)

The labor cost is expected to be the same for the installations of base case and measure case equipment. Because the labor cost cancels out in the incremental measure cost calculation, the labor cost was not determined.

# 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.

For midstream program, the NTG value is based on DEER NTG ID: NonRes-sAll-mHVAC-WCchiller, DEER2022 version and directed by Resolution E-5082 based on 2018 EM&V results. This NTG is applicable to all non-residential water-cooled chillers.

For downstream program, the NTG value is based on DEER NTG IDs: Com-Default>2yrs and Ind-Default>2yrs, DEER2019 version. This is further based upon the average of all NTG ratios for all evaluated 2006 – 2008 commercial and industrial programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. This sector average NTG (“default NTG”) is applicable to all energy efficiency measures that have been offered through commercial and industrial sector programs for more than two years and for which impact evaluation results are not available.

Net-to-Gross Ratios

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Source |
| NTG – nonresidential – midstream/upstream | 0.80 | Resolution E-5082 (DEER2022 updates) based on 2018 EM&V results. August 27, 2020 |
| NTG – commercial – downstream | 0.60 | Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3. |
| NTG – industrial – downstream | 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) 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.

Gross Savings Installation Adjustment Rates

|  |  |  |
| --- | --- | --- |
| Parameter | Value | 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 inputs and methods from 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 | 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 | n/a |
| DEER Measure IDs Used | NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-lt150tons-0.591kwpton-0.374IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-lt150tons-0.626kwpton-0.396IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-150to299tons-0.54kwpton-0.34IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-150to299tons-0.572kwpton-0.36IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-300to399tons-0.506kwpton-0.332IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-300to399tons-0.536kwpton-0.351IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-400to599tons-0.497kwpton-0.323IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-400to599tons-0.527kwpton-0.342IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-gte600tons-0.497kwpton-0.323IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldCentChlr-Conv-1Cmp-gte600tons-0.527kwpton-0.342IPLV- VarSpd-CndRlf  NE-HVAC-Chlr-WtrCldScrewChlr-lt75tons-0.663kwpton-0.425IPLV-VarSpd NE-HVAC-Chlr-WtrCldScrewChlr-lt75tons-0.702kwpton-0.45IPLV-VarSpd  NE-HVAC-Chlr-WtrCldScrewChlr-150to299tons-0.578kwpton-0.374IPLV-VarSpd NE-HVAC-Chlr-WtrCldScrewChlr-150to299tons-0.612kwpton-0.396IPLV-VarSpd NE-HVAC-Chlr-WtrCldScrewChlr-300to599tons-0.531kwpton-0.349IPLV-VarSpd NE-HVAC-Chlr-WtrCldScrewChlr-300to599tons-0.563kwpton-0.369IPLV-VarSpd NE-HVAC-Chlr-WtrCldScrewChlr-75to149tons-0.638kwpton-0.417IPLV-VarSpd NE-HVAC-Chlr-WtrCldScrewChlr-75to149tons-0.675kwpton-0.441IPLV-VarSpd NE-HVAC-Chlr-WtrCldScrewChlr-gte600tons-0.497kwpton-0.323IPLV-VarSpd NE-HVAC-Chlr-WtrCldScrewChlr-gte600tons-0.527kwpton-0.342IPLV-VarSpd |
| NTG | Source:  DEER2022. The NTG of 0.80 for midstream program is associated with NTG ID: *NonRes-sAll-mHVAC-WCchiller*  DEER2019. The NTG of 0.60 for downstream program, commercial is associated with NTG ID: *Com-Default>2yrs*  DEER2019. The NTG of 0.60 for downstream program, industrial is associated with NTG ID: *Ind-Default>2yrs* |
| GSIA | Source: DEER2011. The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA* |
| EUL/RUL | Source: DEER2014. The value of 20 years is associated with EUL ID: *HVAC-Chlr*. |

# REVISION HISTORY

Measure Characterization Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Revision Number | Revision Complete Date | Primary Author, Title, Organization | Revision Summary and Rationale for Revision |
| 01 | 06/30/2018 | Jennifer Holmes Cal TF Staff | Draft of consolidated text for this statewide measure is based upon: |
|  |  |  | SCE17HCO43, Revision 0 (November 14, 2017) |
|  |  |  | SCE13HC043, Revision 2 (January 15, 2016) |
|  |  |  | SCE13HC043, Revision 1 (May 14, 2014) |
|  |  |  | Consensus reached among Cal TF members. |
|  | 05/06/2019 | Akhilesh Endurthy Solaris Technical | Updated based on DEER2020/ E-4952 New Statewide workpaper template  Add New Construction (NC) MAT |
|  | 05/31/2019 | Jennifer Holmes Cal TF Staff | Revisions for submittal of version 01. |
| 02 | 11/18/2020 | Jenna Moon  Solaris-Technical | Updated costs using data collected in October-November 2020  Added non-residential building specific energy impacts  Added SCE’s data tracking requirements  Updated NTG value and ID for midstream program based on Resolution E-5082 |

1. California Public Utilities Commission (CPUC), Energy Division. (n.d.) “DEER2020-Building-Weights.xlsx.” [↑](#footnote-ref-1)
2. Southern California Edison (SCE). 2017. “SWHC005-02 Air-Cooled Chiller-Cost Calculations.xlsx.” [↑](#footnote-ref-2)