

**Work Paper PGECO HVC126  
Unitary Air-Cooled Commercial A/C and  
H/P <65kBtu/h  
Revision #7**

**Pacific Gas & Electric Company**  

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**Customer Energy Solutions**

**Packaged and Split Air-  
Cooled Commercial Air  
Conditioner and Heat  
Pump Units, less than 65k  
Btu/h**

Measure Codes: HV241, HV242, HV243, HV244, HV245, HV246, HV247, HV248, HV249,  
HV250, HV251, HV252, HV253, HV254, HV255, HV256, HV257, HV258, HV259, HV260,  
HV261, HV262, HV263, HV264, HV265, HV266, HV267, HV268, HV269, HV270, HV271,  
HV272, HV273, HV274, HV275, HV276

July 1, 2017

## AT-A-GLANCE SUMMARY

|  |  |
|--|--|
| <b>Applicable Measure Codes:</b>             | HV241, HV242, HV243, HV244, HV245, HV246, HV247, HV248, HV249, HV250, HV251, HV252, HV253, HV254, HV255, HV256, HV257, HV258, HV259, HV260, HV261, HV262, HV263, HV264, HV265, HV266, HV267, HV268, HV269, HV270, HV271, HV272, HV273, HV274, HV275, HV276 |
| <b>Measure Description:</b>                  | Air cooled air conditioning or heat pump units with cooling capacities less than 65 kBtuh, for use in non-residential buildings, meeting the minimum efficiency requirements listed in Table 2.  |
| <b>Energy Impact Common Units:</b>           | kW/ton, kWh/ton, therms/ton of cooling   |
| <b>Base Case Description:</b>                | Air cooled air conditioning or heat pump units with cooling capacities less than 65 kBtuh, for use in non-residential buildings, meeting the federal minimum efficiency standard of 14 SEER.   |
| <b>Base Case Energy Consumption:</b>         | Source: DEER2016 READi (Version 2.3.0)   |
| <b>Measure Energy Consumption:</b>           | Source: DEER2016 READi (Version 2.3.0)   |
| <b>Energy Savings (Base Case – Measure):</b> | Source: DEER2016 READi (Version 2.3.0)<br>Varies by climate zone   |
| <b>Costs Common Units:</b>                   | \$/ton of cooling.   |
| <b>Base Case Equipment Cost (\$/unit):</b>   | Source: DEER2016 and Engineering Calculations.<br>Varies depending on system capacity.   |
| <b>Measure Equipment Cost (\$/unit):</b>     | Source: DEER2016 and Engineering Calculations.<br>Varies depending on system capacity.   |
| <b>Gross Measure Cost (\$/unit)</b>          | Source: DEER2016 and Engineering Calculations.<br>Varies depending on system capacity.   |
| <b>Measure Incremental Cost (\$/unit):</b>   | Source: DEER2016 and Engineering Calculations.<br>Varies depending on system capacity.   |
| <b>Effective Useful Life (years):</b>        | Source: DEER2016<br>15 years, based on Nonresidential “Air Conditioners/Heat Pumps (split and unitary)”  |
| <b>Measure Application Type:</b>             | Replace on Burnout (ROB)   |
| <b>Net-to-Gross Ratios:</b>                  | Source: DEER2016.<br>NTG = 0.75, NonRes-sAll-mHVAC-DX-up for “All package and split system AC & HP replacements.”  |
| <b>Important Comments:</b>                   | PG&E is not doing early retirement. For measures HV264 and HV268 which are 18 SEER, savings claimed will be 17 SEER from DEER2016  |

## DOCUMENT REVISION HISTORY

| Revision #          | Revision Date         | Author (Affiliation)                             | Summary of Changes  |
|---------------------|-----------------------|--|---|
| 0                   | 5/16/2012             | Alex MacCurdy/Elizabeth Joyce (Energy Solutions) | Updated to SCE Work Paper Template 2013 v0.1<br>Updated scaling factor calculation for Tiers 2, 3 and 4.<br>Added Heat Pump Units   |
| 1                   | 11/18/2013            | Alfredo Gutierrez (SCE)                          | Updated the work paper with the following: <ul style="list-style-type: none"> <li>• New delivery early retirement delivery method which includes Added RET for all existing measures</li> <li>• Savings and Costs for RET are actually RET-ROB values in order to prevent the HVAC Upstream program from double counting the savings</li> </ul>   |
| 2                   | 1/27/2014             | Alfredo Gutierrez (SCE)                          | Added in the following building type to be consistent with the ED filed REV 0 of this work paper: <ul style="list-style-type: none"> <li>• Miscellaneous Commercial</li> <li>• RET Measures have been separated into two new solution codes.</li> </ul>   |
| 3                   | 4/17/2014             | Jason Wang (SCE)                                 | - Work paper updated for the reporting period, effective 7/1/14 – 12/31/14<br>- Updated savings and scaling factors using DEER 2014 values<br>- Split measures into the <55 kBtuh and 55-64 kBtuh ranges<br>- Added SEER 14.5 HP measures (SCE13HC019 was merged into this work paper)<br>- Added SEER 18 AC and HP measures<br>- Added the Com building type for PG&E<br>- Added all building types available from DEER that were not already present in the work paper  |
| 4 (SCE)<br>5 (PG&E) | 1/1/2015<br>1/27/2015 | Jason Wang (SCE)<br>Chris Li (PG&E)              | Updated work paper for DEER 2015 measures and federal code 430.32: <ul style="list-style-type: none"> <li>• Most measures now using DEER savings directly; SEER 15, 16, 17, and 18 measures were added to DEER 2015.</li> <li>• Removed SEER 14 AC, SEER 14 HP, and SEER 14.5 HP measures due to code and DEER direction.</li> <li>• Created new capacity ranges to accommodate EER and two-speed fan requirements. These align with DEER measures.</li> <li>• Used scaling of DEER measures to determine SEER 18 Packaged HP savings.</li> <li>• Calculated To Code savings using DEER measures (RET savings minus ROB savings).</li> <li>• Updated costs with values from WO017.</li> </ul> |
| 6                   | 4/8/2016              | Henry Liu (PG&E)                                 | <ul style="list-style-type: none"> <li>• Format update.</li> <li>• Updated NTG from DEER 2016.</li> <li>• Revised savings for HV264 and HV268 18 SEER to claim DEER 17 SEER savings.</li> </ul>   |
| 7                   | 11/16/2017            | Danielle Dragon, PE, CEM, CDSM (PG&E)            | <ul style="list-style-type: none"> <li>• Updated savings values for DEER2017 (effective date 7/1/2017)</li> </ul>   |

- Remove Early Retirement (SCE no longer supports)
- Added midstream
- Removed all non-COM building types
- Used "Packaged Heat Pump <55kBtuh 17 SEER (13 EER)" savings for "Packaged Heat Pump <55kBtuh 18 SEER (14 EER)"
- Used "Packaged Heat Pump 55to65kBtuh 17 SEER (13 EER)" savings for "Packaged Heat Pump 55to65kBtuh 18 SEER (14 EER)"

# SECTION 1: GENERAL MEASURE & BASELINE DATA

## 1.1 MEASURE DESCRIPTION & BACKGROUND

**Measure Description:** Air cooled air conditioning or heat pump units with cooling capacities less than 65 kBtuh, for use in non-residential buildings, meeting the minimum efficiency requirements listed in Table 2 below.

**Base Case Description:** Air cooled air conditioning or heat pump units with cooling capacities less than 65 kBtuh, for use in non-residential buildings, meeting the federal minimum efficiency standard of 14 SEER.

**Table 1: Measures and Codes**

| Solution Code | Measure Code | Measure Name  |
|---------------|--------------|---|
| AC-50375      | HV241        | <55kBtuh 15 SEER (12 EER) Packaged Air Conditioner          |
| AC-81566      | HV242        | <55kBtuh 16 SEER (12.4 EER) Packaged Air Conditioner        |
| AC-37735      | HV243        | <55kBtuh 17 SEER (13 EER) Packaged Air Conditioner          |
| AC-31588      | HV244        | <55kBtuh 18 SEER (14 EER) Packaged Air Conditioner          |
| AC-87532      | HV245        | 55to65kBtuh 15 SEER (12 EER) Packaged Air Conditioner       |
| AC-77878      | HV246        | 55to65kBtuh 16 SEER (12.4 EER) Packaged Air Conditioner     |
| AC-22408      | HV247        | 55to65kBtuh 17 SEER (13 EER) Packaged Air Conditioner       |
| AC-75087      | HV248        | 55to65kBtuh 18 SEER (14 EER) Packaged Air Conditioner       |
| AC-46105      | HV249        | <45kBtuh 15 SEER (12.5 EER) Split System Air Conditioner    |
| AC-83486      | HV250        | <45kBtuh 16 SEER (13 EER) Split System Air Conditioner      |
| AC-26490      | HV251        | <45kBtuh 17 SEER (13.5 EER) Split System Air Conditioner    |
| AC-50319      | HV252        | <45kBtuh 18 SEER (14 EER) Split System Air Conditioner      |
| AC-70613      | HV253        | 45to55kBtuh 15 SEER (12.5 EER) Split System Air Conditioner |
| AC-97648      | HV254        | 45to55kBtuh 16 SEER (13 EER) Split System Air Conditioner   |
| AC-66543      | HV255        | 45to55kBtuh 17 SEER (13.5 EER) Split System Air Conditioner |
| AC-96580      | HV256        | 45to55kBtuh 18 SEER (14 EER) Split System Air Conditioner   |
| AC-69747      | HV257        | 55to65kBtuh 15 SEER (12.5 EER) Split System Air Conditioner |
| AC-86967      | HV258        | 55to65kBtuh 16 SEER (13 EER) Split System Air Conditioner   |
| AC-61866      | HV259        | 55to65kBtuh 17 SEER (13.5 EER) Split System Air Conditioner |
| AC-87169      | HV260        | 55to65kBtuh 18 SEER (14 EER) Split System Air Conditioner   |
| AC-97980      | HV261        | <55kBtuh 15 SEER (12 EER) Packaged Heat Pump                |
| AC-92105      | HV262        | <55kBtuh 16 SEER (12.4 EER) Packaged Heat Pump              |
| AC-59729      | HV263        | <55kBtuh 17 SEER (13 EER) Packaged Heat Pump                |
| AC-65475      | HV264        | <55kBtuh 18 SEER (14 EER) Packaged Heat Pump                |
| AC-99784      | HV265        | 55to65kBtuh 15 SEER (12 EER) Packaged Heat Pump             |
| AC-60134      | HV266        | 55to65kBtuh 16 SEER (12.4 EER) Packaged Heat Pump           |
| AC-65806      | HV267        | 55to65kBtuh 17 SEER (13 EER) Packaged Heat Pump             |
| AC-62068      | HV268        | 55to65kBtuh 18 SEER (14 EER) Packaged Heat Pump             |
| AC-73283      | HV269        | <55kBtuh 15 SEER (12.5 EER) Split System Heat Pump          |
| AC-89637      | HV270        | <55kBtuh 16 SEER (13 EER) Split System Heat Pump            |
| AC-53855      | HV271        | <55kBtuh 17 SEER (13.5 EER) Split System Heat Pump          |

|          |       |  |
|----------|-------|--|
| AC-61202 | HV272 | <55kBtuh 18 SEER (14 EER) Split System Heat Pump                 |
| AC-62602 | HV273 | 55to65kBtuh 15 SEER (12.5 EER) Split System Heat Pump            |
| AC-71681 | HV274 | 55to65kBtuh 16 SEER (13 EER) Split System Heat Pump              |
| AC-94444 | HV275 | 55to65kBtuh 17 SEER (13.5 EER) Split System Heat Pump            |
| AC-89435 | HV276 | 55to65kBtuh 18 SEER (14 EER) Split System Heat Pump              |
| AC-67740 | N/A   | <55kBtuh To Code Savings Portion Packaged Air Conditioner        |
| AC-69545 | N/A   | 55to65kBtuh To Code Savings Portion Packaged Air Conditioner     |
| AC-50853 | N/A   | <45kBtuh To Code Savings Portion Split System Air Conditioner    |
| AC-56930 | N/A   | 45to55kBtuh To Code Savings Portion Split System Air Conditioner |
| AC-75420 | N/A   | 55to65kBtuh To Code Savings Portion Split System Air Conditioner |
| AC-83228 | N/A   | <55kBtuh To Code Savings Portion Packaged Heat Pump              |
| AC-73081 | N/A   | 55to65kBtuh To Code Savings Portion Packaged Heat Pump           |
| AC-53523 | N/A   | <55kBtuh To Code Savings Portion Split System Heat Pump          |
| AC-98919 | N/A   | 55to65kBtuh To Code Savings Portion Split System Heat Pump       |

### Implementation Requirements

Not applicable as early retirement offering has been removed.

### Documentation Requirements

Not applicable as early retirement offering has been removed.

### Efficiency Requirements

The minimum tier efficiency requirements are listed in Table 2. Tier 1 specifications are derived from the Tier 2 CEE Commercial Unitary Air Conditioner Specifications. Tiers 2, 3 and 4 have been added to promote higher efficiency units offered by the HVAC industry.

**Table 2: Minimum Efficiency Requirements**

|                                      | Program Tier | Minimum SEER | Minimum EER |
|--------------------------------------|--------------|--------------|-------------|
| <b>Packaged Air Conditioner</b>      | Code         | 14.0         | 11.6        |
|                                      | Tier 1       | 15.0         | 12.0        |
|                                      | Tier 2       | 16.0         | 12.4        |
|                                      | Tier 3       | 17.0         | 13.0        |
|                                      | Tier 4       | 18.0         | 14.0        |
| <b>Split System Air Conditioner</b>  | Code         | 14.0         | 12.0        |
|                                      | Tier 1       | 15.0         | 12.5        |
|                                      | Tier 2       | 16.0         | 13.0        |
|                                      | Tier 3       | 17.0         | 13.5        |
|                                      | Tier 4       | 18.0         | 14.0        |
| <b>Packaged Air Cooled Heat Pump</b> | Code         | 14.0         | 11.6        |
|                                      | Tier 1       | 15.0         | 12.0        |
|                                      | Tier 2       | 16.0         | 12.4        |
|                                      | Tier 3       | 17.0         | 13.0        |
|                                      | Tier 4       | 18.0         | 14.0        |
| <b>Split System Air</b>              | Code         | 14.0         | 12.0        |

|                         |        |      |      |
|-------------------------|--------|------|------|
| <b>Cooled Heat Pump</b> | Tier 1 | 15.0 | 12.5 |
|                         | Tier 2 | 16.0 | 13.0 |
|                         | Tier 3 | 17.0 | 13.5 |
|                         | Tier 4 | 18.0 | 14.0 |

In order to qualify for the program, units must meet either the SEER or EER requirement; units are not required to meet both specifications.

### Eligibility Requirements

- All unitary DX equipment is eligible. Central systems and DHW systems are not eligible.
- Replacement must be like for like: HP for HP; AC-only for AC-only.
- Retrofitted HVAC equipment must have cooling capacity (e.g., Btu/h) within +/- 5% of existing equipment OR contractor must provide a load calculation verifying that the new unit is sized correctly for the load.
- All non-residential building types and vintages are eligible for the upstream and midstream rebate.

## 1.2 TECHNICAL DESCRIPTION

A unitary system is an air conditioning system that cools one or a few spaces, in contrast to a centralized system where a chiller serves most or all of the building. Unitary systems use direct expansion, are usually factory designed, and are available as packaged or split systems for commercial use. A split system consists of an indoor unit (fan, cooling coil, heating elements, filter) connected by refrigerant piping to an outdoor unit (fan, compressor, condenser, expansion valve). A packaged system incorporates all the equipment into a single unit that is typically mounted on the roof. Heat pumps allow the refrigeration cycle to run in reverse and can therefore provide heating or cooling to the conditioned space.

## 1.3 APPLICATION TYPES AND DELIVERY MECHANISMS

See Appendices A and B for definitions of application types and delivery mechanisms.

The delivery method is Upstream Programs – Up-Stream Incentive and Mid-Stream Programs – Midstream Incentive. Incentives are provided to the HVAC equipment distributor, who provides site installation information for each unit.

The application type is Replace-on-Burnout (ROB).

## 1.4 MEASURE AND BASE CASE COST EFFECTIVENESS DATA

### 1.4.1 DEER Measure and Base Case Analysis

Most of the measures in this work paper are directly from DEER. DEER 2016 contains measures for up to 18 SEER packaged ACs, split system ACs, and split system HPs, and up to 17 SEER packaged HPs. 17 SEER savings were taken for 18 SEER packaged HPs (PG&E only).

**Table 3: DEER Difference Summary**

| <b>DEER Difference Summary Table</b>  |   |
|---------------------------------------|---|
| Referenced versions of DEER and READI | DEER 2016, READI v2.3.0   |
| Summary of deviation from DEER        | Most measures are from DEER. SEER 18 Packaged HP measures are taken from SEER 17 measures in DEER. To Code measures are derived using SEER 15 measures. |
| DEER measures scaled?                 | No  |
| DEER eQUEST prototypes used?          | No  |
| DEER operating hours used?            | No  |

**Net-to-Gross Ratio**

The NTG values were obtained using the DEER READI tool. The relevant NTG values for the measures in this work paper are in the table below.

**Table 4: Net-to-Gross Ratio**

| <b>NTGR ID</b>          | <b>Description</b>                                | <b>Sector</b> | <b>BldgType</b> | <b>ProgDelivID</b> | <b>NTG</b> |
|-------------------------|---|---------------|-----------------|--------------------|------------|
| NonRes-sAll-mHVAC-DX-up | All package and split system AC & HP replacements | Com           | Com             | PreRebUp           | 0.75       |

Note: Direct install measures that are not hard-to-reach will use the default NTG value.

**Installation Rate**

The IR values were obtained using the DEER READI tool. The relevant IR values for the measures in this work paper are in the table below.

**Table 5: Installation Rate**

| <b>GSIA ID</b> | <b>Description</b>  | <b>Sector</b> | <b>BldgType</b> | <b>ProgDelivID</b> | <b>GSIAValue</b> |
|----------------|---------------------|---------------|-----------------|--------------------|------------------|
| Def-GSIA       | Default GSIA values | Any           | Any             | Any                | 1                |

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Technology Fields**

The Technology Fields were obtained from the Ex Ante Database Specification. The relevant Use Category, Use Sub-category, Technology Group, and Technology Type values for the measures in this work paper are in the table below.

**Table 6: Technology Fields**

| <b>Classification</b>    | <b>Value</b>                             |
|--------------------------|--|
| Measure Case UseCategory | HVAC                                     |
| Measure Case UseSubCats  | Space Cooling, Space Heating and Cooling |
| Measure Case TechGroups  | dX AC Equipment, dx HP Equipment         |

|                        |  |
|------------------------|--|
| Measure Case TechTypes | SEER Rated Split System AC, SEER Rated Split System HP |
| Base Case TechGroups   | dX AC Equipment, dx HP Equipment                       |
| Base Case TechTypes    | SEER Rated Split System AC, SEER Rated Split System HP |

### Effective and Remaining Useful Life

The EUL and RUL values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

**Table 7: EUL and RUL**

| EUL ID                   | Description  | Sector | UseCategory | EUL (Years) | RUL (Years) |
|--------------------------|--|--------|-------------|-------------|-------------|
| HVAC-airAC<br>HVAC-airHP | Air Conditioners / Heat Pumps<br>(split and unitary) | Com    | HVAC        | 15          | 5           |

### 1.4.2 Codes and Standards Analysis

#### Code of Federal Regulations (10 CFR 430.32(c)):

Per Federal Register technical amendment to the Code of Federal Regulations [393], the SEER 14 standard will apply to conventional [single phase] central air conditioners and heat pumps manufactured on or after January 1, 2015:

(2) Central air conditioners and central air conditioning heat pumps manufactured on or after January 1, 2015, shall have a Seasonal Energy Efficiency Ratio and Heating Seasonal Performance Factor not less than:

| Product class                                       | Seasonal energy efficiency ratio (SEER) | Heating seasonal performance factor (HSPF) |
|---|---|--|
| (i) Split-system air conditioners                   | 13                                      |  |
| (ii) Split-system heat pumps                        | 14                                      | 8.2  |
| (iii) Single-package air conditioners               | 14                                      |  |
| (iv) Single-package heat pumps                      | 14                                      | 8.0  |
| (v) Small-duct, high-velocity systems               | 12                                      | 7.2  |
| (vi)(A) Space-constrained products—air conditioners | 12                                      |  |
| (vi)(B) Space-constrained products—heat pumps       | 12                                      | 7.4  |

(3) In addition to meeting the applicable requirements in paragraph (c)(2) of this section, products in product class (i) of that paragraph (*i.e.*, split-system air conditioners) that are manufactured on or after January 1, 2015, and installed in the States of Alabama, Arkansas, Delaware, Florida, Georgia, Hawaii, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, or Virginia, or in the District of Columbia, shall have a Seasonal Energy Efficiency Ratio not less than 14.

(4) In addition to meeting the applicable requirements in paragraphs (c)(2) of this section, products in product classes (i) and (iii) of paragraph (c)(2) (*i.e.*, split-system air conditioners and single-package air conditioners) that are manufactured on or after January 1, 2015, and installed in the States of Arizona, California, Nevada, or New Mexico shall have a Seasonal Energy Efficiency Ratio not less than 14 and have an Energy Efficiency Ratio (at a standard rating of 95 °F dry bulb outdoor temperature) not less than the following:

| Product class   | Energy efficiency ratio (EER) |
|---|-------------------------------|
| (i) Split-system rated cooling capacity less than 45,000 Btu/hr                 | 12.2                          |
| (ii) Split-system rated cooling capacity equal to or greater than 45,000 Btu/hr | 11.7                          |
| (iii) Single-package systems  | 11.0                          |

**California Title 20 2014:**

Appliance Efficiency Regulations [422] under California Code of Regulations Title 20, Section 1605.1 (c) (1) states “The EER, SEER, COP, HSPF, and SCOP, as applicable, of all central air conditioners, including computer room air conditioners, shall be not less than the applicable values shown in Tables C-2, C-3, C-4, C-5, and C-6.”

**Table C-2**

**Standards for Single Phase Air-Cooled Air Conditioners with Cooling Capacity Less than 65,000 Btu per Hour and Single Phase Air-Source Heat Pumps with Cooling Capacity Less than 65,000 Btu per Hour, Not Subject to EPA Act**

| <i>Appliance</i>   | <i>Minimum Efficiency</i>         |                     |                                  |                     |                    |  |
|--|-----------------------------------|---------------------|----------------------------------|---------------------|--------------------|--|
|  | <i>Effective January 23, 2006</i> |                     | <i>Effective January 1, 2015</i> |                     |                    |  |
|  | <i>Minimum SEER</i>               | <i>Minimum HSPF</i> | <i>Minimum SEER</i>              | <i>Minimum HSPF</i> | <i>Minimum EER</i> | <i>Average Off-Mode Power Consumption P<sub>w, off</sub> (watts)</i> |
| Split system air conditioners with rated cooling capacity < 45,000 Btu/hour <sup>1</sup> | 13.0                              | —                   | 14.0                             | —                   | 12.2               | 30   |
| Split system air conditioners with rated cooling capacity ≥ 45,000 Btu/hour <sup>1</sup> |                                   |                     | 14.0                             | —                   | 11.7               | 30   |
| Split system heat pumps  | 13.0                              | 7.7                 | 14.0                             | 8.2                 | —                  | 33   |
| Single package air conditioners <sup>1</sup>   | 13.0                              | —                   | 14.0                             | —                   | 11.0               | 30   |
| Single package heat pumps  | 13.0                              | 7.7                 | 14.0                             | 8.0                 | —                  | 33   |
| Space constrained air conditioners – split system  | 12.0                              | —                   | 12.0                             | —                   | —                  | 30   |
| Space constrained heat pumps – split system  | 12.0                              | 7.4                 | 12.0                             | 7.4                 | —                  | 33   |
| Space constrained air conditioners – single package                                      | 12.0                              | —                   | 12.0                             | —                   | —                  | 30   |
| Space constrained heat pumps – single package  | 12.0                              | 7.4                 | 12.0                             | 7.4                 | —                  | 33   |
| Small duct, high velocity air conditioner systems  | 13.0                              | —                   | 13.0                             | —                   | —                  | 30   |
| Small duct, high velocity heat pump systems  | 13.0                              | 7.7                 | 13.0                             | 7.7                 | —                  | 30   |

<sup>1</sup> See 10 C.F.R. section 430.32(c) for less stringent federal standards applicable to these units that are manufactured on or after January 1, 2015 and installed in states other than Arizona, California, Nevada, or New Mexico

**California Title 24 2013:**

Title 24 [355] does not address the measures in this work paper; it provides requirements for unitary AC and HP units ≥ 65k Btu/h.

**Table 8: Code Summary**

| <b>Code</b>                 | <b>Applicable Code Reference</b> | <b>Effective Dates</b> |
|-----------------------------|----------------------------------|------------------------|
| Code of Federal Regulations | 10 CFR 430.32(c)(3), (5)         | January 1, 2015        |
| Title 20 (2014)             | Section 1605.1(c)(1) Table C-2   | January 1, 2015        |

### 1.4.3 Non-DEER Study Review

No Non-DEER studies were referenced in the work paper.

## SECTION 2: CALCULATION METHODOLOGY

Of the 45 measures in this work paper, 34 are directly from DEER. Table 9 shows which measures have exact matches in DEER and which are calculated separately using existing DEER values.

**Table 9: DEER Measures Used**

| Measure Code | Measure Name  | DEER Measures Used                             |
|--------------|---|--|
| HV241        | Packaged Air Conditioner <55kBtuh 15 SEER (12 EER)          | NE-HVAC-airAC-Pkg-It55kBtuh-15p0seer           |
| HV242        | Packaged Air Conditioner <55kBtuh 16 SEER (12.4 EER)        | NE-HVAC-airAC-Pkg-It55kBtuh-16p0seer           |
| HV243        | Packaged Air Conditioner <55kBtuh 17 SEER (13 EER)          | NE-HVAC-airAC-Pkg-It55kBtuh-17p0seer           |
| HV244        | Packaged Air Conditioner <55kBtuh 18 SEER (14 EER)          | NE-HVAC-airAC-Pkg-It55kBtuh-18p0seer           |
| HV245        | Packaged Air Conditioner 55to65kBtuh 15 SEER (12 EER)       | NE-HVAC-airAC-Pkg-55to65kBtuh-15p0seer         |
| HV246        | Packaged Air Conditioner 55to65kBtuh 16 SEER (12.4 EER)     | NE-HVAC-airAC-Pkg-55to65kBtuh-16p0seer         |
| HV247        | Packaged Air Conditioner 55to65kBtuh 17 SEER (13 EER)       | NE-HVAC-airAC-Pkg-55to65kBtuh-17p0seer         |
| HV248        | Packaged Air Conditioner 55to65kBtuh 18 SEER (14 EER)       | NE-HVAC-airAC-Pkg-55to65kBtuh-18p0seer         |
| HV249        | Split System Air Conditioner <45kBtuh 15 SEER (12.5 EER)    | NE-HVAC-airAC-Split-It45kBtuh-15p0seer         |
| HV250        | Split System Air Conditioner <45kBtuh 16 SEER (13 EER)      | NE-HVAC-airAC-Split-It45kBtuh-16p0seer         |
| HV251        | Split System Air Conditioner <45kBtuh 17 SEER (13.5 EER)    | NE-HVAC-airAC-Split-It45kBtuh-17p0seer         |
| HV252        | Split System Air Conditioner <45kBtuh 18 SEER (14 EER)      | NE-HVAC-airAC-Split-It45kBtuh-18p0seer         |
| HV253        | Split System Air Conditioner 45to55kBtuh 15 SEER (12.5 EER) | NE-HVAC-airAC-Split-45to55kBtuh-15p0seer       |
| HV254        | Split System Air Conditioner 45to55kBtuh 16 SEER (13 EER)   | NE-HVAC-airAC-Split-45to55kBtuh-16p0seer       |
| HV255        | Split System Air Conditioner 45to55kBtuh 17 SEER (13.5 EER) | NE-HVAC-airAC-Split-45to55kBtuh-17p0seer       |
| HV256        | Split System Air Conditioner 45to55kBtuh 18 SEER (14 EER)   | NE-HVAC-airAC-Split-45to55kBtuh-18p0seer       |
| HV257        | Split System Air Conditioner 55to65kBtuh 15 SEER (12.5 EER) | NE-HVAC-airAC-Split-55to65kBtuh-15p0seer       |
| HV258        | Split System Air Conditioner 55to65kBtuh 16 SEER (13 EER)   | NE-HVAC-airAC-Split-55to65kBtuh-16p0seer       |
| HV259        | Split System Air Conditioner 55to65kBtuh 17 SEER (13.5 EER) | NE-HVAC-airAC-Split-55to65kBtuh-17p0seer       |
| HV260        | Split System Air Conditioner 55to65kBtuh 18 SEER (14 EER)   | NE-HVAC-airAC-Split-55to65kBtuh-18p0seer       |
| HV261        | Packaged Heat Pump <55kBtuh 15 SEER (12 EER)                | NE-HVAC-airHP-Pkg-It55kBtuh-15p0seer-8p2hspf   |
| HV262        | Packaged Heat Pump <55kBtuh 16 SEER (12.4 EER)              | NE-HVAC-airHP-Pkg-It55kBtuh-16p0seer-8p5hspf   |
| HV263        | Packaged Heat Pump <55kBtuh 17 SEER (13 EER)                | NE-HVAC-airHP-Pkg-It55kBtuh-17p0seer-9p0hspf   |
| HV264        | Packaged Heat Pump <55kBtuh 18 SEER (14 EER)                | NE-HVAC-airHP-Pkg-It55kBtuh-17p0seer-9p0hspf   |
| HV265        | Packaged Heat Pump 55to65kBtuh 15 SEER (12 EER)             | NE-HVAC-airHP-Pkg-55to65kBtuh-15p0seer-8p2hspf |
| HV266        | Packaged Heat Pump 55to65kBtuh 16 SEER (12.4 EER)           | NE-HVAC-airHP-Pkg-55to65kBtuh-16p0seer-        |

|       |  |  |
|-------|--|--|
|       |  | 8p5hspf  |
| HV267 | Packaged Heat Pump 55to65kBtuh 17 SEER (13 EER)                  | NE-HVAC-airHP-Pkg-55to65kBtuh-17p0seer-9p0hspf                       |
| HV268 | Packaged Heat Pump 55to65kBtuh 18 SEER (14 EER)                  | NE-HVAC-airHP-Pkg-55to65kBtuh-17p0seer-9p0hspf                       |
| HV269 | Split System Heat Pump <55kBtuh 15 SEER (12.5 EER)               | NE-HVAC-airHP-Split-It55kBtuh-15p0seer-8p7hspf                       |
| HV270 | Split System Heat Pump <55kBtuh 16 SEER (13 EER)                 | NE-HVAC-airHP-Split-It55kBtuh-16p0seer-9p0hspf                       |
| HV271 | Split System Heat Pump <55kBtuh 17 SEER (13.5 EER)               | NE-HVAC-airHP-Split-It55kBtuh-17p0seer-9p4hspf                       |
| HV272 | Split System Heat Pump <55kBtuh 18 SEER (14 EER)                 | NE-HVAC-airHP-Split-It55kBtuh-18p0seer-9p7hspf                       |
| HV273 | Split System Heat Pump 55to65kBtuh 15 SEER (12.5 EER)            | NE-HVAC-airHP-Split-55to65kBtuh-15p0seer-8p7hspf                     |
| HV274 | Split System Heat Pump 55to65kBtuh 16 SEER (13 EER)              | NE-HVAC-airHP-Split-55to65kBtuh-16p0seer-9p0hspf                     |
| HV275 | Split System Heat Pump 55to65kBtuh 17 SEER (13.5 EER)            | NE-HVAC-airHP-Split-55to65kBtuh-17p0seer-9p4hspf                     |
| HV276 | Split System Heat Pump 55to65kBtuh 18 SEER (14 EER)              | NE-HVAC-airHP-Split-55to65kBtuh-18p0seer-9p7hspf                     |
|       | <55kBtuh To Code Savings Portion Packaged Air Conditioner        | <b>Derived from</b> NE-HVAC-airAC-Pkg-It55kBtuh-15p0seer             |
|       | 55to65kBtuh To Code Savings Portion Packaged Air Conditioner     | <b>Derived from</b> NE-HVAC-airAC-Pkg-55to65kBtuh-15p0seer           |
|       | <45kBtuh To Code Savings Portion Split System Air Conditioner    | <b>Derived from</b> NE-HVAC-airAC-Split-It45kBtuh-15p0seer           |
|       | 45to55kBtuh To Code Savings Portion Split System Air Conditioner | <b>Derived from</b> NE-HVAC-airAC-Split-45to55kBtuh-15p0seer         |
|       | 55to65kBtuh To Code Savings Portion Split System Air Conditioner | <b>Derived from</b> NE-HVAC-airAC-Split-55to65kBtuh-15p0seer         |
|       | <55kBtuh To Code Savings Portion Packaged Heat Pump              | <b>Derived from</b> NE-HVAC-airHP-Pkg-It55kBtuh-15p0seer-8p2hspf     |
|       | 55to65kBtuh To Code Savings Portion Packaged Heat Pump           | <b>Derived from</b> NE-HVAC-airHP-Pkg-55to65kBtuh-15p0seer-8p2hspf   |
|       | <55kBtuh To Code Savings Portion Split System Heat Pump          | <b>Derived from</b> NE-HVAC-airHP-Split-It55kBtuh-15p0seer-8p7hspf   |
|       | 55to65kBtuh To Code Savings Portion Split System Heat Pump       | <b>Derived from</b> NE-HVAC-airHP-Split-55to65kBtuh-15p0seer-8p7hspf |

Since DEER does not have measures for 18 SEER packaged heat pumps, those savings were taken directly out from DEER using the lower savings values of 17 SEER.

The two 18 SEER measures HV264 and HV268 are using the DEER IDs measure savings listed below:  
 NE-HVAC-airHP-Pkg-It55kBtuh-17p0seer-9p0hspf  
 NE-HVAC-airHP-Pkg-55to65kBtuh-17p0seer-9p0hspf

### To Code Savings Portion Measures

The To Code Savings Portion measures in this work paper are the savings from retrofitting customer existing equipment (various SEER values) to 14 SEER code-compliant equipment. The savings were determined by subtracting the "AStdWB" savings from the "APreWB" savings for 15 SEER ACs and HPs. The result was the difference between customer existing equipment and 14 SEER equipment. Measures savings (ROB, NEW) are attributed to the Upstream and Midstream HVAC programs.

Example: <55kBtuh To Code Savings Portion Packaged Air Conditioner, SCE, Assembly, CZ 06

DEER savings:

| EnergyImpactID                       | APreWBkWh | APreWBkW | APreWBtherm | AStdWBkWh | AStdWBkW | AStdWBtherm |
|--------------------------------------|-----------|----------|-------------|-----------|----------|-------------|
| NE-HVAC-airAC-Pkg-lt55kBtuh-15p0seer | 560       | 0.293    | -3.12       | 129       | 0.0454   | -1.2        |

$$\text{kWh Savings} = 560 - 129 = \mathbf{431 \text{ kWh}}$$

$$\text{kW Reduction} = 0.293 - 0.0454 = \mathbf{0.2476 \text{ kW}}$$

$$\text{therm Savings} = -3.12 - (-1.2) = \mathbf{-1.92 \text{ therms}}$$

All savings values are listed in Attachment 1, and the calculations are in Attachment 2.

## SECTION 3: LOAD SHAPES

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

**Table 10: Building Types and Load Shapes**

| Building Type                              | E3 Alt. Building Type | Load Shape  |
|--|-----------------------|---|
| Agricultural                               | NON_RES               | DEER:HVAC_Split-<br>Package_AC,<br>DEER:HVAC_Split-<br>Package_HP |
| Assembly                                   |                       |   |
| Education - Primary School                 |                       |   |
| Education - Secondary School               |                       |   |
| Education - Relocatable Classroom          |                       |   |
| Education - Community College              |                       |   |
| Education – University                     |                       |   |
| Food Store                                 |                       |   |
| Grocery                                    |                       |   |
| Health/Medical – Hospital                  |                       |   |
| Health/Medical - Nursing Home              |                       |   |
| Health/Medical – Clinic                    |                       |   |
| Lodging – Hotel                            |                       |   |
| Manufacturing - Bio/Tech                   |                       |   |
| Manufacturing - Light Industrial           |                       |   |
| Industrial                                 |                       |   |
| Misc – Commercial                          |                       |   |
| Office – Large                             |                       |   |
| Office – Small                             |                       |   |
| Restaurant - Fast-Food                     |                       |   |
| Restaurant - Sit-Down                      |                       |   |
| Retail - Multistory Large                  |                       |   |
| Retail - Single-Story Large                |                       |   |
| Retail – Small                             |                       |   |
| Storage – Conditioned                      |                       |   |
| Transportation - Communication - Utilities |                       |   |
| Warehouse – Refrigerated                   |                       |   |
| Com  |                       |   |

## SECTION 4: BASE CASE & MEASURE COSTS

### 4.1 BASE CASE COST

The 2010–2012 WO017 Ex Ante Measure Cost Study [475] provided per-installation and per-unit equipment and labor costs for split and packaged AC units (13 and 14 SEER only) and HP units (13, 14, and 15 SEER only). These costs were first converted to per-ton costs and then linearly extrapolated to determine costs for up to 18 SEER units. Miscellaneous “non-equipment installation costs” costs were also provided but not used in this work paper.

All measures except the To Code measures use the 14 SEER costs as base case costs; see the following table. The To Code measures use the 13 SEER costs as base case costs.

**Table 11: WO017 Baseline Cost Data, Per-ton**

| Description  | Material Cost |
|--|---------------|
| Pkg AC SEER = 13.0 (< 55 kBtuh), EER = 11.06, Clg EIR = 0.2557, Supply Fan W/cfm = 0.379; no Econo; 1-spd Fan assumed 3 ton                            | \$1,012.79    |
| Pkg AC SEER = 14.0 (< 55 kBtuh), EER = 12.04, Clg EIR = 0.2456, Supply Fan W/cfm = 0.306; no Econo; 1-spd Fan assumed 3 ton                            | \$1,133.38    |
| Pkg AC SEER = 13.0 (55-64 kBtuh), EER = 11.06, Clg EIR = 0.2557, Supply Fan W/cfm = 0.379; no Econo; 2-spd Fan assumed 5 ton                           | \$762.89      |
| Pkg AC SEER = 14.0 (55-64 kBtuh), EER = 12.04, Clg EIR = 0.2456, Supply Fan W/cfm = 0.306; no Econo; 2-spd Fan assumed 5 ton                           | \$835.25      |
| Split AC SEER = 13.0 (< 55 kBtuh), EER = 11.06, Clg EIR = 0.2557, Supply Fan W/cfm = 0.379; no Econo; 1-spd Fan assumed 24,000 BtuH                    | \$468.67      |
| Split AC SEER = 14.0 (< 55 kBtuh), EER = 12.04, Clg EIR = 0.2456, Supply Fan W/cfm = 0.306; no Econo; 1-spd Fan assumed 24,000 BtuH                    | \$606.86      |
| Split AC SEER = 13.0 (55-64 kBtuh), EER = 11.06, Clg EIR = 0.2557, Supply Fan W/cfm = 0.379; no Econo; 2-spd Fan assumed 60,000 BtuH                   | \$386.20      |
| Split AC SEER = 14.0 (55-64 kBtuh), EER = 12.04, Clg EIR = 0.2456, Supply Fan W/cfm = 0.306; no Econo; 2-spd Fan assumed 60,000BtuH - same as baseline | \$441.47      |
| Pkg HP SEER = 13.0 (< 55 kBtuh), EER = 11.07, HSPF = 7.70, COP = 3.28; no Econo; 1-spd Fan assumed 36 MBH  | \$1,109.03    |
| Pkg HP SEER = 14.0 (< 55 kBtuh), EER = 11.6, HSPF = 8.00, COP = 3.52; no Econo; 1-spd Fan assumed 36 MBH   | \$1,250.99    |
| Pkg HP SEER = 13.0 (55-64 kBtuh), EER = 11.07, HSPF = 7.70, COP = 3.28; w/Econo; 2-spd Fan assumed 60 MBH  | \$808.80      |
| Pkg HP SEER = 14.0 (55-64 kBtuh), EER = 11.6, HSPF = 8.00, COP = 3.52; w/Econo; 2-spd Fan assumed 60 MBH   | \$893.98      |
| Split HP SEER = 13 assumed 36,000 BtuH   | \$594.87      |

|  |          |
|--|----------|
| Split HP SEER = 14.0 (< 55 kBTUh), EER = 12.00, HSPF = 8.50, COP = 3.74; no Econo; 1-spd Fan assumed 36,000 BtuH | \$777.64 |
| Split HP SEER = 13 assumed 59,000 BtuH   | \$594.75 |
| Split HP SEER = 14.0 (55-64 kBTUh) - Combined SEER 13 and SEER 14.5 hp assumed 59,000 BtuH                       | \$706.27 |

## 4.2 MEASURE CASE COST

Costs for 15, 16, 17, and 18 SEER ACs and 16, 17, and 18 SEER HPs were linearly extrapolated using SEER value as the independent variable, using costs from WO017.

Example: <55kBtuh 15 SEER (12 EER) Packaged Air Conditioner

$$\text{Equipment cost} = \$1,133.38 + (\$1,133.38 - \$1,012.79) = \$1,253.97$$

Table 12 shows a sample of costs extrapolated for packaged AC units <55 kBtuh:

**Table 12: Sample WO017 and Extrapolated Measure Costs, Per-ton**

| Description   | Packaged AC | Split System AC |
|---|-------------|-----------------|
| Pkg AC SEER = 13.0 (< 55 kBtuh), EER = 11.06, Clg EIR = 0.2557, Supply Fan W/cfm = 0.379; no Econo; 1-spd Fan assumed 3 ton | \$1,012.79  | \$891.21        |
| Pkg AC SEER = 14.0 (< 55 kBTUh), EER = 12.04, Clg EIR = 0.2456, Supply Fan W/cfm = 0.306; no Econo; 1-spd Fan assumed 3 ton | \$1,133.38  | \$891.21        |
| <b>Extrapolated:</b> Pkg AC SEER = 15.0 (< 55 kBtuh)  | \$1,253.97  | \$891.21        |
| <b>Extrapolated:</b> Pkg AC SEER = 16.0 (< 55 kBtuh)  | \$1,374.56  | \$891.21        |
| <b>Extrapolated:</b> Pkg AC SEER = 17.0 (< 55 kBtuh)  | \$1,495.15  | \$891.21        |
| <b>Extrapolated:</b> Pkg AC SEER = 18.0 (< 55 kBtuh)  | \$1,615.74  | \$891.21        |

The cost for the single phase 15 SEER air conditioners and heat pumps are the same as the three-phase 15 SEER AC and HP costs.

## 4.3 GROSS AND INCREMENTAL MEASURE COST

### 4.3.1 Incremental Measure Cost (IMC)

For ROB and NEW, the Incremental Measure Cost is used; see **Error! Reference source not found..**

For RET measures, the IMC is equal to \$0 in order to avoid double counting the costs.

All cost calculations are in Table 1213 and more details are in Attachment 3.

**Table 13: Base Case Costs, Measure Costs and IMC Per-ton**

| Solution Code | Measure Code | Measure Name  | Base Case Equipment Cost Source   | Base Case Equipment Cost | Measure Equipment Cost Source     | Measure Equipment Cost | IMC      |
|---------------|--------------|---|-----------------------------------|--------------------------|-----------------------------------|------------------------|----------|
| AC-50375      | HV241        | <55kBtuh 15 SEER (12 EER) Packaged Air Conditioner          | Pkg AC SEER = 14.0 (< 55 kBtuh)   | \$1,133.38               | Pkg AC SEER = 15.0 (< 55 kBtuh)   | \$1,253.97             | \$120.59 |
| AC-81566      | HV242        | <55kBtuh 16 SEER (12.4 EER) Packaged Air Conditioner        | Pkg AC SEER = 14.0 (< 55 kBtuh)   | \$1,133.38               | Pkg AC SEER = 16.0 (< 55 kBtuh)   | \$1,374.56             | \$241.18 |
| AC-37735      | HV243        | <55kBtuh 17 SEER (13 EER) Packaged Air Conditioner          | Pkg AC SEER = 14.0 (< 55 kBtuh)   | \$1,133.38               | Pkg AC SEER = 17.0 (< 55 kBtuh)   | \$1,495.15             | \$361.77 |
| AC-31588      | HV244        | <55kBtuh 18 SEER (14 EER) Packaged Air Conditioner          | Pkg AC SEER = 14.0 (< 55 kBtuh)   | \$1,133.38               | Pkg AC SEER = 18.0 (< 55 kBtuh)   | \$1,615.74             | \$482.36 |
| AC-87532      | HV245        | 55to65kBtuh 15 SEER (12 EER) Packaged Air Conditioner       | Pkg AC SEER = 14.0 (55-64 kBtuh)  | \$835.25                 | Pkg AC SEER = 15.0 (55-64 kBtuh)  | \$907.60               | \$72.35  |
| AC-77878      | HV246        | 55to65kBtuh 16 SEER (12.4 EER) Packaged Air Conditioner     | Pkg AC SEER = 14.0 (55-64 kBtuh)  | \$835.25                 | Pkg AC SEER = 16.0 (55-64 kBtuh)  | \$979.96               | \$144.71 |
| AC-22408      | HV247        | 55to65kBtuh 17 SEER (13 EER) Packaged Air Conditioner       | Pkg AC SEER = 14.0 (55-64 kBtuh)  | \$835.25                 | Pkg AC SEER = 17.0 (55-64 kBtuh)  | \$1,052.31             | \$217.06 |
| AC-75087      | HV248        | 55to65kBtuh 18 SEER (14 EER) Packaged Air Conditioner       | Pkg AC SEER = 14.0 (55-64 kBtuh)  | \$835.25                 | Pkg AC SEER = 18.0 (55-64 kBtuh)  | \$1,124.66             | \$289.41 |
| AC-46105      | HV249        | <45kBtuh 15 SEER (12.5 EER) Split System Air Conditioner    | Split AC SEER = 14.0 (< 55 kBTUH) | \$606.86                 | Split AC SEER = 15.0 (< 55 kBTUH) | \$745.05               | \$138.19 |
| AC-83486      | HV250        | <45kBtuh 16 SEER (13 EER) Split System Air Conditioner      | Split AC SEER = 14.0 (< 55 kBTUH) | \$606.86                 | Split AC SEER = 16.0 (< 55 kBTUH) | \$883.24               | \$276.38 |
| AC-26490      | HV251        | <45kBtuh 17 SEER (13.5 EER) Split System Air Conditioner    | Split AC SEER = 14.0 (< 55 kBTUH) | \$606.86                 | Split AC SEER = 17.0 (< 55 kBTUH) | \$1,021.43             | \$414.57 |
| AC-50319      | HV252        | <45kBtuh 18 SEER (14 EER) Split System Air Conditioner      | Split AC SEER = 14.0 (< 55 kBTUH) | \$606.86                 | Split AC SEER = 18.0 (< 55 kBTUH) | \$1,159.62             | \$552.76 |
| AC-70613      | HV253        | 45to55kBtuh 15 SEER (12.5 EER) Split System Air Conditioner | Split AC SEER = 14.0 (< 55 kBTUH) | \$606.86                 | Split AC SEER = 15.0 (< 55 kBTUH) | \$745.05               | \$138.19 |
| AC-97648      | HV254        | 45to55kBtuh 16 SEER (13 EER) Split System Air Conditioner   | Split AC SEER = 14.0 (< 55 kBTUH) | \$606.86                 | Split AC SEER = 16.0 (< 55 kBTUH) | \$883.24               | \$276.38 |
| AC-66543      | HV255        | 45to55kBtuh 17 SEER (13.5 EER) Split System Air Conditioner | Split AC SEER = 14.0 (< 55 kBTUH) | \$606.86                 | Split AC SEER = 17.0 (< 55 kBTUH) | \$1,021.43             | \$414.57 |

|          |       |   |                                    |            |                                    |            |          |
|----------|-------|---|------------------------------------|------------|------------------------------------|------------|----------|
| AC-96580 | HV256 | 45to55kBtuh 18 SEER (14 EER) Split System Air Conditioner   | Split AC SEER = 14.0 (< 55 kBTUh)  | \$606.86   | Split AC SEER = 18.0 (< 55 kBTUh)  | \$1,159.62 | \$552.76 |
| AC-69747 | HV257 | 55to65kBtuh 15 SEER (12.5 EER) Split System Air Conditioner | Split AC SEER = 14.0 (55-64 kBTUh) | \$441.47   | Split AC SEER = 15.0 (55-64 kBTUh) | \$496.75   | \$55.28  |
| AC-86967 | HV258 | 55to65kBtuh 16 SEER (13 EER) Split System Air Conditioner   | Split AC SEER = 14.0 (55-64 kBTUh) | \$441.47   | Split AC SEER = 16.0 (55-64 kBTUh) | \$552.02   | \$110.55 |
| AC-61866 | HV259 | 55to65kBtuh 17 SEER (13.5 EER) Split System Air Conditioner | Split AC SEER = 14.0 (55-64 kBTUh) | \$441.47   | Split AC SEER = 17.0 (55-64 kBTUh) | \$607.30   | \$165.83 |
| AC-87169 | HV260 | 55to65kBtuh 18 SEER (14 EER) Split System Air Conditioner   | Split AC SEER = 14.0 (55-64 kBTUh) | \$441.47   | Split AC SEER = 18.0 (55-64 kBTUh) | \$662.58   | \$221.10 |
| AC-97980 | HV261 | <55kBtuh 15 SEER (12 EER) Packaged Heat Pump                | Pkg HP SEER = 14.0 (< 55 kBTUh)    | \$1,250.99 | Pkg HP SEER = 15.0 (< 55 kBTUh)    | \$1,392.95 | \$141.96 |
| AC-92105 | HV262 | <55kBtuh 16 SEER (12.4 EER) Packaged Heat Pump              | Pkg HP SEER = 14.0 (< 55 kBTUh)    | \$1,250.99 | Pkg HP SEER = 16.0 (< 55 kBTUh)    | \$1,534.92 | \$283.93 |
| AC-59729 | HV263 | <55kBtuh 17 SEER (13 EER) Packaged Heat Pump                | Pkg HP SEER = 14.0 (< 55 kBTUh)    | \$1,250.99 | Pkg HP SEER = 17.0 (< 55 kBTUh)    | \$1,676.88 | \$425.89 |
| AC-65475 | HV264 | <55kBtuh 18 SEER (14 EER) Packaged Heat Pump                | Pkg HP SEER = 14.0 (< 55 kBTUh)    | \$1,250.99 | Pkg HP SEER = 18.0 (< 55 kBTUh)    | \$1,818.84 | \$567.85 |
| AC-99784 | HV265 | 55to65kBtuh 15 SEER (12 EER) Packaged Heat Pump             | Pkg HP SEER = 14.0 (55-64 kBTUh)   | \$893.98   | Pkg HP SEER = 15.0 (55-64 kBTUh)   | \$979.16   | \$85.18  |
| AC-60134 | HV266 | 55to65kBtuh 16 SEER (12.4 EER) Packaged Heat Pump           | Pkg HP SEER = 14.0 (55-64 kBTUh)   | \$893.98   | Pkg HP SEER = 16.0 (55-64 kBTUh)   | \$1,064.33 | \$170.36 |
| AC-65806 | HV267 | 55to65kBtuh 17 SEER (13 EER) Packaged Heat Pump             | Pkg HP SEER = 14.0 (55-64 kBTUh)   | \$893.98   | Pkg HP SEER = 17.0 (55-64 kBTUh)   | \$1,149.51 | \$255.53 |
| AC-62068 | HV268 | 55to65kBtuh 18 SEER (14 EER) Packaged Heat Pump             | Pkg HP SEER = 14.0 (55-64 kBTUh)   | \$893.98   | Pkg HP SEER = 18.0 (55-64 kBTUh)   | \$1,234.69 | \$340.71 |
| AC-73283 | HV269 | <55kBtuh 15 SEER (12.5 EER) Split System Heat Pump          | Split HP SEER = 14.0 (< 55 kBTUh)  | \$777.64   | Split HP SEER = 15.0 (< 55 kBTUh)  | \$960.40   | \$182.76 |
| AC-89637 | HV270 | <55kBtuh 16 SEER (13 EER) Split System Heat Pump            | Split HP SEER = 14.0 (< 55 kBTUh)  | \$777.64   | Split HP SEER = 16.0 (< 55 kBTUh)  | \$1,143.16 | \$365.53 |
| AC-53855 | HV271 | <55kBtuh 17 SEER (13.5 EER) Split System Heat Pump          | Split HP SEER = 14.0 (< 55 kBTUh)  | \$777.64   | Split HP SEER = 17.0 (< 55 kBTUh)  | \$1,325.93 | \$548.29 |

|          |       |  |                                    |            |                                    |            |          |
|----------|-------|--|------------------------------------|------------|------------------------------------|------------|----------|
| AC-61202 | HV272 | <55kBtuh 18 SEER (14 EER) Split System Heat Pump                 | Split HP SEER = 14.0 (< 55 kBTUh)  | \$777.64   | Split HP SEER = 18.0 (< 55 kBTUh)  | \$1,508.69 | \$731.05 |
| AC-62602 | HV273 | 55to65kBtuh 15 SEER (12.5 EER) Split System Heat Pump            | Split HP SEER = 14.0 (55-64 kBTUh) | \$706.27   | Split HP SEER = 15.0 (55-64 kBTUh) | \$817.78   | \$111.52 |
| AC-71681 | HV274 | 55to65kBtuh 16 SEER (13 EER) Split System Heat Pump              | Split HP SEER = 14.0 (55-64 kBTUh) | \$706.27   | Split HP SEER = 16.0 (55-64 kBTUh) | \$929.30   | \$223.03 |
| AC-94444 | HV275 | 55to65kBtuh 17 SEER (13.5 EER) Split System Heat Pump            | Split HP SEER = 14.0 (55-64 kBTUh) | \$706.27   | Split HP SEER = 17.0 (55-64 kBTUh) | \$1,040.82 | \$334.55 |
| AC-89435 | HV276 | 55to65kBtuh 18 SEER (14 EER) Split System Heat Pump              | Split HP SEER = 14.0 (55-64 kBTUh) | \$706.27   | Split HP SEER = 18.0 (55-64 kBTUh) | \$1,152.33 | \$446.07 |
| AC-67740 | N/A   | <55kBtuh To Code Savings Portion Packaged Air Conditioner        | Pkg AC SEER = 13.0 (< 55 kBtuh)    | \$1,012.79 | Pkg AC SEER = 14.0 (< 55 kBtuh)    | \$1,133.38 | \$0.00   |
| AC-69545 | N/A   | 55to65kBtuh To Code Savings Portion Packaged Air Conditioner     | Pkg AC SEER = 13.0 (55-64 kBtuh)   | \$762.89   | Pkg AC SEER = 14.0 (55-64 kBtuh)   | \$835.25   | \$0.00   |
| AC-50853 | N/A   | <45kBtuh To Code Savings Portion Split System Air Conditioner    | Split AC SEER = 13.0 (< 55 kBTUh)  | \$468.67   | Split AC SEER = 14.0 (< 55 kBTUh)  | \$606.86   | \$0.00   |
| AC-56930 | N/A   | 45to55kBtuh To Code Savings Portion Split System Air Conditioner | Split AC SEER = 13.0 (< 55 kBTUh)  | \$468.67   | Split AC SEER = 14.0 (< 55 kBTUh)  | \$606.86   | \$0.00   |
| AC-75420 | N/A   | 55to65kBtuh To Code Savings Portion Split System Air Conditioner | Split HP SEER = 13.0 (55-64 kBTUh) | \$594.75   | Split HP SEER = 14.0 (55-64 kBTUh) | \$706.27   | \$0.00   |
| AC-83228 | N/A   | <55kBtuh To Code Savings Portion Packaged Heat Pump              | Pkg HP SEER = 13.0 (< 55 kBTUh)    | \$1,109.03 | Pkg HP SEER = 14.0 (< 55 kBTUh)    | \$1,250.99 | \$0.00   |
| AC-73081 | N/A   | 55to65kBtuh To Code Savings Portion Packaged Heat Pump           | Pkg HP SEER = 13.0 (55-64 kBTUh)   | \$808.80   | Pkg HP SEER = 14.0 (55-64 kBTUh)   | \$893.98   | \$0.00   |
| AC-53523 | N/A   | <55kBtuh To Code Savings Portion Split System Heat Pump          | Split HP SEER = 13.0 (< 55 kBTUh)  | \$594.87   | Split HP SEER = 14.0 (< 55 kBTUh)  | \$777.64   | \$0.00   |
| AC-98919 | N/A   | 55to65kBtuh To Code Savings Portion Split System Heat Pump       | Split HP SEER = 13.0 (55-64 kBTUh) | \$594.75   | Split HP SEER = 14.0 (55-64 kBTUh) | \$706.27   | \$0.00   |

## **ATTACHMENTS**

Savings calculations are found in the accompanying calculation spreadsheet.

1. PGECO HVC126 R7 - Unitary ACHP under 65kBtuh.xlsx
2. Cost Calculations.xlsx

## REFERENCES

- [355] 2013 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24)
- [393] Code of Federal Regulations Title 10 - Energy
- [422] 2014 Appliance Efficiency Regulations (Title 20)
- [475] 2010–2012 WO017 Ex Ante Measure Cost Study Final Report

## APPENDIX A: APPLICATION TYPES

This table compares the application types in SCE's systems with those in DEER.

| SCE Application (Program) Type | DEER Application Type                             | Savings                       |                    | Cost               |                    | Life               |                    |
|--------------------------------|---|-------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
|                                |   | 1 <sup>st</sup> Baseline (BL) | 2 <sup>nd</sup> BL | 1 <sup>st</sup> BL | 2 <sup>nd</sup> BL | 1 <sup>st</sup> BL | 2 <sup>nd</sup> BL |
| New Construction (NEW)         | New Construction (Nc)                             | Above Code or Standard        | N/A                | Incremental Cost   | N/A                | EUL                | 0                  |
| Replace on Burnout (ROB)       | Replace on Burnout (Rob), Normal Replacement (NR) | Above Code or Standard        | N/A                | Incremental Cost   | N/A                | EUL                | 0                  |

## APPENDIX B: DELIVERY MECHANISMS

A delivery mechanism is a delivery method paired with an incentive method. PG&E's delivery methods include:

- Upstream Programs

The following table describes the incentive methods.

| Incentive Method                        | Description   |
|---|---|
| Up-Stream Buy Down, Up-Stream Incentive | The utility program offers buydowns and incentives to vendors (typically manufacturers and distributors), who then manufacture, stock, promote, lower prices on, and/or sell energy efficient equipment. There is some overlap between the mid-stream and up-stream approaches. |