Work Paper SCE17HC045

**Revision 0**

**Short Form**

**Southern California Edison**

**Enhanced Ventilation and VFD for Packaged HVAC Units with Gas Heating and Packaged Heat Pumps**

**Introduction**

This short form workpaper documents (WP) the values adopted from PGE’s WP entitled “Enhanced Ventilation and VFD for Packaged HVAC Units with Gas Heating and Packaged Heat Pumps” (PGECOHVC143 R3). SCE adopts all the values in PGECOHVC143 R3 – “Enhanced Ventilation and VFD for Packaged HVAC Units with Gas Heating and Packaged Heat Pumps”, with the following exceptions.

* Changed applicable climate zones to only SCE climate zones.
* Added Up-Stream Programs: Up-Stream Incentives, Mid-Stream Programs: Mid-Stream Incentives, and Financial Support: Direct Install delivery mechanisms.
* Corrected load shapes for Heat Pump measures from AC-unit load shape to Heat Pump load shape in calculation template.
* Added clarification on SCE’s incentive method description and applicability.
* For 2019 program year, the install type has been updated to Add-on Equipment, “AOE”.

# Document Revision History

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| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 12/27/2018 | Sergio Corona, TRC | * Transferred savings to calculation templates for the 2019 program year * Install type has been updated to Add-on Equipment, “AOE”. * Only SCE Climate zones are adopted * Added Up-Stream Programs: Up-Stream Incentives, Mid-Stream Programs: Mid-Stream Incentives, and Financial Support: Direct Install delivery mechanisms*.* * Corrected load shapes for Heat Pump measures from AC-unit load shape to Heat Pump load shape in calculation template.   General Policy Requirements:   * 2019 Workpaper updates are primarily in response to Resolution E-4818 which added new measure application types including but not limited to Add-On Equipment (AOE) and BRO-Retrocommissioning (BRO-RCx). |

**Measure Summary**

Table 1: Measure Summary Table

| **Section** | **Value** |
| --- | --- |
| **Summary & Purpose** | This short form work paper documents the inputs for measures that reduce the energy associated with constant speed motor supply fans found in a packaged single zone direct expansion (DX) HVAC unit. The savings values are based on PGE’s workpaper PGECOHVC143 R3 – “Enhanced Ventilation and VFD for Packaged HVAC Units with Gas Heating and Packaged Heat Pumps” document.  The target market for Enhanced Ventilation and VFD for Packaged HVAC Units with Gas Heating and Packaged Heat Pumps is spaces in commercial buildings served by packaged single zone HVAC units, sometimes referred to as rooftop units (RTUs). |
| **1.1 Measure & Baseline** | Baseline  This measure assumes the existing unit is a single zone DX HVAC unit with a functional economizer and constant speed motor for the supply fan.  Measure  Installation of a VFD to single zone DX HVAC unit with an economizer. The VFD operates at two discrete speeds based on ventilation and cooling or heating demand.  Please refer to Attachment #1 Calculation Templates for additional information on codes and baseline condition. |
| **1.2 Technical Description** |  |
| **Measures** | The measures consist of adding one or more efficiency measures, including VFD, NEMA motor, permanent magnet motor (PMM), and Advanced Digital Economizer Controller (ADEC), to cooling units with gas heat, cooling only units, and heat pumps, respectively. |
| **Code for All Measures** | This measure is a retrofit to an existing system and is not governed by either state or federal codes or standards as long as the project does not include other code-triggering activities such as replacement of HVAC systems. However, Title 24 2016 provides economizer control and general ventilation requirements that are considered to be best practice in Table 140.4-B: High limit shut-off control requirements by device type and climate zone, and in Section 120.1: Minimum ventilation requirements.  Refer to Section 1.4.2 of PGECOHVC143 R3 for more details. |
| **Requirements** | Eligibility Requirements:   * Existing system must be:   + Packaged single zone DX cooling unit with gas heat [AC-72014, AC-97565, AC-63277, AC-42889, AC-88048, AC-52735, AC-20769,  AC-20770, AC-20771]   + Packaged single zone DX unit with cooling only [AC-14815, AC-30287, AC-67253, AC-32686, AC-70123, AC-62985]   + Packaged single zone DX heat pump  [AC-18726, AC-36894, AC-32399, AC-71385, AC-28655, AC-12899, AC-20772, AC-20773, AC-20774] * Existing system must have a constant volume supply fan * Existing system must have an operable airside economizer installed   Implementation and installation requirements:   * Economizer high limit must be optimized for the climate per Title 24 2016 Table 140.4-B * Maintenance and repairs to economizer should be completed prior to or in conjunction with this measure * Total unit airflow must be verified for at least one of the fan speeds * The percentage of outdoor air must be verified for each of the unit’s operating modes, including heating and cooling for each stage as well as the ventilation only mode.   Measures presented in this Workpaper apply to SCE climate zones. The building types eligible for this measure vary slightly by solution code. Please refer to Attachment #1 Calculation Templates for details. |
| **1.3 Installation Type and Delivery Mechanisms** |  |
| **Installation Type** | Deviation. Install type changed from Retrofit Add-On (REA) to **Add-on Equipment (AOE)** |
| **Delivery Mechanisms** | Financial Support: Down-Stream Incentive – Deemed  Deviation, adding:   * **Financial Support: Direct Install** * **Mid-Stream Programs: Mid-Stream Incentive** * **Up-Stream Programs: Up-Stream Incentive**   For SCE, incentive methods include On-bill Finance/Loan - The program offers financing for the cost an efficient measure as part of the utility bill. This can be an add-on option to an existing program or can serve as an organizing principle for its own program. |
| **1.4.1 DEER Data** |  |
| **Net-Gross-Ratio** | NTG ID: Com-Default>2yrs, Agric-Default>2yrs, Ind-Default>2yrs  NTGR = 0.6 |
| **Effective and Remaining Useful Life** | EUL ID: HVAC-VSD-DCV (EUL: 15 / RUL: 5)  As this is an AOE measure, the first baseline life is the RUL of the host equipment life. 1st Baseline life = 5 years. |
| **Section 2. Calculation Methodology** |  |
| **Energy savings/Peak Demand Reduction – All Measures** | Energy savings and demand reduction for the measures contained in this workpaper were estimated using eQUEST version 3.64.7130 energy modeling software. Savings were calculated for each building type and the seven building vintages below:   * v75 (Before 1978) * v85 (1978 – 1992) * v96 (1993 – 2001) * v03 (2002 – 2005) * v07 (2006 – 2009) * v11 (2010 – 2013) * v14 (2014 – 2015)   Savings for each vintage were weighted by the vintage weights in the DEER2014 Energy Impact Weights Tables. DEER 2014 and 2015 prototypes were generated using MASControl software for the customer average (CAv) cases of the following Tech IDs:   * D08-NE-HVAC-airAC-SpltPkg-110to134kBtuh-11p5eer * D08-NE-HVAC-airHP-SpltPkg-110to134kBtuh-11p5eer-3p4cop   DEER prototypes for AC and Heat Pump measures were created using the “110to134kBtuh” cooling capacity range. Savings variation between the size ranges simulated was minimal, and results from a single size range were determined to be an adequate representation for all applicable system size ranges. In addition, larger systems generally operate less efficiently than systems in the selected size range. Savings for larger units of these types are therefore slightly conservative.  The baseline prototypes were modified slightly to better fit the base cases for this workpaper:  Min Outside Air: Varies changed to 20%  Max Outside Air: 100% changed to 70%  Outside Air Control: Fixed changed to OA Temp  Economizer dry-bulb changeover temperatures: Varies changed to Varies by climate zone from 69°F to 75°F depending on Title 24 2016 Table 140.4B requirement  These modifications were not made to packaged terminal air conditioners (PTACs) which are unlikely to have economizers and thus economizer damper leakage. The only three building types affected by the omission of PTACs were hospitals (Hsp), hotels (Htl), and universities (EUn).  The following changes were made to the baseline models to simulate the measure cases:  Fan EIRL: One-Speed changed to Two-Speed Standard,  Two-Speed NEMA,  Two-Speed PMM  Air Temperature Control: Variable changed to Staged Volume  Cool Stages: n/a changed to 0.99  Heat Stages: n/a changed to 0.99  Min Flow Ratio: ­100% changed to 40% (Standard Motor)  30% (NEMA)  20% (PMM)  Min Fan Ratio: ­100% changed to 40% (Standard Motor)  30% (NEMA)  20% (PMM)  Details on the modifications to the baseline and measure case models are provided in Section 2 of PGECOHVC143 R3.  Peak demand calculations were calculated taking the average values of the hourly energy profiles from the models during the applicable DEER peak demand periods for each climate zone.  Refer to Section 2 of PGECOHVC143 R3 for more details.  Adjusted calculations are found in Attachment 1 |
| **Section 3. Load Shapes** | DEER:HVAC\_Split-Package\_AC  DEER:HVAC\_Split-Package\_HP |
| **Section 4. Costs** |  |
| **Section 4.1 Base and Measure Costs** | Deviation from PG&E’s calculation template. StdCostID catenation has been adjusted to only use MeasureCode-CostQualifier, eg. SA07-None |

**Savings and Calculation Methodology**

This short form made no changes to the adopted PGE savings.

**Costs**

This short form made no changes to the adopted PGE costs. However, this adoption includes a deviation from PG&E’s cost IDs. StdCostID has been adjusted to only use MeasureCode-CostQualifier, eg. SA07-None.

**Savings Calculation Workbook**

1. SCE17HC045.0\_A1 – Calc Templates\_2019