

# HVAC Subcommittee Meeting #7



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# Residential HVAC Measure List – Q3 Consolidation

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- HVAC Measure List for today

- ❑ \*\*5.10 – Residential HVAC Quality Maintenance and Motor Retrofit – **Hold**, SCE updating now
  - ❑ \*5.11 – Quality Installation for Residential Split Systems and Package Systems
  - ❑ \*\*5.13 – Efficient Fan Controller for Residential Air Conditioners – **Hold**, SCE updating now
    - ✦ 5.42, Brushless Fan Motor for Residential Central AC – **Combine?**
  - ❑ 5.20 – Gravity Wall Furnaces in Single-Family and Multi-Family Homes – **Keep?**
  - ❑ 5.23 – Water Cooled AC and Residential AC with an Evaporative Condenser – **Keep?**
  - ❑ 5.29, Air Filter Replacement – **Keep?**
  - ❑ 5.33, Residential Single Family and Multi-Family Coil Cleaning – Updated workpaper
  - ❑ \*5.34, Window Evaporative Coolers
  - ❑ 5.35, Direct Evaporative Coolers, Res
  - ❑ \*5.36, Direct-Indirect Evaporative Coolers
  - ❑ 5.38, Portable Room Air Conditioner
  - ❑ \*\*5.47, Smart Thermostat
- 
- ❑ 5.08 Energy Upgrade California - Prescriptive Whole Home Upgrade – *Hold, Requesting models*
  - ❑ \*5.09 Res Duct Test and Seal
  - ❑ \*5.18 High Efficiency Furnaces-Residential
  - ❑ 5.17 Whole House Fan
  - ❑ 5.40, Upstream Residential HVAC
  - ❑ 5.37, Energy Star Room Air Conditioners – Moved to 7.14a
  - ❑ 5.43, Multifamily Domestic Hot Water Temperature Reset Controller – Moved to 6.19
  - ❑ 5.52, Whole House - Res (Duct Leakage, Duct Insul, Attic Insul, other) – Moved to 5.08

# Measure Consensus

## 5.10 – Residential HVAC Quality Maintenance and Motor Retrofit

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### • Offering

- ❑ Workpaper (SCE17HC029 July 2018) – waiting for workpaper
  - ✦ SCE only updating Motor Retrofit
  - ✦ PG&E includes both QM and Motor Retrofit
- ❑ Offerings
  - ✦ ACCA 4 System Assessment and Report. Condenser Coil Cleaning
  - ✦ Blower Motor Retrofit
  - ✦ 1-Yr QM Service Agreement
  - ✦ Single Measure Kicker
  - ✦ Comprehensive Kicker
  - ✦ Increase Refrigerant Charge - System with thermal expansion valve (TXV)\*
  - ✦ Increase Refrigerant Charge - System with No thermal expansion valve (TXV)\*
  - ✦ Decrease Refrigerant Charge - System with thermal expansion valve (TXV)\*
  - ✦ Decrease Refrigerant Charge - System with No thermal expansion valve (TXV)\*
  - \*Typical (8% rated charge)
  - ✦ Airflow Adjustment
- ❑ 2017 Savings (Q1-Q3):

BldgType	kWh			
	PGE	SCE	SDGE	
DMo	967,803	195,874	177,854	
MFm	811,794		593	
SFm	1,882,138	8,579	78	

# Measure Consensus

## 5.11, Quality Installation for Residential Split Systems and Package Systems

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- Offering

- Workpaper (SCE13HC023.3, Mar 2016; WPSDGEREHC1064 Rev0.1, Jun 2014)
- Offering
  - ✦ Quality Installation + Efficiency Upgrade- Split Air Conditioner (*SCE only*)
    - SEER 14.0, 14.5, 15.0, 16.0, 18.0 Replacing SEER 13.0
  - ✦ Quality Installation + Efficiency Upgrade-Package Air Conditioner (*SCE only*)
    - SEER 14.5, 15.0 Replacing SEER 13.0
  - ✦ Quality Installation + Efficiency Upgrade-Split Heat Pump (*SCE only*)
    - SEER 14.0, 14.5, 15.0, 16.0 Replacing SEER 13.0
  - ✦ Quality Installation + Efficiency Upgrade-Package Heat Pump (*SCE only*)
    - SEER 14.5, 15.0, 16.0 Replacing SEER 13.0
  - ✦ Quality Installation Only-Packaged/Split Air Conditioner (*SDG&E and SCE*)
    - SEER 13.0, 14.0, 15.0, 16.0
  - ✦ Quality Installation Only -Packaged/Split Heat Pump (*SDG&E and SCE*)
    - SEER 13.0, 14.0, 15.0
- Base Case:
  - ✦ HVAC unit over-sized by 20% - How often is this done?
  - ✦ Low air flow rate, 350 cfm/ton
  - ✦ Ducts not properly sealed
  - ✦ High duct system static pressure

# Measure Consensus

## 5.11, Quality Installation for Residential Split Systems and Package Systems

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- Savings (SCE and SDG&E methodologies similar)
  - Single Family DEER Prototypes developed
    - ✦ 2 two-story; 2 single-story with different orientations
    - ✦ Pre 78 vintage
  - QI and Efficiency Upgrade
    - ✦ Scales energy (kWh) and demand (kW) impacts from previous version of workpaper - SCE13HC023.0 to accommodate updated weather data (2014)

Variable	Base Case	Measure (DEER Model Assumptions)
SEER*	13	14
Cooling Capacity (Btu/h)	60,535.68	50,446.4
CFM	1,765.624	1,658.68**
Duct Air Loss Ratio <sup>£</sup>	0.0804	0.0402
Supply Delta T***	1.5931	1.21028
Supply kW/cfm****	0.000510	0.000383

- QI only measures do not include changes to SEER, Supply Delta T or Supply kW/cfm

# Measure Consensus

## 5.11, Quality Installation for Residential Split Systems and Package Systems

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- Savings

- Savings for

- ✦ SCE: CZ06, 08-10, 13-16
  - QI and QI with efficient system
  - Split and Package Systems, both A/C and HP
  - Norm Unit: Area-ft<sup>2</sup>
- ✦ SDG&E: CZ06-08, 10, 14-15
  - QI only
  - Split and Package Systems only
  - Norm Unit: Cap-tons

- Should QI be combined with High Efficiency system – [Double-counting issues?](#) (SCE)
- Should additional climate zones be created for PG&E and SDG&E?
- Normalizing unit difference
- Ask for wish-list from HEUS, Home Energy Use Survey (tons, single-stage/multi-stage, sqft, ???) – [send request for Stage 2](#),
- Should we include New Construction? (currently through SCE)
- 2017 Savings (Q1-Q3):

BldgType	kWh	kW	Therms
	SCE	SCE	SCE
SFm	148,387	57.12	1,027

# Measure Consensus

## 5.13, Efficient Fan Controller for Residential Air Conditioners

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### • Offering

- Workpaper ([SCE13HC052.2, Mar 2016](#); [PGE3PHVC150 R4 Apr 2014](#); [WPSDGEREHC0024-R2-Short Form, Dec 2016](#)) – SCE update expected in 2018
  - ✦ 2017 Claims:

BldgType ▾	PGE	SCE	SDGE
DMo	206,385	769,266	62,957
MFm	411,783	745,663	2,947
SFm	1,855,879	879,580	6,282

- Base Case:
  - ✦ The base case is a 14 SEER AC unit without an EFC.
- Measure Case:
  - ✦ Efficient fan controller (EFC) device onto a residential single-family, multi-family or double-wide mobile home split-system air conditioner.
  - ✦ EFC devices delay the evaporator fan cycle off time to take advantage of the residual liquid refrigerant remaining in the evaporator after the compressor cycles off.

- Savings

- Modeled measure

- ✦ Minimally above-code SEER 14 split-AC system
- ✦ Cooling capacity varied by building type and climate zone based on the DEER building prototypes for double-wide mobile home, multi-family, and single family residential buildings
- ✦ DEER building prototypes updated in 2014 to include the Title 24 2008 and Title 24 2013 code based vintages
- ✦ Four hourly variables were captured from the eQUEST simulations:
  - Total cooling load (Btu/hr),
  - Condensing unit energy (kWh),
  - Supply (indoor) fan energy (kWh), and
  - AC total cooling capacity (Btu/hr)
- ✦ Hourly performance calculated using ET Study methodology with part-load modeled values

- Normalizing Unit: per-ton (SCE, PG&E); per-controller (SDG&E)

- ✦ Which Norm Unit to use?
- ✦ 1.1 tons for MFm; 2.1 tons for Dmo



# Measure Consensus

## 5.42, Brushless Fan Motor for Residential Central AC

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### • Offering

- Workpaper (SCE13HC028.4, Feb 2016; PGE3PMOT102 R1, May 2014) – Suggested to combine with 5.13 – New SCE workpaper available

- ✦ 2017 Claims (Q1-Q3):

BldgType <input type="text"/>	kWh	kW	Therms
	SCE	SCE	SCE
DMo	931,687	915.29	(6,365)
MFm	6,176	3.46	(5)
SFm	700,311	404.68	(974)

- Base Case:

- ✦ Shaded pole (SP) or permanent split capacitor (PSC) motor; minimum 350 cfm/ton.
- ✦ Fan operates in (1) Auto or (2) Continuous mode.

- Measure Case:

- ✦ Brushless permanent magnet (BPM), direct current motor with selectable speed control designed to replace a PSC motor in a residential direct drive fan application.

- Question: Should these measures (5.13 and 5.42) be combined? – What additional applications may be excluded? - Measure effected by DEER2020 updates. – Keep separate.

# Measure Consensus

## 5.20, Gravity Wall Furnaces in Single-Family and Multi-Family Homes

### ● Offering

- ❑ Workpaper (WPSCGREHC110603A-Rev02, Jan 2014;  
**WPSDGEREHC1062 Rev0, Jun 2012 - based on SCG wp)**
  - ✦ Minimal savings in 2017 (Q1-Q3)
- ❑ Base Case:

Capacity	AFUE
over 19,000 Btu/hour up to 27,000 Btu/hour	65%
over 27,000 Btu/hour up to 46,000 Btu/hour	66%
over 46,000 Btu/hour	67%



- ❑ Measure Case:
  - ✦ The Annual Fuel Utilization Efficiency (AFUE) on the new measure furnace must exceed 70%

# Measure Consensus

## 5.20, Gravity Wall Furnaces in Single-Family and Multi-Family Homes

- Savings

- eQUEST models for MFm

- ✦ DMO savings taken from regression data due to errors in model

- Calibrated against 889 homes in SCG Territory

- ✦ Home size not available in customer data set, but collected for some homes from Internet data

BldgType	kWh	kW	Therms
	SCG	SCG	SCG
MFm	-	-	244
SFm	-	-	8

Furnace Capacity (Btu/h):	25,000	35,000	50,000
Baseline AFUE:	65.0%	66.3%	66.8%
Measure AFUE:	70.0%	70.0%	70.0%
Savings:	7.1%	5.3%	4.6%

- Question: Is it valuable to keep this Measure in the eTRM? – Stage 2 item to improve electronic pilot control (planned for new workpaper)

# Measure Consensus

## 5.23, Water Cooled AC and Residential AC with an Evaporative Condenser

### ● Offering

- ❑ Workpaper (SCE13HC025.3, April 2014)
  - ✦ No savings in 2017 (Q1-Q3)
- ❑ Offering (10 NonRes / 1 Res)
  - ✦ Residential: Air-Cooled to Evap-Cooled
    - 10 SEER (9.1 EER) -> 17.4 SEER (15.1 EER)
  - ✦ Non-Residential: Evap-Cooled to Evap-Cooled
    - < 5.4 ton (11.09 -> 14, 15, 16 SEER)\*
    - 5.4 up to 11.3 ton (10.1 -> 15 SEER)\*
    - 11.3 up to 20 ton (10.1 -> 14 SEER)\*
    - ≥ 20 ton (10.1 -> 13 SEER)\*
  - ✦ \*To-Code Offering
- ❑ Norm Unit: Cap-ton
- ❑ Question: Is it valuable to keep this Measure in the eTRM?

# Measure Consensus

## 5.23, Water Cooled AC and Residential AC with an Evaporative Condenser

### • Savings

#### ✦ Non-Residential

##### ○ Modeled measures

- H.E. Evap/Water-Cooled Pkg A/C <65kBTU (Measure ID: D03-082)
- H.E. Evap/Water-Cooled Pkg A/C ≥65kBTU (Measure ID: D03-083)

##### ○ Scaled values

$$Savings_{Program} = Savings_{DEER} \times \frac{(MeasureEER_{Program} - BaseEER_{Program})}{(MeasureEER_{DEER} - BaseEER_{DEER})}$$

Table 11 DEER Measure Scaling Summary

Measure	Program Measure Efficiency	DEER Measure Efficiency	Title 20/24 Code Base Efficiency	DEER Code Base Efficiency
< 5.4 ton 14 EER Package/Split System Air Conditioner Condenser	14 EER	14 EER	12.1 EER	11.09 EER
< 5.4 ton 15 EER Package/Split System Air Conditioner Condenser	15 EER	14 EER	12.1 EER	11.09 EER
< 5.4 ton 16 EER Package/Split System Air Conditioner Condenser	16 EER	14 EER	12.1 EER	11.09 EER
5.4 up to 11.3 ton 14 EER Package/Split System Air Conditioner Condenser	14 EER	14 EER	11.5 EER	10.1 EER
11.3 up to 20 ton 14 EER Package/Split System Air Conditioner Condenser	14 EER	14 EER	11.0 EER	10.1 EER
≥ 20 ton 13 EER Package/Split System Air Conditioner Condenser	13 EER	14 EER	11.0 EER	10.1 EER

# Measure Consensus

## 5.23, Water Cooled AC and Residential AC with an Evaporative Condenser

- Savings

- Residential

- ✦ Modeled measures – Through MASControl / DOE2.2
  - Tech ID: RE-HV-ResEvapAC-17p4S
  - Building Types: SFm, MFm, DMO

# Measure Consensus

## 5.29, Air Filter Replacement with Alarm

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- Offering

- ❑ Workpaper (SCE17HC011-R0, Dec 2016; WPSDGENRHC1030 Rev0.1, Jun 2014)
  - ✦ No savings in 2017 (Q1-Q3)
- ❑ Offering
  - ✦ Air Filter Alarm (SCE – Residential only)
    - An air filter alarm in the form of a hardware that accounts for the differential pressure difference on the filter media notifies the user by means of a sound signal or other signals, that the filter must be cleaned or replaced with a new one.
  - ✦ Air Filter Replacement (SDG&E – Small Office, Restaurant, Retail only)
    - Scheduled replacement of air filters saves energy by reducing the workload for the air-handling unit and by protecting the evaporator coils, thus preserving optimal heat transfer.
- ❑ Question: Is it valuable to keep this Measure in the eTRM?
  - ✦ Should Filter Alarm concept be included in both measures?

- Savings

- Filter Alarm

- ✦ Excel based calculation for savings
  - Physics model and empirical inputs from studies
- ✦ Climate Zones: 6, 8-10, 13-16 (SCE)
- ✦ Bldg Types: SFm, MFm, DMo
- ✦ Norm Unit: per Sensor

- Filter Replacement

- ✦ DEER models used to obtain
  - Primary End Use (kWh/ton)
  - Number of Tons
  - Area (square footage)
- ✦ Estimate of 3.5% based upon an EM&V report (SDG&E 2004-05)
- ✦ Climate Zones: 7, 10 (SDG&E)
- ✦ Bldg Types: Small Office, Restaurant, Retail only
- ✦ Norm Unit: per Ton



# Measure Consensus

## 5.33, Residential Single Family and Multi-Family Coil Cleaning

### • Offering

- ❑ Workpaper (**WPSDGERERN001 Rev0.1, Jun 2014; WPSDGERERN001 Rev 3, Dec 2017**)
  - ✦ No savings in 2017 (Q1-Q3)
- ❑ Offering
  - ✦ Bldg Types: Res, SFm, MFm, Dmo
  - ✦ **Climate Zones: CZ06, 07, 08, 10, 14, 15 SDG&E-IOU**
- ❑ Savings
  - ✦ **DEER 2018 savings, Res-RCA-wtd (modified)**
  - ✦ **Disposition methodology...**
- ❑ **REA, Direct Install**
- ❑ **EUL: 3 yrs; RUL: 1 yr**
- ❑ **Question: Is it valuable to keep this Measure in the eTRM?** – Yes; still used by IOUs.
- ❑ **Question: Is this measure being captured in some other way for other IOUs?** – Yes; PG&E claims these savings as part of 5.10 (Res QI).
  - ✦ Note that SDG&E commented that EAR Team recommends not using Incidence Factors for measures that are not part of a bundle.
  - ✦ PG&E includes separate offerings (measure codes) as part of their Res QI workpaper, but it is unclear if these offerings are bundled or installed independently. Since they are separate measure codes, they must be claimed independently.

# Measure Consensus

## 5.33, Residential Single Family and Multi-Family Coil Cleaning

### • Savings

- ❑ Staff estimate that non-charge related services may account for an additional 25% savings on top of RCA.
  - ✦ Gross Charge Adjustment Savings = DEER values
  - ✦ Gross Non-Charge Adjustment Savings = **DEER values \* 0.25**
- ❑ Commission staff recommends the following apportioning of non-charge adjustment savings among the three possible measures:
  - ✦ Condenser Coil Cleaning: **50%** of the total
  - ✦ Evaporator Coil Cleaning: 25% of the total
  - ✦ Air Flow Adjustment: 25% of the total
- ❑ Staff also assigns the following incidence fractions to the gross savings results:
  - ✦ Condenser Coil Cleaning: **0.80**
  - ✦ Evaporator Coil Cleaning: 0.60
  - ✦ Air Flow Adjustment: 0.60
- ❑ Measure savings = DEER values \* 0.25 \* 0.50 \* 0.80

# Measure Consensus

## 5.34, Window Evaporative Coolers

- Offering

- Workpaper (SCE17HC026.0, Oct 2016)
  - ✦ Savings in 2017 (Q1-Q3)

BldgType	kWh SCE	kW SCE	Therms SCE
DMo	16,116	50.08	(2,869)
MFm	997	0.75	(15)
SFm	265,218	428.96	(18,605)

- Base Case

- ✦ Residential building with a code compliant (14 SEER) DX central AC

- Measure Case

- ✦ One or more window evaporative coolers are added to the building. They do not replace the central AC.
- ✦ During very high ambient temperatures and/or humidity and in the event that the evaporative cooler cannot satisfy the cooling setpoint in the space, the occupant is expected to disable the evaporative cooler and enable the DX central AC.

# Measure Consensus

## 5.34, Window Evaporative Coolers

- Savings

- ❑ A direct evaporative cooler (not window-mounted) measure is included in the DEER (D03-405)
- ❑ Climate Zones: 6, 8-10, 13-16
  - ✦ Question: Does this measure need to be expanded to other CZs?

- ❑ Calculation

- ✦ Annual energy savings = DEER kWh savings \* ESAF \* HEAF
- ✦ Demand reduction = DEER kW reduction \* PDAF \* HEAF
- ✦ Annual therm savings = DEER therm savings \* ESAF \* HEAF
  - Where:
    - DEER savings are from the READi tool v.2.4.7, measure D03-405
    - ESAF is the Energy Savings Adjustment Factor
    - PDAF is the Peak Demand Adjustment Factor
    - HEAF is the Human Error Adjustment Factor

# Measure Consensus

## 5.34, Window Evaporative Coolers

### ● Savings

- ✦ Annual energy savings = DEER kWh savings \* ESAF \* HEAF
- ✦ Demand reduction = DEER kW reduction \* PDAF \* HEAF
- ✦ Annual therm savings = DEER therm savings \* ESAF \* HEAF

#### ○ Where:

- DEER savings from READi tool v.2.4.7, D03-405
  - ESAF is the Energy Savings Adjustment Factor
  - PDAF is the Peak Demand Adjustment Factor
  - HEAF is the Human Error Adjustment Factor, 75%
- ✦ As there have been no studies performed to measure this particular factor, the HEAF will be arbitrarily set at 75% until a study yields a more conclusive value. This implies that up to 25% of the savings will be lost due to non-ideal operation of the evaporative cooler and DX system.
  - ✦ **Question: Does the Human Error Adjustment Factor need to be updated?**

CZ	ESAF	PDAF
6	44%	56%
8	31%	33%
9	27%	0%
10	49%	0%
13	65%	0%
14	88%	100%
15	60%	11%
16	95%	100%

# Measure Consensus

## 5.35, Direct Evaporative Coolers, Residential

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### • Offering

- ❑ Workpaper (SCE17HC013.0, Feb 2017; PGECOHC163 R2, Apr 2016; WPSDGEREHC0031 Rev 0 (Short Form from SCE), Oct 2017)

- ✦ Savings in 2017 (Q1-Q3)

BldgType	kWh SCE	kW SCE	Therms SCE
SFm	8,868	12.28	-

- ❑ Base Case

- ✦ DxAC equipment / DxHP equipment

- ❑ Measure Case

- ✦ REA = SCE/SDG&E: Adds but does not replace existing DX system

- ✦ ~~ROB = PG&E: Replaces existing DX system~~

- ✦ With / without pressure relief damper

- ✦ Are there potential conflicts that could arise if we offer both.

- ❑ Bldg Type / Climate Zones

- ✦ PG&E (MFm / CZ11,12,13); SDG&E (DMo / CZ14)

- ❑ Norm Unit – per Household

## Measure Consensus

### 5.35, Direct Evaporative Coolers, Residential

23

- Savings

- PG&E: ROB savings
  - Annual energy savings = DEER kWh Savings*
  - Demand reduction = DEER kW reduction*
- SCE: REA savings

$$\begin{aligned} \text{Annual energy savings} &= \text{DEER kWh Savings} * \text{ESAF} * \text{HEAF} \\ \text{Demand reduction} &= \text{DEER kW reduction} * \text{PDAF} * \text{HEAF} \end{aligned}$$

where:

DEER savings are from the READi tool v.2.4.7,  
measure D03-405

ESAF is the Energy Savings Adjustment Factor

## PDAF is the Peak Demand Adjustment Factor

HEAF is the Human Error Adjustment Factor, 75%

- ❏ With Dampers: 38 kWh/home is added
  - ✦ 2004-2005 incentive program direct evaporative cooler savings values

IOU	CZ	ESAF	PDAF
PG&E	1	100%	100%
PG&E	2	100%	100%
PG&E	3	100%	100%
PG&E	4	100%	100%
PG&E	5	100%	100%
SCE	6	56%	33%
SCE	8	33%	33%
SCE	9	26%	0%
SCE	10	48%	0%
PG&E	11	100%	100%
PG&E	12	100%	100%
Both	13	65%	0%
SCE	14	88%	100%
SCE	15	57%	11%
Both	16	95%	89%

### • Questions

- ❑ Should both REA and ROB offerings persist?
- ❑ With the REA offering, are the factors appropriate?
- ❑ Are Damper savings appropriate?
- ❑ Low adoption. Should the offerings be changed?
- ❑ Workpaper originally included NonRes/ROB installations but were removed by SCE in 2017. Why?

Include water savings (negative value) in the eTRM?



# Measure Consensus

## 5.36, Direct-Indirect Evaporative Coolers, Residential

25

### ● Offering

- ❑ Workpaper ([SCE17HC017.0, Dec 2016](#); [PGECO HVC166 R2, Apr 2016](#))

- ✦ Savings in 2017 (Q1-Q3)

BldgType	kWh	kW	Therms
	SCE	SCE	SCE
SFm	281,595	465.25	-

- ❑ Base Case

- ✦ Standard compressor-based DX space cooling

- ❑ Measure Case

- ✦ Replace with direct-indirect or two-stage evaporative coolers in residential buildings – **ROB only?** Only REA claimed.

- ❑ Bldg Type / Climate Zones

- ✦ PG&E (MFm / CZ11,12,13); SDG&E (DMo / CZ14)

- ❑ Norm Unit – per Household

### ● Savings

- ✦ Replace with direct-indirect or two-stage evaporative coolers in residential buildings
- ✦ An Advanced Evaporative Cooler Level 2 (AEC-2) must have
  - An indirect evaporative stage,
  - Rigid media direct stage,
  - Manufactured evaporative media with a rated saturation effectiveness of 0.95 or better (a natural fiber pad is not allowed – the rigid media is generally 8” or 12” thick),
  - A two speed fan,
  - A multi-position control switch that allows two fan speed operation and
  - Fan only operation and be equipped with water quality management system that provides positive removal of sump water on a regular interval (a bleed system is not allowed).
- ✦ DEER savings – D03-407
- ✦ PG&E – per Home; SCE – per 1000 sqft

- Offering

- Workpaper (SCE17HC017.0, Nov 2016)
  - ✦ Savings in 2017 (Q1-Q3) – None
  - ✦ Vast majority of units are Energy Star
    - Connected tier has limited models available

# Measure Consensus

## 5.38, Portable Room Air Conditioner

### ● Offering

- ❑ Workpaper ([SCE13HC027.1, Apr 2014](#))
  - ✦ Savings in 2017 (Q1-Q3) – None
- ❑ Base Case
  - ✦ 12,000 BTU/h room air conditioner (room AC) with an average EER of 11.0
- ❑ Measure Case
  - ✦ 12,000 BTU/h portable room AC with an average EER of at least 11.9
  - ✦ May include multi-cooling speeds, humidification control, automatic restart, and/or self-evaporating technology
- ❑ Bldg Type / Climate Zones
  - ✦ SCE CZ (CZ06, 08-10,13-16); DMo, SFm
- ❑ Norm Unit – per Cap-ton
  - ✦ Question: Is it valuable to keep this Measure in the eTRM?
  - ✦ Question: Does this measure need to be expanded to other CZs?

# Measure Consensus

## 5.38, Portable Room Air Conditioner

- Savings

- Full Load Hours

- ✦ 2006-2008 impact study report for room ACs was used to obtain typical room AC operating hours in climate zones 6, 8, 9, and 10
    - ✦ Remaining CZ's scaled based upon degree days

- Baseline EER: 11.7

- Measure EER: ~11.0 (from average of six typical models)

# Measure Consensus

## 5.47, Smart Thermostat, Residential

30

- Offering

- ❑ Workpaper ([SCE17HC054.0, Mar 2017](#); [PGE COHVC167 R1 \(SF-SCE\), Oct 2017](#); [WPSDGEREHC0030 Rev 0.1 \(SF-SCE\), Mar 2018](#)) – update planned in Dec 2018

- ✦ Savings in 2017 (Q1-Q3)

BldgType	kWh		
	PGE	SCG	SDGE
MFm	39,348	2,298	
SFm	448,022	228,214	166,891

- ❑ Are these the correct/latest workpapers?
- ❑ Who is the right person to report out on the latest/proposed methodology and dispositions?

# Measure Consensus

## 5.47, Smart Thermostat, Residential

31

### • Offering

- ❑ Workpaper (SCE17HC054.0, Mar 2017; PGECO HVC167 R1 (SF-SCE), Oct 2017; WP SDGEREH C0030 Rev 0.1 (SF-SCE), Mar 2018) – update planned in 2018 & 19

- ✦ Savings in 2017 (Q1-Q3)

BldgType <input type="text"/>	kWh		
	PGE	SCG	SDGE
MFm	39,348	2,298	
SFm	448,022	228,214	166,891

- ❑ Norm Unit – each (thermostat)

- ❑ Base Case

- ✦ Setback Programmable Thermostats or Non-Programmable Thermostats
  - 85% Programmable (ER); 15% Manual (ROB); <1% Smart (HEUS)

- ❑ Measure Case

- ✦ Residential Smart Communicating Thermostat with two way communication and automatic scheduling capabilities
- ✦ With and without Demand Response

- ❑ Measure Application Type

- ✦ IOU – mix of ER (85%) / ROB (15%) – BRO? (disposition – needs EUL of 5 yrs to be cost effective)
- ✦ POU – ROB

- ❑ All CZs; Building Types: SFm, MFm, DMO

# Measure Consensus

## 5.47, Smart Thermostat, Residential

- EUL

- Measure Application Type

- ✦ IOU – mix of ER (85%) / ROB (15%) – BRO?
- ✦ POU – ROB

- Based upon survival study, energy savings persist for 9.2 – 13.8 yrs

- ✦ Assumes a 10-40% of units going offline still produce savings
- ✦ Average of 11 yrs used
- ✦ BRO would use 3 yrs

EUL ID	Description	Sector	UseCategory	Life	
				1 <sup>st</sup> Baseline	2 <sup>nd</sup> Baseline
TBD (ROB – 15%)	Smart Thermostats	Res	HVAC	11 (EUL)	N/A
TBD (RET/ER – 85%)	Smart Thermostats	Res	HVAC	3.66* (RUL)	7.34 (EUL-RUL)
TBD – POU Programs	Smart Thermostats	Res	HVAC	11 (EUL)	N/A



# Measure Consensus

## 5.47, Smart Thermostat, Residential

- Savings

- Is same method used? – No, methodology uses PG&E ET Study for electric savings and SCG independent study for gas savings.

Work Paper Input	SCG Work Paper (previously submitted)	Nest-SCE Work Paper (this document)
Study design	RCT with matched control group	Pooled fixed effects regression model and comfort temperature set point analysis
Sample size	~500 thermostats	Over 150,000 thermostats (CA Specific)
Data Collection Period	Winter 2014 - 2015	May 2015 – April 2016
Climate zones captured in input data set	8, 9, 10, 15, 16	1 (heating only), 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
End-uses analyzed	Heating	Heating and cooling
Demographics	Single Family Home	Single Family Home

# Modelling Status

34

# Agenda

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- Q3 HVAC Measure review – Residential Measures
  - Review measures today
  - Note and ask **Questions**
    - ✦ Goal is to revisit questions next Thursday to get consensus.
    - ✦ Input today is welcome to help team begin consideration for next week
- Discuss HVAC Measure Summary Status
  - Goal refined due to model collection / creation issues
  - Goals:
    - ✦ Full set of models (not possible, but as close as we can – understand holes)
    - ✦ Understand measure definition (keywords in DOE2.2/eQUEST)

# Discuss HVAC Measure Summary Status

36

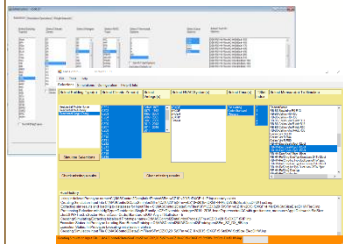
- Goal refined due to model collection / creation issues
  - ❑ Limited measures available through MASControl (various versions)
  - ❑ Different/limited functionality through MASControl2
    - ✦ Quirky performance
    - ✦ Savings / usage stored but no hourly results generated
  - ❑ Collecting DEER-modified models (slow process – lots of models, can be large, modelled years ago)
- Goals:
  - ❑ Full set of models (not possible, but as close as we can – understand holes)
  - ❑ Understand measure definition (keywords in DOE2.2/eQUEST)

# Discuss HVAC Measure Summary Status

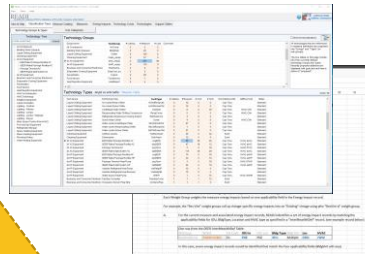
37

DEER Direct (maybe with scaling)

Model:  
MASControl or  
MASControl2



39  
Measures



24 Measures

15

TechID exist

9

TechID does  
not exist in  
MC/MC2

DEER Modified – waiting for models



15 Measures

Not modeled

- Excel
- Disposition
- Other

11 Measures

Measures consolidated / moved

5 Measures

# Previous Measures

38

# Measure Consensus -

## 5.03 – Space Heating Boilers

39

### • Offering

- ❑ Workpaper (PGECOHC101 R6, Jan 2017; WPSCGNRHC120206A R4, Mar 2014; WPSDGENRHC1061 R1, Sept 2016 (short form))
- ❑ Base Case:
  - ✦ **Space heating boilers** are pressure vessels that transfer heat to water for use primarily in space heating applications.
- ❑ Measure Case:
  - ✦ Energy efficient units often feature high-efficiency and/or low NOx burners, and typically have features such as forced air burners, relatively large heat exchange surfaces, and/or utilize heat recovery from stack gases.
  - ✦ High-efficiency gas-fired boilers, typically rated above 90% thermal efficiency, are commonly known as condensing boilers.
- ❑ **Question:** Table of offerings needs review by IOUs. Some tiers did not line up.

		Tier 1			Tier 2	
		Base Eff	Qual Eff	Measure Eff	Qual Eff	Measure Eff
Hot Water	<300	82 AFUE	≥ 84% AFUE	84.5% AFUE	≥ 90% AFUE	94% AFUE
	<300 (MFm)	82 AFUE	≥ 84.5% AFUE	84.5% AFUE		
	300 - 2,500	80%TE	≥ 83% TE	85% TE	≥ 90% TE	94% TE
	≥ 2,5000	80%TE	≥ 83% TE	85% TE	≥ 94% TE	94% TE
Steam	<300	79%TE	≥ 82% AFUE	82% AFUE		
	300 - 2,500	79%TE	≥ 81% TE	83% TE		
	≥ 2,5000		≥ 81% TE	83% TE		

# Measure Consensus -

## 5.03 – Space Heating Boilers

40

### • Savings

#### □ MFm – Modified DEER Prototypes

- ✦ Energy savings for this building type was calculated using energy models in eQUEST. The energy models were based on DEER prototype buildings for each climate zone (CZ01-CZ16) over the following building vintages: 1975, 1985, 1996, 2003 and 2005.

		Base Eff	Tier 1 Qual Eff	Measure Eff	Tier 2 Qual Eff	Measure Eff
Hot Water	<300	82 AFUE	> 84% AFUE	84.5% AFUE	> 90% AFUE	94% AFUE
	<300 (MFm)	82 AFUE	≥ 84.5% AFUE	84.5% AFUE		
	300 - 2,500	80%TE	≥ 83% TE	85% TE	≥ 90% TE	94% TE
	≥ 2,5000	80%TE	≥ 83% TE	85% TE	≥ 94% TE	94% TE
Steam	<300	79%TE	≥ 82% AFUE	82% AFUE		
	300 - 2,500	79%TE	≥ 81% TE	83% TE		
	≥ 2,5000		≥ 81% TE	83% TE		

#### □ Other Offerings are DEER Values



# Measure Consensus -

## 5.03 – Space Heating Boilers

### ● Cost

- ❑ PG&E workpaper (updated 2017)
  - ✦ WO017 2010 – 2012
- ❑ SCG workpaper (updated 2014)
  - ✦ DEER 2011 data (from DEER 2008)
- ❑ SDG&E workpaper (updated 2016, short form)
  - ✦ From WPSCGNRWH120206C Rev6 (Commercial DHW Boilers)
  - ✦ From DOE Technical Support Document (TSD) (2014?)

# Measure Consensus -

## 5.22 – Variable Refrigerant Flow - NonRes

43

### ● Offering

- ❑ **Question:** PG&E and SCE are no longer offering these measures. Show we drop this measure?
- ❑ PGECOHVC142 R1, Jan 2016
  - ✦ Base Case
    - S287 and S289 replace existing rooftop packaged air conditioners and heat pumps
    - S288 and S290 replace existing VAV HVAC equipment
  - ✦ Measure Case
    - Variable Refrigerant Flow units with or without heat recovery, <80 tons
- ❑ SCE13HC036 R1, Mar 2016
  - ✦ Base Case
    - Single-zone Packaged DX Air Conditioners with gas heating
    - Multi-zone Packaged DX Variable Air Volume (VAV) Air Conditioners with gas heating
  - ✦ Measure Case
    - $\geq 65$  kBtu/hr Variable Refrigerant Flow Heat Pump DX Equipment
    - $\geq 65$  kBtu/hr Variable Refrigerant Flow Heat Recovery DX Equipment

# Measure Consensus -

## 5.41 – Water Source Heat Pumps

44

### • Offering

#### □ Workpapers (two methodologies are consistent)

✦ SCE13HC048 R5, Sept 2015; PGECOHC162 R3, Jan 2016

Solution Code	Measure Code	Measure Name	Measure EER	Measure kW/ton	Code EER	Code kW/ton	Scaling Factor	kWh Savings
AC-61742	HB4	<65kBtu/hr 14.0 EER Water-Source Heat Pump	14.0	0.857	12.0	1.000	1.00	75,158
AC-70694	HB5	<65kBtu/hr 15.0 EER Water-Source Heat Pump	15.0	0.800	12.0	1.000	1.40	25,045
AC-80912	HB6	<65kBtu/hr 16.0 EER Water-Source Heat Pump	16.0	0.750	12.0	1.000	1.75	237,589
AC-57464	HV233	<65kBtu/hr 17.0 EER Water-Source Heat Pump	17.0	0.706	12.0	1.000	2.06	157,264
AC-73817	HV234	<65kBtu/hr 18.0 EER Water-Source Heat Pump	18.0	0.667	12.0	1.000	2.33	19,541
AC-29674	HB7	65-135 kBtu/hr 14.0 EER Water-Source Heat Pump	14.0	0.857	12.0	1.000	1.00	1,619
AC-88035	HV235	65-135 kBtu/hr 15.0 EER Water-Source Heat Pump	15.0	0.800	12.0	1.000	1.40	5,912
AC-58661	HV236	65-135 kBtu/hr 16.0 EER Water-Source Heat Pump	16.0	0.750	12.0	1.000	1.75	
AC-96782	HV237	65-135 kBtu/hr 17.0 EER Water-Source Heat Pump	17.0	0.706	12.0	1.000	2.06	
AC-55861	HV238	65-135 kBtu/hr 18.0 EER Water-Source Heat Pump	18.0	0.667	12.0	1.000	2.33	
AC-98021	HB8	135-240 kBtu/hr 14.0 EER Water-Source Heat Pump	14.0	0.857	12.3	0.976	0.83	7,406
AC-78624	HV239	135-240 kBtu/hr 15.0 EER Water-Source Heat Pump	15.0	0.800	12.3	0.976	1.23	
AC-10953	HB9	>240 kBtu/hr 13.0 EER Water-Source Heat Pump	13.0	0.923	12.2	0.984	0.42	
AC-73615	HV240	>240 kBtu/hr 14.0 EER Water-Source Heat Pump	14.0	0.857	12.2	0.984	0.89	
AC-89140	N/A	<65kBtu/hr To Code Savings Portion Water-Source Heat Pump					1.00	
AC-98263	N/A	65-135 kBtu/hr To Code Savings Portion Water-Source Heat Pump					1.00	
AC-51802	N/A	135-240 kBtu/hr To Code Savings Portion Water-Source Heat Pump					1.00	
AC-77978	N/A	>240 kBtu/hr To Code Savings Portion Water-Source Heat Pump					1.00	
		DEER: WLHP system with 14.0 EER / 4.6 COP replacing T24 minimum	14.0	0.857	12.0	1.000	1	

# Measure Consensus -

## 5.05 – Water Cooled Chillers

45

### ● Offering

#### □ SCE workpaper (SCE17HC043.0)

##### ✦ Variable speed centrifugal chiller

###### ○ 5 capacity sizes:

- <150 tons, (added)
- ≥150 to <300 tons,
- ≥300 to <400 tons,
- ≥400 to <600 tons
- ≥600 tons

###### ○ Path A and Path B (10% improvement of kW/ton and IPLV)

##### ✦ Variable speed screw chiller

###### ○ 5 capacity sizes:

- <75 tons,
- ≥75 to <150 tons,
- ≥150 to <300 tons,
- ≥300 to <600 tons, (split)
- ≥600 tons

###### ○ Path A and Path B (10% improvement of kW/ton and IPLV)

Blue text = Changing and first time that item is mentioned  
*Italics text* = Item that has not been completed

# Measure Consensus -

## 5.05 – Water Cooled Chillers

46

### ● Offering

- ❑ Savings use a weighted average approach for building type and select Climate Zones are chosen for savings, which matches the lighting approach.
- ❑ **Question:** Agree to use CZ-savings without PA. (Action from Last Meeting)

Program Type	HVAC Vintage	Building Type	PA	Climate Zone
ROB	Ex	Com	SCE	CZ06, CZ08, CZ09, CZ10, CZ13, CZ14, CZ15, CZ16
			PGE	CZ01, CZ02, CZ03, CZ04, CZ05, CZ11, CZ12
			SDG	CZ07

- ❑ Savings come directly from DEER.
- ❑ **Question:** Recommend moving CZ13 to the PG&E value based upon weighted area (or does this weighting reflect a larger percentage of claims from SCE/CZ13?).

Ref No	Name	PGE	SCE	SCG	SDGE
5.05	Water-Cooled Chillers		1,071,870		

- ❑ HVAC Types: cWtd
- ❑ Delivery: Upstream / Midstream; ROB
- ❑ Climate Zones: Includes all climate zones

Blue text = Changing and first time that item is mentioned  
*Italics text* = Item that has not been completed

# Measure Consensus - 5.24 and 5.25 – Unitary Air-Cooled

47

- Action: Understand impact to savings when removing PA impact from Climate Zone
  - Recommendation: Look at effect with Unitary Package Units
- Claims Data
  - <65kBTU/hr (1% overlap)

Row Labels	3A	3B	CZ02	CZ04	CZ05	CZ06	CZ07	CZ08	CZ09	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16	IOU	Grand Total
PGE	653	288	206	266	101						381	1,344	1,116			14	125	4,495
SCE						254		1,105	435	845			60	536	43	26		3,303
SDGE							207			31								238

- >65kBTU/hr (<1% overlap)

Row Labels	3A	3B	CZ02	CZ04	CZ05	CZ06	CZ07	CZ08	CZ09	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16	IOU	Grand Total
PGE	3,518	3,231	905	9,742	417						892	4,775	1,987			14	2,530	28,011
SCE						1,164		1,012	822	434			99	410	107	57		4,106
SDGE							25											25

- Very limited overlap in measures
- Need to understand when PG&E reports as IOU

# Savings Comparison

## 5.24 and 5.25 – Unitary Air-Cooled

- **DEER MeasureID**

- NE-HVAC-airAC-Pkg-lt55kBtuh-15p0seer
- NE-HVAC-airAC-Pkg-lt55kBtuh-16p0seer
- NE-HVAC-airAC-Pkg-lt55kBtuh-17p0seer
- NE-HVAC-airAC-Pkg-lt55kBtuh-18p0seer
- NE-HVAC-airAC-Pkg-55to65kBtuh-15p0seer
- NE-HVAC-airAC-Pkg-55to65kBtuh-16p0seer
- NE-HVAC-airAC-Pkg-55to65kBtuh-17p0seer
- NE-HVAC-airAC-Pkg-55to65kBtuh-18p0seer
- NE-HVAC-airAC-Split-lt45kBtuh-15p0seer
- NE-HVAC-airAC-Split-lt45kBtuh-16p0seer
- NE-HVAC-airAC-Split-lt45kBtuh-17p0seer
- NE-HVAC-airAC-Split-lt45kBtuh-18p0seer
- NE-HVAC-airAC-Split-45to55kBtuh-15p0seer
- NE-HVAC-airAC-Split-45to55kBtuh-16p0seer
- NE-HVAC-airAC-Split-45to55kBtuh-17p0seer
- NE-HVAC-airAC-Split-45to55kBtuh-18p0seer
- NE-HVAC-airAC-Split-55to65kBtuh-15p0seer
- NE-HVAC-airAC-Split-55to65kBtuh-16p0seer
- NE-HVAC-airAC-Split-55to65kBtuh-17p0seer
- NE-HVAC-airAC-Split-55to65kBtuh-18p0seer
- NE-HVAC-airHP-Pkg-lt55kBtuh-15p0seer-8p2hspf

- NE-HVAC-airHP-Pkg-lt55kBtuh-16p0seer-8p5hspf
- NE-HVAC-airHP-Pkg-lt55kBtuh-17p0seer-9p0hspf
- NE-HVAC-airHP-Pkg-lt55kBtuh-17p0seer-9p0hspf
- NE-HVAC-airHP-Pkg-55to65kBtuh-15p0seer-8p2hspf
- NE-HVAC-airHP-Pkg-55to65kBtuh-16p0seer-8p5hspf
- NE-HVAC-airHP-Pkg-55to65kBtuh-17p0seer-9p0hspf
- NE-HVAC-airHP-Pkg-55to65kBtuh-17p0seer-9p0hspf
- NE-HVAC-airHP-Split-lt55kBtuh-15p0seer-8p7hspf
- NE-HVAC-airHP-Split-lt55kBtuh-16p0seer-9p0hspf
- NE-HVAC-airHP-Split-lt55kBtuh-17p0seer-9p4hspf
- NE-HVAC-airHP-Split-lt55kBtuh-18p0seer-9p7hspf
- NE-HVAC-airHP-Split-55to65kBtuh-15p0seer-8p7hspf
- NE-HVAC-airHP-Split-55to65kBtuh-16p0seer-9p0hspf
- NE-HVAC-airHP-Split-55to65kBtuh-17p0seer-9p4hspf
- NE-HVAC-airHP-Split-55to65kBtuh-18p0seer-9p7hspf

# Savings Comparison

## 5.24 and 5.25 – Unitary Air-Cooled

49

- **DEER MeasureID**

- ❑ NE-HVAC-airAC-Pkg-lt55kBtuh-15p0seer
- ❑ Look at CZ10, CZ13, CZ16

Row Labels	Any	SCE	SCG	SDG	Row Labels	Any	PGE	SCE	SCG	Row Labels	Any	PGE	SCE	SCG
[-] CZ10	305	332	332	325	[-] CZ13	310	338	336	336	[-] CZ16	246	262	264	264
[-] OfS	305	332	332	325	[-] OfS	310	338	336	336	[-] OfS	246	262	264	264
1975	321				1975	333				1975	254			
1985	327				1985	339				1985	271			
1996	309				1996	310				1996	246			
2003	524				2003	535				2003	403			
2007	241				2007	244				2007	203			
2011	243				2011	245				2011	205			
2014	235				2014	233				2014	189			
Ex	332	332	325		Ex	338	336	336		Ex	262	264	264	
New	239				New	238				New	194			

- ❑ Savings values 1-2% different
- ❑ Total Difference = 1-2% (savings diff) \* 1-2% (overlapping) = small value



# Savings Comparison

## 5.24 and 5.25 – Unitary Air-Cooled

50

- Look at, CZ13, Office Small

Row Labels	Any	PGE	SCE	SCG
<b>CZ13</b>	<b>310</b>	<b>338</b>	<b>336</b>	<b>336</b>
<b>OfS</b>	<b>310</b>	<b>338</b>	<b>336</b>	<b>336</b>
1975	333	}	}	}
1985	339			
1996	310			
2003	535			
2007	244			
2011	245			
2014	233			
Ex		338	336	336
New	238			

Wtd Field	PG&E	SCE
1975	40%	45%
1985	30%	25%
1996	13%	14%
2003	8%	7%
2007	4%	4%
2011	4%	4%
2014	2%	2%

# Measure Consensus -

## 5.05 – Water Cooled Chillers

51

### • Stage 1 Issues

#### □ Programs offer incentives in both Path A and Path B

- ✦ Exceed Path A requirements for full-load and integrated part-load efficiency
- ✦ Exceed Path B requirements for full-load and integrated part-load efficiency

*TABLE 110.2-D WATER CHILLING PACKAGES – MINIMUM EFFICIENCY REQUIREMENTS*

Equipment Type	Size Category	Path A Efficiency <sup>a,b</sup>	Path B Efficiency <sup>a,b</sup>		
Water Cooled, Electrically Operated Positive Displacement	< 75 Tons	≤ 0.750 kW/ton ≤ 0.600 IPLV	≤ 0.780 kW/ton ≤ 0.500 IPLV		
	≥ 75 tons and < 150 tons	≤ 0.720 kW/ton ≤ 0.560 IPLV	≤ 0.750 kW/ton ≤ 0.490 IPLV	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.695 kW/ton ≤ 0.440 IPLV
	≥ 150 tons and < 300 tons	≤ 0.660 kW/ton ≤ 0.540 IPLV	≤ 0.680 kW/ton ≤ 0.440 IPLV	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.635 kW/ton ≤ 0.400 IPLV
	≥ 300 Tons and < 600 tons	≤ 0.610 kW/ton ≤ 0.520 IPLV	≤ 0.625 kW/ton ≤ 0.410 IPLV	≤ 0.560 kW/ton ≤ 0.520 IPLV	≤ 0.595 kW/ton ≤ 0.390 IPLV
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV
			≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV

### • Savings Methodology

#### □ Direct from DEER

Blue text = Changing and first time that item is mentioned  
*Italics text* = Item that has not been completed

# Measure Consensus -

## 5.05 – Water Cooled Chillers

52

- Cost Methodology
  - ❑ SCE approach (only option)

	Capacity Range	New Data				Tier 1 GMC	Tier 2 GMC
		Baseline Cost	Tier 1 IMC	Tier 2 IMC	Size Category		
Water Cooled Variable Speed Screw Chiller	< 75 tons	\$ 636.30	\$ 161.60	\$ 295.53	1	\$ 797.90	\$ 931.83
	75 to 149 tons	\$ 448.32	\$ 143.54	\$ 244.79	2	\$ 591.86	\$ 693.11
	150 to 299 tons	\$ 320.64	\$ 123.43	\$ 206.76	3	\$ 444.07	\$ 527.40
	300 to 599 tons	\$ 253.26	\$ 101.27	\$ 181.43	4	\$ 354.53	\$ 434.69
	>= 600 tons	\$ 246.19	\$ 77.05	\$ 168.82	5	\$ 323.24	\$ 415.00
Water Cooled Variable Speed Centrifugal Chiller (Conventional Compressor)	< 150 tons	\$ 642.21	\$ 132.43	\$ 248.61	1	\$ 774.64	\$ 890.82
	150 to 299 tons	\$ 399.24	\$ 98.13	\$ 168.50	2	\$ 497.36	\$ 567.74
	300 to 399 tons	\$ 301.58	\$ 97.89	\$ 144.13	3	\$ 399.47	\$ 445.71
	400 to 599 tons	\$ 284.13	\$ 68.46	\$ 150.21	4	\$ 352.59	\$ 434.34
	>= 600 tons	\$ 212.11	\$ 41.57	\$ 99.35	5	\$ 253.68	\$ 311.47

Data was not provided for cells in red. Trend lines were created to estimate IMC and Baseline Costs

- ❑ Manufacturer data used
- ❑ Data from Centrifugal Chillers used to estimate Screw Chillers
  - ✦ Curve shifted to align with know point (300-599 tons)

# Measure Consensus -

## 5.39 – Air Cooled Chiller

### ● Offering

- ❑ Workpaper (SCE17HC030.1, PGECOAPP120 R7-short form)
- ❑ Base = Code / Path A
  - ✦ Air-Cooled Constant Speed Screw Chillers, for use in non-residential buildings, meeting the 2016 California Title 24 minimum efficiency standards in both full load (EER) AND part load conditions (IPLV)
- ❑ Measure
  - ✦ Tier 1 – 10% Improvement (EER and IPLV)
  - ✦ Tier 2 – 20% Improvement (EER and IPLV)
  - ✦ 2 capacity bins: <150 tons and >=150 tons
  - ✦ **Updated Decision**: Note that this measures excludes Title 24 “Path B” chillers ; limit technology meets the Tier 2 standard currently. – **No change; consider for Stage 2.**
- ❑ Delivery: Upstream and Midstream; ROB
- ❑ Climate Zones: 1-16

# Measure Consensus -

## 5.39 – Air Cooled Chiller

54

### • Offering

- ❑ Question: Any insights from Impact Evaluation 2015 (Upstream HVAC program)
- ❑ Savings use a weighted average approach for building type and select Climate Zones are chosen for savings, which matches the lighting approach.
- ❑ **Question:** Agree to use CZ-savings without PA.

Program Type	HVAC Vintage	Building Type	PA	Climate Zone
ROB	Ex	Com	SCE	CZ06, CZ08, CZ09, CZ10, CZ13, CZ14, CZ15, CZ16
			PGE	CZ01, CZ02, CZ03, CZ04, CZ05, CZ11, CZ12
			SDG	CZ07

- ❑ Savings come directly from DEER.
- ❑ **Question:** Recommend moving CZ13 to the PG&E value based upon weighted area.
  - ✦ FYI – no claims in 2017 (Q1-Q3) in CZ13 for either PG&E or SCE

Ref No	Name	PGE	SCE	SCG	SDGE
5.39	Air-Cooled Packaged Chiller	100,295	1,516,405		

# Measure Consensus -

## 5.39 – Air Cooled Chiller

55

### • Cost – SCE approach (only option)

- ❑ Baseline and measure costs were determined by surveying manufacturers for cost information (information was collected directly from the market and **not from Program data**).
- ❑ Cost documentation for both base and measure case was collected from two manufacturers. Data was a combination of data from 2017 and 2016.
- ❑ Distributors provided costs for tier 1 and tier 2 equipment for both units under 150 tons and those greater than or equal to 150 tons.
- ❑ In some cases, only incremental costs were provided and actual prices were not provided. Therefore, baseline costs were determined by subtracting IMCs from Tier 2 cost data.

Measure	Size	Tier	EER	IPLV	Percent over Title 24	Tier kW/ton Demand Reduction	Tier kWh/ton Energy Savings	IMC	Baseline Cost	GMC
Air-Cooled Chiller	< 150 tons	1	11.1	15.1	10%	0.0631	102	\$ 180.68	\$ 477.58	\$ 658.26
		2	12.1	16.6	20%	0.116	187	\$ 326.08	\$ 477.58	\$ 803.66
	≥ 150 tons	1	11.1	15.4	10%	0.0631	102	\$ 139.23	\$ 450.09	\$ 589.32
		2	12.1	16.9	20%	0.116	187	\$ 189.05	\$ 450.09	\$ 639.15

# Measure Consensus -

## 5.09 – Duct Test & Seal, Residential

### ● Offering

- ❑ Workpaper (PGE3PHVC159, R4)
- ❑ High Duct Leakage:
  - ✦ Base case description for High Duct Leakage:
    - 40% (20% Supply/20% Return) Leakage (single- and multi-family)
    - 35% Supply Leakage (mobile home)
  - ✦ Measure case description for High Duct Leakage Reduction:
    - Residential: Duct Sealing (Total Leakage Reduced from High (35/40%) to Low (15/12%)
    - (35% to 15% for mobile home and 40% to 12% for single- and multi- family)
- ❑ Medium Duct Leakage:
  - ✦ Base case description for Medium Duct Leakage:
    - 24% (12% Supply/12% Return) Leakage (single- and multi-family)
    - 25% Supply Leakage (mobile home)
  - ✦ Measure case description for Medium Duct Leakage Reduction:
    - Residential: Duct Sealing (Total Leakage Reduced from High (25/24%) to Low (15/12%)
    - (25% to 15% for mobile home and 24% to 12% for single- and multi- family)
- ❑ Building Types
  - ✦ Res: MFm, DMO, SFm
- ❑ HVAC Types
  - ✦ rDXGF
- ❑ Delivery: Upstream; RC (Retro-commissioning)
- ❑ Climate Zones: 1-5, 11-13, 16 (PG&E)

Blue text = Changing and first time that item is mentioned  
*Italics text* = Item that has not been completed

# Measure Consensus -

## 5.09 – Duct Test & Seal, Residential

57

- Stage 1 Issues

- Offering:

- ✦ Climate zones seem to be limited to PG&E territory

- Savings Methodology

- DEER values

Measure Name	Impact ID
Residential: Duct Sealing (Total Leakage Reduced from (40/35%) to (12/15%))	Res-DuctSeal-HighToLow-wtd
Residential: Duct Sealing (Total Leakage Reduced from (25/24%) to (15/12%))	Res-DuctSeal-MedToLow-wtd

- Normalized units

- ✦ **Question:** Translated from “Cap-Tons” to “per Household” (next slide summary)
    - ✦ “Capacity values per Household” comes from EnergyImpacts\_RB-HV-MHDuctSeal-25pct-15pct; EnergyImpacts\_RB-HV-MFDuctSeal-40pct-12pct
      - Varies by BT and CZ (except DMO)

Ref No	Name	PGE	SCE	SCG	SDGE
5.09	Res DuctTestSeal	56,299		84,744	87,493



# Measure Consensus -

## 5.09 – Duct Test & Seal, Residential

58

### ● Savings Methodology

#### □ Normalized units

- ✦ **Question:** What should be the normalized unit: “Cap-Tons” or “per Household”
- ✦ Use “Cap-Tons”
  - Concern that using “Cap-tons” may drive installations to larger home systems, while “Household” may drive installations to smaller home systems
  - We don’t have data to support this point since the last two years are “per household”
- ✦ Use “Household”
  - Better to describe this way to the customer
  - Some IOU systems cannot support two normalized units
    - Cannot rebate on “Household” and claim savings on “Cap-tons”
  - Concern that the reported “Cap-tons” may not be accurate
  - Concern that many residential systems are oversized, so savings may be over-claimed if using “Cap-tons”

# Measure Consensus -

## 5.09 – Duct Test & Seal, Residential

59

- Cost
  - PG&E methodology (only option)
  - WO017

Measure Code	Building Type	Transaction	Baseline	Equipment Cost	Labor / Installation Cost	Maintenance / Other Cost	Total Measure Case Cost
H768, HV286	SFM, MFM	RC	Ex	\$71.45	\$181.24	\$0.00	\$252.69
H768, HV286	DMO	RC	Ex	\$30.62	\$78.54	\$0.00	\$109.16

# Measure Consensus -

## 5.17 – Whole House Fan (WHF), Residential

60

- **Offering** (no claims in 2017, Q1-Q3)
  - ❑ Workpaper (SCE13HC005.2, PGECOHV134 R2) – SCE to update in 2018
  - ❑ Base case
    - ✦ Includes an HVAC system; however, does not include air-economizing
  - ❑ Measure case
    - ✦ Requires that WHF be sized at least 2 cfm/sqft. of conditioned floor area
    - ✦ Have at least 1 sqft. of attic vent free area for each 375 cfm of rated WHF air flow
    - ✦ May include a control timer (e.g., 30 min. WHF operation) and/or a two speed controller (e.g., low fan speed and high fan speed).
  - ❑ Building Types
    - ✦ Res: MFm, DMO, SFm
  - ❑ HVAC Types
    - ✦ rDXGF
  - ❑ Delivery: DI and Downstream; REA (Retrofit Add-On)
  - ❑ Climate Zones: 6, 8, 9, 10, 13 – 16 (SCE)

# Measure Consensus -

## 5.17 – Whole House Fan (WHF), Residential

### • Stage 1 Issues

#### □ Offering:

- ✦ Climate zones seem to be limited to SCE territory
- ✦ Older version of PG&E workpaper can extend climate zones

### • Savings Methodology

Measure Name	Impact ID
Whole house fan	D03-441

#### □ Normalized units

- ✦ Translated from “1000 sqft” (measure area) to “per Household”
- ✦ Translation based upon prototype buildings (per BT and CZ). Example:

Climate Zone	Bldg. Type	Bldg. Vintage	Bldg. HVAC	Square Feet/Home	Num. Unit
6	DMo	Ex	rWtd	1,220	1.22
6	MFm	Ex	rWtd	1,000	1.00
6	SFm	Ex	rWtd	1,710	1.71

Blue text = Changing and first time that item is mentioned  
*Italics text* = Item that has not been completed

# Measure Consensus -

## 5.17 – Whole House Fan (WHF), Residential

62

### • Cost

#### □ PG&E – last update 2010

##### ✦ DEER 2005 costs

Cost Case Description	Material Cost	Installation Labor Cost - Retrofit	Installed Cost
Whole House Fan	\$400.56	\$295.32	\$695.88

#### □ SCE – last updated Jan 2016

##### ✦ DEER 2005 costs

Size	Measure Equipment Cost	Labor Cost	Full Measure Cost
< 4000 CFM	\$450.91	\$244.12	\$695.03
4000 – 6000 CFM	\$425.74*	\$269.72	\$695.46
6000 – 8000 CFM	\$400.56	\$295.32	\$695.88
> 8000 CFM	\$409.65	\$320.92	\$730.57
Average	\$421.72	\$282.52	\$704.24

#### □ Question: Should we use the average or single value?

# Measure Consensus -

## 5.18 – High Efficiency Furnaces, Residential

### ● Offering

- ❑ Workpaper (PGECO HVC145 R3, PGECO HVC147 R3, WPSCGREHC130115A-Rev04)
- ❑ Common Offerings
  - ✦ Res-GasFurnace-AFUE95 (AFUE  $\geq 95\%$  &  $< 96\%$ )
  - ✦ Res-GasFurnace-AFUE97 (AFUE  $\geq 97\%$ )
- ❑ PG&E Specific Offerings
  - ✦ Furnace with variable speed motor (VFD or ECM), only CZ11, 12, 13
- ❑ SCG Specific Offerings
  - ✦ Res-GasFurnace-AFUE92 (AFUE  $\geq 92\%$  &  $< 95\%$ )
  - ✦ Res-GasFurnace-AFUE96 (AFUE  $\geq 96\%$  &  $< 97\%$ )
- ❑ Building Types
  - ✦ Res: MFm, DMO, SFm
- ❑ HVAC Types
  - ✦ rWtd
- ❑ Delivery: DI and Downstream; ROB (PG&E) / ROBNC (SCG)
- ❑ Climate Zones: 1-16, IOU

# Measure Consensus -

## 5.18 – High Efficiency Furnaces

### • Stage 1 Issues

#### ❑ Offering:

- ✦ **Updated Decision:** SCG uses additional tiers – Confirmed to keep the measure simple because of low update currently.
  - Note that savings come from DEER, so easy to include other offerings in future
- ✦ **Updated Decision:** PG&E offers variable speed fan addition – Low update, but offering is still being piloted; planned to keep the offering

### • Savings Methodology

#### ❑ DEER values

Measure Name	Impact ID
High efficiency furnace	Res-Furnace-dHIR

#### ❑ Normalized units

- ✦ Translated from “cap-kBTUh” to “per Household”

#### ❑ Motor calculations

- ✦ Based upon scaled values from a disposition from a high efficiency blower motor workpaper (PGECHVC139)
- ✦ Calculates kWh, kW, and negative gas impact

# Measure Consensus -

## 5.18 – High Efficiency Furnaces

65

### • Stage 1 Issues

#### □ Offering:

- ✦ SCG uses additional tiers

<i>(source 2017, Q1-Q3 IOU Claims Data)</i>		Gross Therms			
Ref No	Name	PGE	SCE	SCG	SDGE
5.18	High Efficiency Furnaces - Residential			11,196	542

SCG	PG&E	Measure Description	Number of Units	Gross Therms
540357		Central Gas Furnace 92% AFUE	7	169
540358	x	Central Gas Furnace 95% AFUE	237	6,338
530641		Central Gas Furnace 96% AFUE	85	2,805
530642	x	Central Gas Furnace 97% AFUE	54	1,885

#### □ Notes

- ✦ Not a large savings measures
- ✦ More savings could be claimed with additional offerings (like SCG), but equivalent of about 6% increase.



# Measure Consensus -

## 5.24 – Unitary Air-Cooled A/C ≥65 kBTU/hr

66

### ● Offering

- ❑ Workpaper (PGECOHC128 R9, SCE17HC035.0)
- ❑ Base case = Code
  - ✦ Standard Efficient EER/IEER Rated Packaged/Split Air Conditioner, 65kBtu/h or larger
- ❑ Measure case
  - ✦ High Efficient EER/IEER Rated Packaged/Split Air Conditioner, 65kBtu/h or larger
  - ✦ Split-package or Single-package units
  - ✦ Like for like; within 5% of existing capacity
- ❑ Capacity Ranges / Efficiency Tiers
  - ✦ ≥5.4 to <11.3 tons; 4 tiers plus to-code offering
  - ✦ ≥11.3 to <20 tons; 3 tiers plus to-code offering
  - ✦ ≥20 to <63.3 tons; 3 tiers plus to-code offering
  - ✦ ≥63.3 tons; 3 tiers plus to-code offering
- ❑ Building Types
  - ✦ Com (weighted average commercial building type)
- ❑ HVAC Types
  - ✦ cDXGF
- ❑ Delivery: Upstream / Midstream; ROB and NC (PG&E)
- ❑ Climate Zones: 1-16, IOU

<i>(source 2017, Q1-Q3 IOU Claims Data)</i>		Gross kWh			
Ref No	Name	PGE	SCE	SCG	SDGE
5.24	Unitary Air-Cooled Commercial Air Conditioners and Heat Pumps ≥65 kBTU/h	1,736,774	322,188		1,833

# Measure Consensus -

## 5.24 – Unitary Air-Cooled A/C $\geq 65$ kBTU/hr

67

### ● Cost

- ❑ SDG&E adopted all DEER ID costs
- ❑ PG&E methodology; SCE adopting PG&E methodology
  - ✦ Workpaper (PGECO HVC128 R9, SCE17HC035.0)
  - ✦ The Base Case, Measure Case, and Incremental Costs were surveys on distributors based on 2016 proposed efficiency tiers and interpolated to DEER 2017 tiers.
  - ✦ Labor hours and labor hourly rates were taken from labor cost recommended values from Large Packaged DX (>5 Tons) documented in the 2010 -2012 WO017 Ex Ante Measure Cost Study, Table 4-3.

# Measure Consensus -

## 5.24 – Unitary Air-Cooled A/C ≥65 kBTU/hr

68

### ● Cost

- PG&E methodology; SCE adopting PG&E methodology

2016 Proposed Tiers					Market IMC \$/ton									
Capacity Range	Tier	EER	Or	S/IEER	Dist #1	Dist #2	Dist #3	Dist #4	Dist #5	Dist #6	Dist #7	Avg IMC \$/ton	Standard Dev.	Standard Dev. %
<5.4 tons	1	12	Or	15								\$185	\$67	36%
	2	12.5	Or	16								\$264	\$125	47%
	3	13	Or	17								\$402	\$85	21%
	4	13.5	Or	18								\$771	\$169	22%
5.4-11.3	1	11.5	Or	13								\$64	\$20	31%
	2	12	Or	13.8								\$121	\$44	37%
	3	12.5	Or	14.8								\$174	\$106	61%
	4	13	Or	18								\$291	\$127	44%
11.3-20	1	11.5	Or	12.5								\$87	\$32	37%
	2	12	Or	13.3								\$130	\$51	39%
	3	12.5	Or	14								\$208	\$77	37%
	4	13	Or	17.5								\$376	\$140	37%
20-63.3	1	10.5	Or	12								\$70	\$20	28%
	2	10.8	Or	12.5								\$135	\$48	35%
	3	11.1	Or	13.5								\$182	\$49	27%
	4	11.6	Or	15								\$199	\$22	11%
≥63.3	1	10.2	Or	12								\$110	\$0	0%
	2	10.8	Or	12.8								\$141	\$41	29%
	3	11.4	Or	14								\$267	\$117	44%
	4	12	Or	16								\$250	\$25	10%

Blue text = Changing and first time that item is mentioned  
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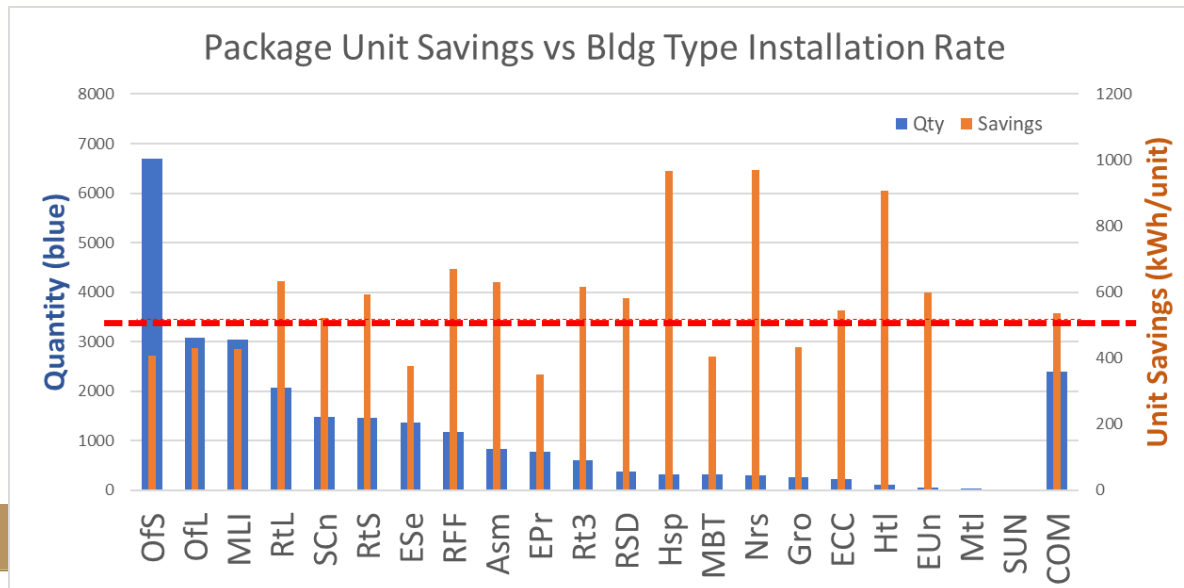
# Measure Consensus -

## 5.24 – Unitary Air-Cooled A/C $\geq 65$ kBTU/hr

69

### ● Savings Methodology

- DEER savings are used directly
  - ✦ **Updated Decision:** Agreement on using actual Building Type (not weighted COM average)
  - ✦ COM is currently used because of direction that should be certain what building type is
    - Recommend using actual building type versus IOU weighted average
      - Savings can vary significantly
      - Non-PA specific values are the goal for statewide measures
    - NOTE; 10% of PG&E claims use IOU
- Weighted value – claims quantity (dotted red line) is very similar to COM value



# Measure Consensus -

## 5.25 – Unitary Air-Cooled A/C <65 kBTU/hr

70

### • Offering

- ❑ Workpaper (PGECOHC126 R7, SCE17HC012.0, WPSDGENRHC0023 R1)
- ❑ Base case = Code
  - ✦ 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.
- ❑ Measure case
  - ✦ 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
  - ✦ Packaged A/C, Split System A/C, Packaged HP, Split System HP
  - ✦ Like for like; within 5% of existing capacity
- ❑ Capacity Ranges / Efficiency Tiers
  - ✦ Packaged Air Conditioner
    - <55 kBTUh; 4 tiers plus to-code offering
    - 55 to <65 kBTUh; 4 tiers plus to-code offering
  - ✦ Split System Air Conditioner
    - <45 kBTUh; 4 tiers plus to-code offering
    - 45 to <55 kBTUh; 4 tiers plus to-code offering
    - 55 to <65 kBTUh; 4 tiers plus to-code offering
  - ✦ Packaged Heat Pump
    - <55 kBTUh; 4 tiers plus to-code offering
    - 55 to <65 kBTUh; 4 tiers plus to-code offering
  - ✦ Split System Heat Pump
    - <55 kBTUh; 4 tiers plus to-code offering
    - 55 to <65 kBTUh; 4 tiers plus to-code offering
- ❑ Building Types
  - ✦ Com (weighted average commercial building type)
- ❑ HVAC Types
  - ✦ cDXGF
- ❑ Delivery: Upstream / Midstream; ROB and NC (PG&E)
- ❑ Climate Zones: 1-16, IOU

**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 Cooled Heat Pump</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

(source 2017, Q1-Q3 IOU Claims Data)		Gross kWh			
Ref No	Name	PGE	SCE	SCG	SDGE
5.25	Unitary Air Cooled Commercial Air Conditioning and Heat Pump Units Under 65 kBTuh	856,208	395,891		54,665

# Measure Consensus -

## 5.25 – Unitary Air-Cooled A/C <65 kBTU/hr

71

### • Savings Methodology

- ❑ DEER savings are used directly
- ❑ “To-Code” savings are calculated as follows:

#### 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

kWh Savings = 560 - 129 = **431 kWh**

kW Reduction = 0.293 - 0.0454 = **0.2476 kW**

therm Savings = -3.12 - (-1.2) = **-1.92 therms**

Blue text = Changing and first time that item is mentioned  
*Italics text* = Item that has not been completed

# Measure Consensus -

## 5.27 – High Efficiency PTAC and HP (<2 tons)

72

### ● Offering

- ❑ Workpaper (PGECOHC114 R5, SCE17HC007.0, WPSDGENRHC1052 R0)
- ❑ Base = Code
  - ✦ Package terminal air conditioning units (PTAC) or package terminal heat pumps (PTHP) that are through the wall, self-contained and less than or equal to 2 tons ( $\leq 24\text{kBtu/h}$ )
- ❑ Measure = 20% Higher than Code
  - ✦ Ductless mini-split A/C do not apply

Installation Type	Unit Capacity	T24 Minimum EER (AC)	T24 Minimum EER (HP)	Measure Minimum EER (AC)	Measure Minimum EER (HP)
ROB	$\leq 7,000 \text{ Btu/hr}$	9.41	9.31	11.29	11.17
	$> 7,000 \text{ and } \leq 15,000 \text{ Btu/hr}$	8.56	8.46	10.27	10.15
	$> 15,000 \text{ Btu/hr}$	7.71	7.61	9.25	9.13
NEW	$\leq 7,000 \text{ Btu/hr}$	11.9	11.9	14.28	14.28
	$> 7,000 \text{ and } \leq 15,000 \text{ Btu/hr}$	10.7	10.7	12.84	12.84
	$> 15,000 \text{ Btu/hr}$	9.5	9.5	11.4	11.4

### ❑ Building Types

- ✦ SDG&E – no residential

DEER Building Type used for Measure Savings	Work Paper Building Type
Lodging – Hotel	Agricultural
	Health/Medical - Nursing Home
	Health/Medical - Clinic
	Lodging - Hotel
	Lodging - Guest Rooms
	Manufacturing - Bio/Tech
	Manufacturing - Light Industrial
	Industrial
	Office - Large
	Office - Small
	Restaurant - Fast-Food
	Retail - Small
	Warehouse - Refrigerated
Lodging - Motel	Residential Multi-family (Dwelling)
	Lodging - Motel
	Residential Multi-family (Common)
	Residential Single Family

### ❑ Delivery: Downstream; ROB, NC

#### ✦ Updated Decision:

- PG&E/SDG&E = ROB only
- Change to ROB and NC with different savings

### ❑ Climate Zones: 1-16, IOU

# Measure Consensus -

## 5.27 – High Efficiency PTAC and HP (<2 tons)

73

### ● Offering

□ Norm Unit: Cap-Tons

□ HVAC Types

✦ dxAC, dxHP

✦ **Updated Decision**: Does this breakdown seem reasonable/accurate? - [Agreed](#)

□ Energy Savings – from DEER

✦ DEER provided data for the following unit capacity ranges for PTAC and PTHP units:

- <7 kBtuh
- 7-15 kBtuh
- >15 kBtuh

✦ **Question**: Which is the preferable approach? [Recommend the weighted average approach.](#)

- PG&E: These ranges were combined, via a **weighted average**, into one <=24kBtuh range for PTAC units and one <=24kBtuh range for PTHP units per the following table.
- SCE: Savings for this work paper are based on **7-15 kBtuh capacity range**, since nearly all of the previous participation falls under this range
- SDG&E: Uses savings that align with each bin (2 types and 3 capacity ranges)

Unit Capacity Ranges	% of Units Installed
PTAC/PTHP <7kBtuh	5%
PTAC/PTHP 7-15kBtuh	90%
PTAC/PTHP >15kBtuh	5%

<i>(source 2017, Q1-Q3 IOU Claims Data)</i>		Gross kWh			
Ref No	Name	PGE	SCE	SCG	SDGE
5.27	High Efficiency Package Terminal Air Conditioners & Heat Pumps 24kBtu/h (2 tons) and under		232,306		



# Measure Consensus -

## 5.40 – Upstream HVAC, Residential

74

### • Offering

- ❑ Workpaper (PGECOHC166 R3, SCE13HC062.1)

Tier 2					
	Air Conditioners		Heat Pumps		Gas Furnaces
	Split System	Packaged	Split Air Source	Packaged	AFUE
Efficiency	17 SEER, 13 EER	15 SEER, 12 EER	17 SEER, 13 EER, 9 HSPF	15 SEER, 12 EER, 8 HSPF	96% AFUE gas and propane furnaces, gas and propane boilers, oil furnaces and hot water boilers

Tier 3					
	Air Conditioners		Heat Pumps		Gas Furnaces
	Split System	Packaged	Split Air Source	Packaged	AFUE
Efficiency	18 SEER, 13 EER	16 SEER, 12 EER	18 SEER, 13 EER, 9 HSPF	16 SEER, 12 EER, 9 HSPF	97% AFUE gas and propane furnaces, gas and propane boilers, oil furnaces and hot water boilers

- ❑ Building Types: Residential
- ❑ Delivery: Upstream; ROB
- ❑ Climate Zones: 1-16, IOU
- ❑ **Question:** Pull out overlapping measures. Any concerns?

# Review “Measure Summary Template”



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# Back-up...

76

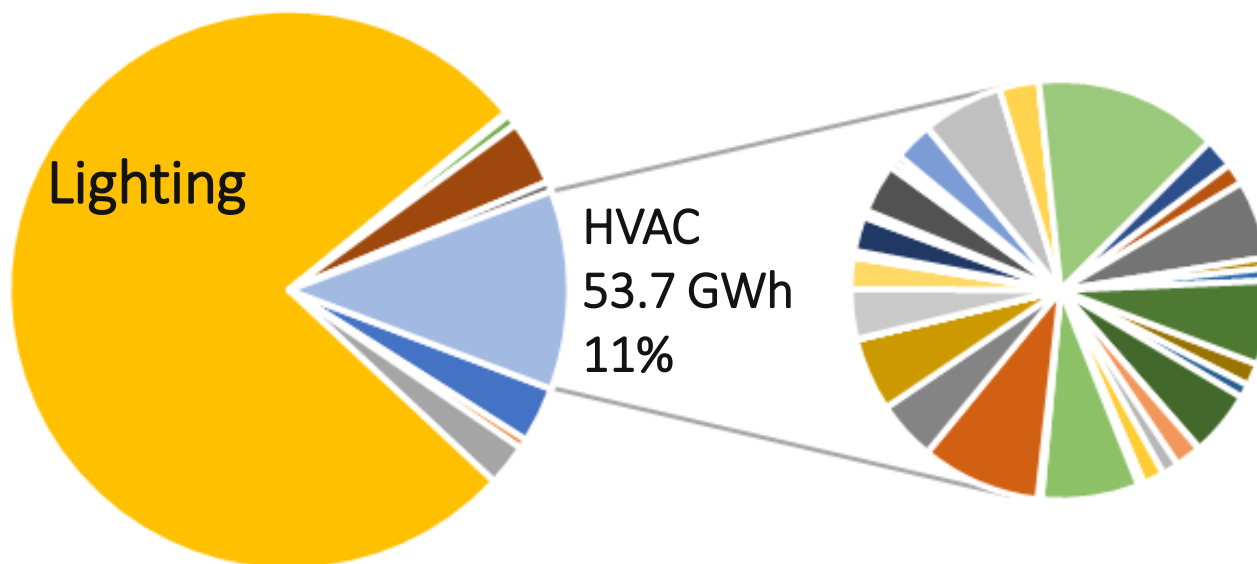
# HVAC Electric Savings

(Source – 2017 Q1-Q3, IOU Claims Data)

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## HVAC - Electric Savings by Measure

(Source - 2017 Q1-Q3 IOU Deemed Claims)



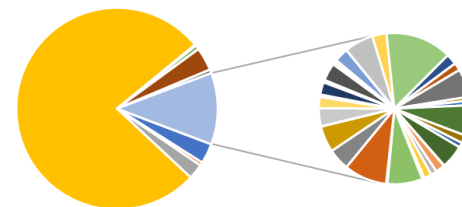
# HVAC Electric Savings

(Source – 2017 Q1-Q3, IOU Claims Data)

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## HVAC - Electric Savings by Measure

(Source - 2017 Q1-Q3 IOU Deemed Claims)



Ref No	Name	Gross kWh	PGE	SCE	SDGE
5.45	Guest Room PTAC/PTHP Energy Management System	7,626,835	7,599,985		
5.13	Efficient Fan Controller for Residential Air Conditioners	4,940,741	2,474,047	2,394,509	72,185
5.10	Residential HVAC Quality Maintenance and Motor Retrofit	4,044,713	3,661,735	204,453	178,525
5.52	Whole House - Residential	3,460,215	290,621	3,169,595	
5.41	Variable Speed Drive on HVAC Fan Control	3,332,090	2,223,110	1,108,980	
5.49	Enhanced Ventilation for Packaged HVAC Units with Gas Heating and Packaged Heat Pumps	3,232,393	1,740,763	1,422,159	
5.15	Unoccupied Supply Fan Control	3,038,106	2,113,409	924,697	
5.02	Economizer Repair	2,704,019	679,997	2,024,022	
5.14	VFD Retrofit to Central Plant Systems	2,484,678		2,484,678	
5.24	Unitary Air-Cooled Commercial Air Conditioners and Heat Pumps >=65 kBtu/h	2,060,795	1,736,774	322,188	1,833
5.32	Commercial Condenser Coil Cleaning	2,039,439	66,164	490,331	1,482,943
5.42	Brushless Fan Motor for Residential Central AC	1,638,174		1,638,174	
5.39	Air-Cooled Packaged Chiller	1,616,700	100,295	1,516,405	
5.30	Refrigerant Charge	1,433,067	164,420	732,081	536,566
5.25	Unitary Air Cooled Commercial Air Conditioning and Heat Pump Units Under 65 kBtu/h	1,306,765	856,208	395,891	54,665
5.46	Programmable Communicating Thermostat for Demand Response	1,233,427	1,218,918		14,508
5.05	Water-Cooled Chillers	1,071,870		1,071,870	

*Includes measures with at least 1M kWh; 18 more measures with savings not shown.*

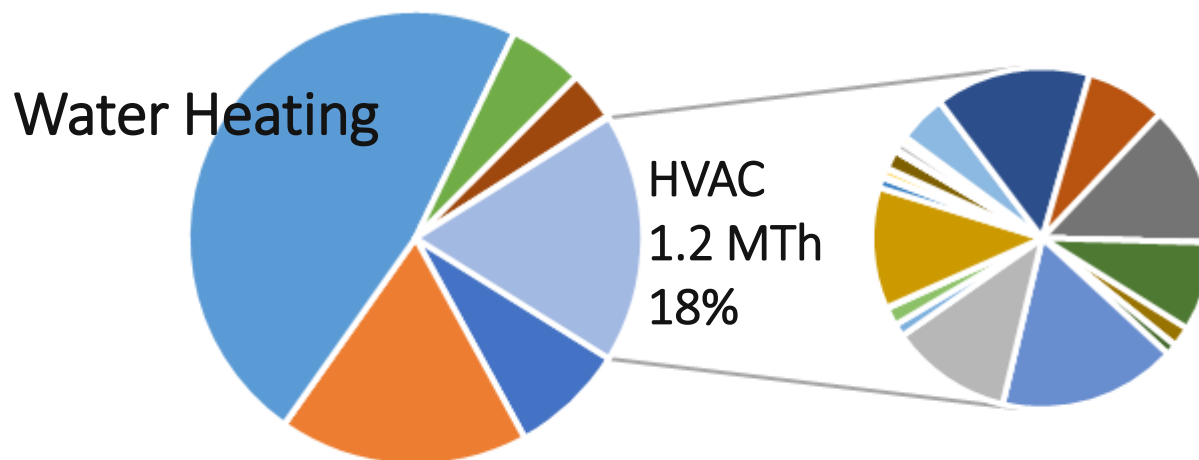
# HVAC Gas Savings

(Source – 2017 Q1-Q3, IOU Claims Data)

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## HVAC - Gas Savings by Measure

(Source - 2017 Q1-Q3 IOU Deemed Claims)  
(negative gas from lighting removed, -4.2MTh)



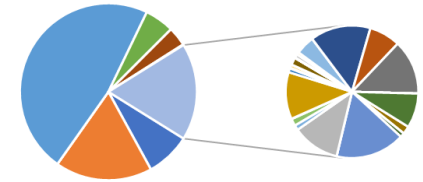
Note: “DEER Measures”, which includes some HVAC measures, was removed since it is only a small part (SDG&E – Refrig Charge Adjustment, VAV Box).

# HVAC Gas Savings

(Source – 2017 Q1-Q3, IOU Claims Data)

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**HVAC - Gas Savings by Measure**  
(Source - 2017 Q1-Q3 IOU Deemed Claims)  
(negative gas from lighting removed, -4.2MTh)



Ref No	Name	Gross Therms	PGE	SCE	SCG	SDGE
5.03	Space Heating Boilers	203,869	131,218		72,651	
5.46	Programmable Communicating Thermostat for Demand Response	177,985	174,913			3,072
5.49	Enhanced Ventilation for Packaged HVAC Units with Gas Heating and Packaged Heat Pumps	161,068	156,723	1,311		
5.06	Demand Controlled Ventilation for Single Zone Packaged HVAC	139,559	130,290	9,269		
5.15	Unoccupied Supply Fan Control	138,272	124,211	14,061		
5.52	Whole House - Residential	101,711	34,536	67,175		
5.47	Smart Thermostat	91,797	63,393		17,719	10,685
5.43	Multifamily Domestic Hot Water Temperature Reset Controller	55,749			55,749	
5.09	Res DuctTestSeal	14,603	6,052		4,321	4,230
5.02	Economizer Repair	12,644	9,122	3,522		
5.18	High Efficiency Furnaces - Residential	11,737			11,196	542
5.40	Upstream Residential HVAC	1,587	1,587			
5.19	High Efficiency Furnaces-Com	1,583	1,583			
5.11	Quality Installation for Residential Split Systems	1,027		1,027		
5.20	Gravity Wall Furnaces in Single-Family and Multi-Family Homes	252			252	
5.22	Variable Refrigerant Flow Commercial Heat Pumps & Heat Recovery Systems >65kBtu/h	14	14			

Note: “DEER Measures”, which includes some HVAC measures, was removed since it is only a small part (SDG&E – Refrig Charge Adjustment, VAV Box).

Eight (8) measures with negative gas savings, not shown.

# HVAC “Types”: DEER Measure

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- Step 1: From READi, download a Measure ID and savings
- Step 2: Reproduce savings for a few test cases (if you have correct version of MASControl, possible to reproduce)
- Step 3: Using MASControl, generate base case and measure case for all applicable permutations (Building Type, Climate zone)
  - Vintage and HVAC Type may be required
  - Save as documentation in eTRM
- Step 4: Identify key differences between base and measure case (HVAC measure and other parameters)
- Step 5: Prepare “Measure Summary” template
- Step 6: Seek subcommittee feedback (for Stage II) on Measure Summary template
  - “Correctness” of base and measure case
  - Identified sensitive parameters (perhaps this is area for more EM&V)
- Step 7: Review OpenStudio measures to see if measure could be re-run in EnergyPlus to compare with DOE 2.2/eQUEST results.



# HVAC “Types”: “Roots” Within DEER Measure

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- Step 1: From READi, download a Measure ID and savings
- Step 2: Locate building simulation models (from all utilities with WP) and results
  - Probably with utility WP developer consultant
- Step 3: Compare base case and measure case for all applicable permutations (Building, Climate zone)
  - Save as documentation in eTRM
  - Likely many fewer permutations because “typical” vintage and “typical” HVAC type used
- Step 4: Identify key differences between base and measure case for an individual utility (HVAC measure and other parameters) for each utility model.
- Step 5: Compare utility modeling approaches across utilities: 1. base case models and 2. measure case models
  - Identify key differences between utility base cases and utility measure cases
- Step 6: Complete “Measure Summary” template
- Step 7: Seek subcommittee feedback (for Stage II) on
  - “Correctness” of base and measure case
  - Different approaches taken by each utility
  - Which utility approach is best and run preferred models to fill in gaps throughout state
  - Identified sensitive parameters (perhaps this is area for more EM&V)
- Step 6: Review OpenStudio measures to see if measure could be re-run in EnergyPlus to compare with DOE 2.2/eQUEST results.

# HVAC Types: Non-DEER HVAC Measure

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- Same approach as used for other non-HVAC measures, examples
  - Review RCT
  - Review savings calculation
  - Etc.