HVAC Subcommittee Meeting #9

CALIFORNIA
TECHNICAL FORUM

AYAD AL-SHAIKH

SEPTEMBER 2018

Residential HVAC Measure List – Q3 Consolidation

- HVAC Measure List for today
  - **5.10 – Residential HVAC Quality Maintenance and Motor Retrofit – *Hold, SCE updating now*
    - Note: SMUD offers a bonus for Residential when ensuring 800 cfm/ton; is this similar to airflow adjustment?
  - **5.13 – Efficient Fan Controller for Residential Air Conditioners – *Hold, SCE updating now*
    - *2 Workpapers being updated by SCE; Have other IOUs seen these and will they be adopted statewide?*
  - 5.42, Brushless Fan Motor for Residential Central AC
    - *We agreed that this measure should not be combined with 5.13 (Efficient Fan Controller). Agree?*
  - *5.11 – Quality Installation for Residential Split Systems and Package Systems
    - SDG&E expressed concerns for double-counting savings if combine QI with Efficient System upgrade. Can they be separated (SCE)?
  - 5.20 – Gravity Wall Furnaces in Single-Family and Multi-Family Homes – Keep –
    - Yes, SCG is using this and will submit an add-on offering with an intermittent pilot.
  - 5.23 – Water Cooled AC and Residential AC with an Evaporative Condenser – Keep? –
    - Planning to split this into Residential and Commercial since offerings and methodologies are different.
  - 5.29 – Air Filter Replacement – Keep?
    - SCE – Residential with Alarm
    - SDG&E – Commercial with no Alarm
  - 5.40 – Upstream Residential HVAC
    - SDG&E is still pursuing this.

Green text = Reviewed in Q2
Blue text = New measures this week

Commercial Measures – Q3 only

Closure from Last Week (9/6/18):

- 5.12, Comprehensive Commercial HVAC Rooftop Unit Quality Maintenance
  - Commercial Bundle will not move into the eTRM; measures will be separated - Agree
  - I do not have the Airflow workpaper; heard that some people are claiming the savings put not incenting it. Agree

- 5.01, Economizer Controls , Commercial
- 5.02, Economizer Repairs , Commercial
- 5.15, Unoccupied Supply Fan Control
  - 3 Workpapers being updated by PG&E; same except that updates Relocatable Classroom Models (previously from 2014 MC) TBD
  - Will SCE and SDG&E adopt new PG&E workpaper?

- 5.30, Refrigerant Charge, Commercial – HOLD (due to measure changes wrt E-4952)
- 5.31, Evaporator Coil Cleaning, Commercial – HOLD (due to measure changes wrt E-4952)
- 5.32, Condenser Coil Cleaning, Commercial – HOLD (due to measure changes wrt E-4952)
  - 3 Workpapers being updated by PG&E; hold until resolution final - Agree

- 5.46, Programmable Communicating Thermostat for Demand Response
  - Heard that Programmable Thermostats are considered ISP. We will not move that Measure into the eTRM. Agree
  - SDG&E is still using their DR Communicating Thermostat wp. Thoughts about making this statewide?

Blue text = New measures this week
Red text = Consolidated or moved

Commercial Measures – Q3 only

Closure from Last Week (9/6/18):

- 5.07, VFD Demand Control System Retrofit to Parking Structure Exhaust Fan
- 5.16, Air Handler Variable Speed Motor
- 5.41, Variable Speed Drive on HVAC Fan Control
- 5.50, Cogged V-Belt Non-Residential HVAC Fans
- 5.28, Ductless Air Conditioners under 24 kBTU-hr
- 5.53, Ductless Air Conditioners under 60 kBTU-hr
- 5.19, High Efficiency Furnaces-Commercial
- 5.44, Guest Room PTAC-PTHP Adaptive Climate Controller
- 5.45, Guest Room PTAC-PTHP Energy Management System
- 5.55, Heat Pump Electric Resistance Heater Controls
- 5.56, Single Package Vertical Heat Pump

- 5.14, VFD Retrofit to Central Plant System – HOLD SCE Update coming
- 5.21, Classroom HVAC Occupancy Sensor – HOLD SCE Update coming
- 5.06, Demand Controlled Ventilation for Single Zone Packaged HVAC – HOLD P&GE update coming
- 5.49, Enhanced Ventilation for Packaged HVAC Units with Gas Heating and Packaged Heat Pumps – HOLD P&GE update coming

Blue text = New measures this week
Red text = Consolidated or moved

Measure Consensus – 5.07 VFD Demand Control System Retrofit to Parking Structure Exhaust Fan

- Offering
  - Workpaper (SCE13HC038.2, Apr 2016)
  - Claims – Q1-Q3 2017

BldgType	MeasAppType	kWh SCE
Htl	REA	886,648

  - Base Case:
    - An existing constant speed exhaust fan within an existing parking structure either operated on a time schedule or allowed to run 24 hours per day 7 days a week.
  - Measure Case:
    - A variable speed exhaust fan equipped with a variable frequency drive that will be controlled by carbon monoxide (CO) sensors located throughout the parking structure.
  - Offering
    - Motor Rated HP: <10 HP, 10-40 HP, 41-100 HP
    - Building Type
      - High Hours (ECC,Eun,GsR,Hsp,Htl,Mtl,Nrs,Rt3,RtL)
      - Low Hours (Epr,Ese,MFm,OfL,OfS)
    - Norm Unit: Rated HP

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

Measure Consensus – 5.07 VFD Demand Control System Retrofit to Parking Structure Exhaust Fan

- Savings
  - Building Type
    - High Hours (ECC,Eun,GsR,Hsp,Htl,Mtl,Nrs,Rt3,RtL) – 24 hrs/day, 7 day/wk
    - Low Hours (Epr,Ese,MFm,OfL,OfS) – 12 hrs/day, 6 day/wk
    - Consider increasing to 52.14 wks/yr to be consistent with 8,760 analysis that is typically used
  - Motor Rated HP: <10 HP, 10-40 HP, 41-100 HP
    - Variation in savings due to:
      - Motor efficiency varies with Rated HP (source – NEMA table)
      - VFD efficiency varies with Rated HP (source – DOE table)
        - Assumption that 90% motor load is used – Is this a good assumptions for a garage fan?
      - Measure Fan kWh/day= Sum over 24 hours of (Baseline Power Demand x 0.XX%[3])
      - Savings variation is less than 2%, should offerings be combined?

BldgType	MeasAppType	MeasDescription	kWh SCE
Htl	REA	<10 HP Variable Speed Drive on Garage Exhaust Fan Control	397,066
		11 HP - 40 HP Variable Speed Drive on Garage Exhaust Fan Control	489,582

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

Measure Consensus – 5.07 VFD Demand Control System Retrofit to Parking Structure Exhaust Fan

- Savings
  - Measure Fan kWh/day= Sum over 24 hours of (Baseline Power Demand x 0.XX%[3])

Source: Parking Garage LPA and Controls, 2013 Building Efficiency Standards, Draft of February 15, 2011, Figure 62			
Day	Occupancy (%)		
Hour	Weekday	Saturday	Sunday
1:00	25%	40%	30%
2:00	15%	20%	15%
3:00	8%	10%	10%
4:00	8%	5%	5%
5:00	8%	5%	5%
6:00	8%	5%	5%
7:00	15%	10%	9%
8:00	30%	10%	10%
9:00	50%	20%	20%
10:00	50%	20%	20%
11:00	45%	20%	20%
12:00	45%	30%	30%
13:00	50%	40%	30%
14:00	50%	40%	30%
15:00	60%	30%	25%
16:00	70%	30%	25%
17:00	70%	30%	30%
18:00	70%	30%	30%
19:00	70%	40%	40%
20:00	70%	50%	50%
21:00	70%	50%	50%
22:00	60%	60%	50%
23:00	50%	60%	50%
0:00	35%	60%	50%

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

Measure Consensus – 5.16, Air Handler Variable Speed Motor

- Offering
  - Workpaper (PGECOHVC125 R5, Mar 2016; SCE13HC031.2, Jan 2016 (*same methodology*))
  - No Claims – Q1-Q3 2017 – Do we still want this measure?
  - Base Case:
    - Nonresidential air handler unit with a permanent split capacitor motor. They turn on and off as required by thermostat control.
  - Measure Case:
    - Variable speed motors of 10HP or less. Please note that variable speed motors are different from variable frequency drives (VFD); a VFD is an electronic drive added to a motor, while a multiple speed brushless motor is a motor with built-in speed-modulating capability.
  - Offering
    - Building Type: Any
    - Climate Zones: CZ06, CZ08-16
      - Do we want/need the other climate zones?
    - Norm Unit: Each (Should this be rated HP?)

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

Measure Consensus – 5.16, Air Handler Variable Speed Motor

- Savings
  - Bin calculation
    - TMY3 data (available for all CZ within calculator)
    - Base fan:
      - ½-hp, 80% load, 77% motor efficiency
      - ECM motor efficiency of 85%
        - Based on a 10% efficiency increase cited by DOE document (Energy Consumption Characteristics of Commercial Building HVAC Systems Volume III: Energy Savings Potential)
    - Fan curve methodology:
      - This relationships between fan energy and fan flow are taken from the California Energy Commission Guide to Preparing Feasibility Studies and the 1998 Nonresidential ACM Approval Manual. Note that a typical system curve, DOE2 default, is assumed and these relationships are not applicable to all systems.

Control / Coefficients	BI/AF Outlet Dampers(1)	BI/AF Inlet VANES	FC Outlet Dampers	FC Inlet VANES	Van Axial Variable Pitch	VFD
a	0.2271429	0.5843452	0.1906667	0.3396190	0.2120476	0.2197619
b	1.1789286	-0.5791670	0.3100000	-0.8481390	-0.5692860	-0.8747840
c	-0.4107140	0.9702381	0.5000000	1.4956710	1.3452381	1.6525947
Min Load%	68%	48%	22%	22%	15%	10%

      - The supply air CFM is calculated so that the zone load is met with the SAT.
  - Long-term, should this methodology be consistent with ECM for high efficiency furnace measure?

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

Measure Consensus – 5.41, Variable Speed Drive on HVAC Fan Control

- Offering
  - Workpaper (PGECOHVC106 R5, Mar 2016; SCE13HC050.2, Jan 2016 (*same methodology*))
  - Claims – Q1-Q3 2017

Name	kWh PGE	kWh SCE
Variable Speed Drive on HVAC Fan Control	2,223,110	1,108,980

  - Base Case:
    - The baseline fans are simulated as forward curved fans with discharge dampers on an existing constant speed HVAC supply or return fan.
  - Measure Case:
    - Install a variable frequency drive and associated controls.
  - Offering
    - Building Type: ECC,Ese,Eun,**Hsp**,Htl,Nrs,**OfL,Rt3,RtL**
      - Savings focused on bold building types
    - CZ01-16 (taken from DEER D03-051)
      - Should we extend this to SDG&E?

BldgType	kWh PGE	kWh SCE
Hsp	199,875	317,250
OfL	908,185	791,730
Rt3	664,460	
RtL	450,590	

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

Measure Consensus – 5.41, Variable Speed Drive on HVAC Fan Control

- Savings
  - DEER 2005 measure ID: D03-051
  - Code Section:
    - This measure falls under Title 24 of the California Energy Regulations.
    - However, installing a VFD is not required to meet performance compliance of the 2013 Title 24 regulations, nor is it a mandatory measure.

VSD Supply Fan Measure

Variable speed drives on supply and return fans reduce fan energy compared to flow restricting technologies such as inlet vanes and discharge dampers because the VSD will vary the fan speed with load, greatly reducing electrical input at low flow conditions.

Methodology: The baseline fans are simulated as forward curved fans with discharge dampers. The oldest vintage prototypes with central systems include constant volume reheat systems. For this measure, the oldest vintage prototypes include variable air volume systems so that a comparison is possible between VSD fans and forward curved fans with discharge dampers. Current requirements for variable flow fans are contained in Title 24, Section 144(c) 2, Page 96. Generally, Title 24 has required VSDs for larger supply fans since 1992. Therefore, no above code savings are reported for this measure.

VSD Supply Fan Motors	
ID: **D03-051**	Abbreviation: **VSDSF**
Measure Description	Variable Frequency Drive motors use on VAV fans
Baseline Characteristics	damper controlled VAV with 30% min-cfm-ratio
Code Baseline Characteristics	T24 minimum: VAV w/30% min-cfm-ratio & w/VSD fans
Measure Characteristics	VFD with 30% min-cfm-ratio
Savings Reporting Units	nameplate HP
Savings Scalable By	n/a

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

Measure Consensus – 5.50, Cogged V-Belt Replacement for HVAC Fans

- Offering
  - Workpaper (PGECOHVC144 R2, Mar 2016; SCE13HC040.2, Feb 2015 (*same methodology*))
  - Claims – Q1-Q3 2017

	kWh	
Name	PGE	SCE
Cogged V-Belt Non-Residential HVAC Fans	42,531	400,301

  - Base Case:
    - Typical existing smooth fan, V-belts in non-residential package rooftop and split HVAC systems. A v-belt typically connects the motor and the supply air fan. Some of the larger unitary equipment may also have a v-belt between the return air motor and fan.
  - Measure Case:
    - Install cogged V-belts.
  - Offering
    - Building Types (21 BTs, 6 vintages)
      - Asm,ECC,EPr,ERC,ESe,EUn,Gro,Hsp,Htl,MBT,MLI,Mtl,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL,RtS,SCn
    - CZ01-16 (no savings for CZ07)
    - Norm Unit: Cap-Tons
    - EUL = 24,000 hours / annual hours of operation (per building type)

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

Measure Consensus – 5.50, Cogged V-Belt Replacement for HVAC Fans

- Savings
  - Which approach is more appropriate / reason for each?
    - PG&E uses 3 system types
      - Gas Packs (SA13), Heat Pumps (SA14), Unitary AC-Only (SA15)
    - SCE based upon the Gas Pack system
  - eQUEST/DOE2.2 models
    - Measure Case SYSTEM:SUPPLY-KW/FLOW
      - = Base Case SYSTEM:SUPPLY-KW/FLOW * 0.98
      - Update PG&E text from "1.02" to "0.98"
    - Measure Case SYSTEM:SUPPLY-EFF
      - = Base Case SYSTEM: SUPPLY-EFF * 1.02

	kWh	
BldgType	PGE	SCE
Asm	1,102	6,665
EPr	4,515	63,038
ESe	418	25,161
EUn		1,086
Gro		527
MLI		97,143
Nrs		1,114
OfL	2,783	7,713
OfS	169	1,488
RFF	1,189	1,441
RSD	2,160	7,179
Rt3		167,311
RtL	30,026	19,915
RtS	169	519

	Asm														
Row Labels	CZ01	CZ02	CZ03	CZ04	CZ05	CZ06	CZ08	CZ09	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16
PGE															
SA13		16.90	19.00	19.00	19.00	19.00				19.10	19.00	19.40			18.70
SA14		13.30	7.40	9.80	8.30	12.20				6.80	6.40	6.90			9.80
SA15		16.90	19.00	19.00	19.00	19.00				19.10	19.00	19.40			18.70
SCE															
AC-46275						26.00	25.85	25.68	21.67			22.56	22.54	24.73	20.52

	kWh	
MeasureID	PGE	SCE
AC-46275		400,301
SA13	40,225	
SA14	2,306	

Note:
Predominantly Gas Packs

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

Measure Consensus – 5.28, Ductless Air Conditioners under 24 kBTU/hr

- Offering
  - Workpaper (SCE13HC032.2, Nov 2014)
  - No Claims – Q1-Q3 2017
  - Is this workpaper still active and should be moved to the eTRM?
  - Base Case:
    - 14 SEER (Title 24), single phase, split system air conditioning unit in commercial applications under 24 kBtu/hr.
  - Measure Case:
    - 16 and 19 SEER ductless mini-split air conditioning unit in commercial applications under 24 kBtu/hr.
    - Definition question: Single indoor fan coil or multiple for this measure?
  - Offering
    - Building Types (22 BTs)
      - Asm,COM,ECC,EPr,ERC,ESe,EUn,Gro,Hsp,Htl,MBT,MLI,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL, RtS,SCn,WRf
    - CZ01-16 (no savings for CZ07)
    - Norm Unit: Cap-Tons

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

Measure Consensus – 5.28, Ductless Air Conditioners under 24 kBTU/hr

- Savings – From DEER
  - NE-HVAC-airAC-Split-lt45kBtuh-16p0seer
  - NE-HVAC-airAC-Split-lt45kBtuh-18p0seer (scaled – ED recommendation)
    - Scaled to 19 SEER based upon Residential ratio that is applied to Commercial

SEER	Average Residential Savings (kWh/ton)	Average Residential Demand Reduction (kW/ton)	kWh Scaling Factor	kW Scaling Factor
18	49.83	0.05954	1	1
19	70.69	0.08168	1.41861	1.37194

  - Recommend common climate zones like other package systems

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

    - Currently, climate zones are PA-independent
  - No gas savings

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

Measure Consensus – 5.53, Ductless Air Conditioners under 60 kBTU/hr

- Offering
  - Workpaper (SCE13HC033.3, Sept 2015)
  - No Claims – Q1-Q3 2017
  - Is this workpaper still active and should be moved to the eTRM?
  - Base Case:
    - Commercial: 14 SEER (Title 24), single phase, split system heat pump unit.
    - Residential: 14 SEER (Title 24), single phase, split system AC or heat pump unit.
  - Measure Case:
    - Commercial: Ductless mini-split or multi-split heat pump unit.
    - Residential: Ductless mini-split or multi-split AC or heat pump unit.
  - Offering
    - Building Types (22 BTs)
      - Asm,COM,ECC,EPr,ERC,ESe,EUn,Gro,Hsp,Htl,MBT,MLI,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL, RtS,SCn,WRf
    - CZ01-16 (no savings for CZ07)
    - Norm Unit: Cap-Tons

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

Measure Consensus – 5.53, Ductless Air Conditioners under 60 kBTU/hr

- Savings
  - Assumptions:
    - A high efficiency split system AC will provide similar electrical cooling savings to a ductless AC with an equivalent SEER rating.
    - A high efficiency split system HP will provide similar electric cooling and heating savings to a ductless HP with an equivalent SEER rating.
    - A mini-split system will provide similar savings and demand reduction to an equivalently sized and rated multi-split system.
    - The DEER residential AC measures are used to scale the commercial measures. In accordance with ED's recommendation provided in SCE Workpaper Review 2011 [C], it is assumed that the ratio of savings and demand reduction from residential units is the same as it is for commercial units.

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

Measure Consensus – 5.19, High Efficiency Furnaces, Commercial

- Offering
  - Workpaper (PGECOHVC146 R4, Jan 2017, PGECOHVC148 R4, Jan 2017)
    - SCG workpaper is coming – WPSCGREHC180412A / WPSCGNRHC18052A
  - Claims – Q1-Q3 2017

Name	kWh PGE	kW PGE	Therms PGE
High Efficiency Furnaces-Com	2,064	2.03	1,583

  - Base Case:
    - Non-residential base case gas furnace meeting 2015 federal standard requirements of 81% AFUE for weatherized furnaces.
  - Measure Case:
    - Central natural gas furnace rated at 95% AFUE, with or without a built-in variable speed motor (VSM), including ECM motors, for air handling.
  - Offering
    - Building Types (22 BTs)
      - Asm,ECC,EPr,ERC,ESe,Gro,Hsp,Htl,MBT,MLI,Nrs,OfS,RFF,RSD,RtL,RtS,SCn,WRf
    - CZ01-05, CZ11-13, CZ16 (PG&E CZ only)
    - Norm Unit: Each (assumes average input capacity of 80 MBTUh/furnace)
      - Agreement on Norm Unit? For commercial, typically done by capacity.

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

Measure Consensus – 5.19, High Efficiency Furnaces-Commercial

- Savings
  - DEER savings (per Area-1kFP = 1000 ft^2 footprint)
  - No VSD Motor:
    - Claimed Savings (therms per each) = DEER Savings * NumUnits / MeasArea (th/ft^2) * Connected Load * 80 kBTU/hr
      - Connected Load = data obtained from the CEUS website, that is, the average furnace capacity installed per surface area.
      - 80 kBTU/hr = estimated an average furnace input capacity based on the DOE Rules and Regulations Report
  - With VSD Motor:
    - Claimed Savings (therms per each) = Claimed Savings-No VSD Motor (th/each) – Ratio (Com/Res) * Res Therm Loss
      - Res Therm Loss = is the savings estimated from using a BPM motor from DOE2 models from the residential quality maintenance workpaper, PGECOHVC139 R2)

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

Measure Consensus –
5.44, Guest Room PTAC-PTHP Adaptive Climate Controller

- Offering
  - Workpaper (WPSDGENRHC1051 Rev 1, Sept 2016)
  - No Claims – Q1-Q3 2017
  - Base Case:
    - Existing PTAC or PTHP units.
  - Measure Case:
    - Optically Programmable (OP) controller combination which continually monitors, controls, powers and regulates the speed of fractional horsepower AC motors. This technology is applicable to most single phase AC induction motors up to 240 VAC and 10 amps, and can be used to upgrade unit ventilators, fan coils, PTACs and exhaust fans.
  - Offering
    - Building Types Htl, Mtl, Com
    - CZ06-08, CZ10, CZ14-15, IOU (SDG&E CZ only)
    - Norm Unit: Cap-tons
  - Savings
    - Based upon 30% improvement from Environmental Testing Labs 8/2007 study taken from DEER building prototype usage.

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

Measure Consensus –
5.45, Guest Room PTAC-PTHP Energy Mgmt System

- Offering
  - Workpaper (WPSDGENRHC1050 Rev 1, Sept 2014; PGE3PHVC149 R2, Jan 2016)
    - PG&E workpaper may be retired.
    - Measure maybe retired due to Title 24 code update – Confirm. POUs are still interested in keeping.
  - Claims – Q1-Q3 2017

	kWh	kW	Therms
Name	PGE	PGE	PGE
Guest Room PTAC/PTHP Energy Management System	7,599,985	2,895.76	-

  - Base Case:
    - Existing 6.50 EER to 10.5 EER (based on vintage) package terminal A/C; 6.50 EER / 2.7 COP to 10.5 EER (based on vintage) package terminal HP.
  - Measure Case:
    - EMS system is installed in guest rooms with existing PTAC or PTHP units. Each installation includes a power controller and an occupancy sensor. When the room is unoccupied, the power controller allows the temperature in the room to drift to a setpoint to reduce PTAC/PTHP runtime.
  - Offering
    - Building Types Htl, Mtl
    - CZ07, CZ10 (SDG&E CZ only)
    - Norm Unit: Cap-tons
  - Savings
    - Based upon 22-23% improvement from SDG&E ET study (12/08) taken from DEER building prototype usage.
      - Showed increase heating (so no gas savings claimed).
    - PG&E methodology is similar: 45% improvement taken from Program Data (no gas savings)

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

Measure Consensus – 5.55, Heat Pump Electric Resistance Heater Controls, Residential

- Offering
  - Workpaper (WPSDGEREHC0029 Rev 0, Sept 2014)
  - No Claims – Q1-Q3 2017
  - Base Case:
    - Existing heat pump system with electric resistance auxiliary heat, without outdoor thermostatic controls.
  - Measure Case:
    - Electric resistance heat controls upgrade by adding an outdoor thermostat and repair for heat pump systems. Includes verification of proper heating control sequencing and correcting systems with improper sequencing causing unnecessary operation of electric resistance auxiliary heat.
  - Offering
    - Building Types: SFm, MFm, DMo
    - SDG&E CZ only
    - Norm Unit: household

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

Measure Consensus – 5.55, Heat Pump Electric Resistance Heater Controls, Residential

- Savings
  - Improvement = 10% + 19% * 10% = 11.7%
    - Based upon PG&E Study (10%) improvement with controls
    - Proctor Engineering Group CheckMe! Database (19%) of 10% also running fulltime
  - EFLH = DOE / Energy Star heat pump calculator
  - Tons/household
    - SFm – 3.3 tons (taken from DEER 2008)
    - MFm – 2.1 tons (taken from Proctor database)
    - DMo – 3.5 tons (and small commercial) (taken from DEER 2008)
  - System efficiency = 7 HSPF (heating seasonal performance factor)

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

Measure Consensus –
5.56, Single Package Vertical Heat Pump

- Offering
  - Workpaper (PGECOHVC172 Rev 0, Sept 2017)
    - Disposition related to PGECOHVC174
    - Were updated costs submitted in Q2 2018? – New cost data is expected
  - No Claims – Q1-Q3 2017
  - Base Case:
    - Existing standard efficiency single package vertical air-cooled heat pump (SPVHP).
  - Measure Case:
    - High efficiency (above code) single package vertical air-cooled heat pump with the option of included air-side economizer and demand control ventilation (DCV) controls.
  - Offering
    - Building Types: ERC (Education - Relocatable Classroom)
    - PG&E CZ only, (CZ01-05, CZ11-13, CZ16)
    - Norm Unit: cap-ton
    - Measure Application Type: ER, ROB

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

Measure Consensus –
5.56, Single Package Vertical Heat Pump

- Savings
  - eQUEST / MASControl v3.00.28
  - Tech ID D08-NE-HVAC-airHP-Pkg-55to64kBtuh-15p0seer-8p2hspf with a 2007 vintage
  - Keyword changes to simulate no ducts, no return fan, PTAC system, less than or equal to 90% occupancy, and tiered efficiency levels:

Measure Base Case and Proposed Tier Levels for Normal Replacement Installation Type

Option	Base Case (Title 24 2016)	Tier 0	Tier 1	Tier 2
Cooling mode efficiency	10.00 EER (0.288 EIR)	11.00 EER (0.258 EIR)	11.00 EER (0.258 EIR)	11.50 EER (0.245)
Heating mode efficiency	3.00 COP (0.304 EIR)	3.25 COP (0.278 EIR)	3.25 COP (0.278 EIR)	3.25 COP (0.278 EIR)
Economizer	No	No	Yes	Yes
DCV	No	No	Yes	Yes

Measure Base Case and Proposed Tier Levels for Accelerated Replacement Installation Type

Option	Base Case	Tier 0 (Title 24 2016)	Tier 1	Tier 2	Tier 3
Cooling mode efficiency	9.00 EER (0.324 EIR)	10.00 EER (0.288 EIR)	10.00 EER (0.288 EIR)	11.0 EER (0.258 EIR)	11.5 EER (0.245 EIR)
Heating mode efficiency	3.00 COP (0.304 EIR)	3.00 COP (0.304 EIR)	3.00 COP (0.304 EIR)	3.25 COP (0.278 EIR)	3.25 COP (0.278 EIR)
Economizer	No	No	Yes	Yes	Yes
DCV	No	No	Yes	Yes	Yes

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

Measure Consensus – 5.12 Comprehensive Commercial HVAC Rooftop Unit Quality Maintenance

- Offering
  - Workpaper (SCE13HC037 R3, Dec 2014; PGECOHVC138 (*retired*))
    - No Claims – Confirm that this workpaper is inactive.
  - Base Case:
    - RTU that has typical maintenance without the QM+ treatments. The typical level of maintenance of RTUs is assumed to be low, with only the minimum service being performed and units being run until they fail.
  - Measure Case:
    - Airflow and Coil Cleaning **(5.31 and 5.32)**
      - Evaporator and condenser coil cleaning
      - Airflow adjustment
    - Refrigerant Adjustment **(5.30)**
      - Refrigeration System Test
      - Refrigeration Charge Adjustment – Single and Multiple Compressors
    - Schedule Management **(5.46)**
      - Schedule Adjustment
      - Thermostat Replacement and Adjustment
    - Economizer Service (QM+Econo and QM+EconoHP only) **(5.01 and 5.02)**
      - Economizer Survey
      - Economizer Temperature High Limit Control
      - Economizer Controls Commissioning
      - Integrate Economizer: wiring
      - Integrate Economizer: wiring + thermostat
      - Economizer linkage Renovation
      - Economizer Renovation: Damper Motor
      - Economizer Renovation: Damper Motor and Controller/Sensor
  - Savings based upon 2013-14 Com HVAC Disposition

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

Measure Consensus - 5.01 - Economizer Controls

- Offering
  - Workpaper (PGE3PHVC152 R4, Aug 2016; WPSDGENRHC0028 Rev0*, Jun 2014 (based upon PG&E, R0); SCE13HC046.3, Jan 2016*)
  - Base Case: (AC with Gas Heat, AC only, HP)
    - (PG&E) Existing economizer is either equipped with a snapdisc or malfunctioning analog sensor or has a fully operational analog sensor but requires adjustment
    - (SCE) The base case is one of the commercial building types with an HVAC system that does not have an air side economizer
  - Measure Case:
    - Replace existing economizer control sensor or optimizing existing economizer controls by adjusting the changeover setpoint

		kWh	
Name	BldgType	PGE	SCE
Economizer Controls		406,088	150,130

  - Offerings
    - SCE: <54 kBtu/hr, >54 kBtu/hr (same savings); Commercial QM program; REA; DI/Downstream/Midstream
    - PG&E: Part of HVAC QM and HVAC Tune-up programs; REA; DI/Downstream
    - All commercial building types
    - Climate zones: PG&E (CZ01-05, 11-13, 16); SCE (CZ06, 08-10, 13-16)
    - Norm Unit: Cap-Tons

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

Measure Consensus - 5.01 - Economizer Controls

Name	BldgType	kWh PGE	kWh SCE
Economizer Controls	Asm	24,333	1,159
	EPr	37,785	9,861
	ESe	2,004	442
	EUn		1,309
	Gro	43	17,905
	MLI	24,688	
	OfL	95,134	3,989
	OfS	3,496	3,826
	RFF	20,940	2,629
	RSD	5,344	
	Rt3		25,929
	RtL	137,782	83,079
	RtS	54,540	

- Savings
  - SCE
    - DEER 2005 Measure: D03-058
  - PG&E
    - Modeled measure with a DEER basis
    - MASControl v3.00.20 and v3.00.27
    - Prototype varied depending upon building
      - Base models modified

Modeled Faults	eQUEST Keyword	Fault Weight	Modified Baseline
55°F Dry Bulb High Limit	SYSTEM:DRYBULB-LIMIT	0.56	55
63°F Dry Bulb High Limit	SYSTEM:DRYBULB-LIMIT	0.34	63
68°F Dry Bulb High Limit	SYSTEM:DRYBULB-LIMIT	0.10	68

      - Measure models – unmodified prototype models
    - Damper Leakage assumptions:
      - A minimum outside air fraction of 20% was used instead of 0 that indicates closed damper leakage for packaged HVAC systems are higher than previously thought.
      - A maximum outside air fraction of 70% was used instead of 100% due to emerging research (was not yet published) that indicates return air damper leakage and exhaust air re-entrainment for packaged HVAC systems are higher than previously thought, leading to inability of most systems to provide 100% outside air.
  - Question: Can these savings be combined where the measure case from PG&E's calculation matches the base case from SCE's calculation? – Planned with updated workpaper.
  - Question: How can we extend savings to SDG&E? – Planned with updated workpaper.

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

Measure Consensus - 5.01 - Economizer Controls

- Savings
  - PG&E

Table 14 ECONO-LIMIT-T Values From DEEER2015 Prototypes

Vintage	w01	w02	w03	w04	w05	w06	w07	w08	w09	w10	w11	w12	w13	w14	w15	w16
v75	70	75	70	70	70	70	70	70	70	70	75	70	75	75	75	75
v85	70	75	70	70	70	70	70	70	70	70	75	70	75	75	75	75
v96	70	75	70	70	70	70	70	70	70	70	75	70	75	75	75	75
v03	70	75	70	70	70	70	70	70	70	70	75	70	75	75	75	75
v07	70	75	70	70	70	70	70	70	70	70	75	70	75	75	75	75
v11	70	75	70	70	70	70	70	70	70	70	75	70	75	75	75	75
v14	70*	73	70*	73	70*	71	69	71	71	73	75	75	75	75	75	75

*For these climate zones reduced high limit values were used to prevent excessive cooling loads in annual simulations.

  - SCE

Air Economizer High Limit Shut Off Control Requirements[1]

Device Type[a]	Climate Zones	Required High Limit (Economizer Off When):[b]
Fixed Dry Bulb	1,3,5,11-16	T_{OA}>75°F
	2,4,10	T_{OA}>73°F
	6,8,9	T_{OA}>71°F
	7	T_{OA}>69°F
Differential Dry Bulb	1,3,5,11-16	T_{OA}>T_{RA}°F
	2,4,10	T_{OA}>T_{RA}-2°F
	6,8,9	T_{OA}>T_{RA}-4°F
	7	T_{OA}>T_{RA}-6°F
Fixed Enthalpy[c] + Fixed Drybulb	All	h_{OA}>28 Btu/lb[c] or T_{OA}>75°F

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

Measure Consensus - 5.01 - Economizer Controls

- Delivery
  - SCE = Midstream
  - PG&E = Direct Install
- Building Types
  - Mix
  - Majority in Retail, Large

			kWh	
Name	DeliveryType	BldgType	PGE	SCE
Economizer Controls	NonUpStrm	Asm		1,159
		EPr		9,861
		ESe		442
		EUn		1,309
		Gro		17,905
		OfL		3,989
		OfS		794
		RFF		2,629
		Rt3		25,929
		RtL		83,079
	PreRebDI	Asm	24,333	
		EPr	37,785	
		ESe	2,004	
		Gro	43	
		MLI	24,688	
		OfL	95,134	
		OfS	3,496	
		RFF	20,940	
		RSD	5,344	
		RtL	137,782	
		RtS	54,540	
	PreRebDown	OfS		3,032

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

Measure Consensus - 5.02 Economizer Repairs

- Offering
  - Workpaper (PGE3PHVC151 R3, Nov 2017; WPSDGENRHC0027 Rev0*, Jun 2014 (based upon PG&E-152, R0); SCE13HC044.3, Jan 2016*)
  - Base Case: (AC with Gas Heat, AC only, HP)
    - (PG&E) Existing HVAC equipment with non-functional economizer, either failed closed (25%) or partially open (75%)
    - (SCE) The base case for this work paper assumes that the air-economizer has degraded over time, it is non-functional, and operates fixed at 18% open.
  - Measure Case:
    - Restore economizer functionality through repairs; option of adding Advanced Digital Economizer Controller (ADEC)

	kWh	
Name	PGE	SCE
Economizer Repair	679,997	2,024,022

  - Offerings
    - SCE: Degraded Economizer / 24-Hour Fitness Center; Commercial QM program; REA; DI/Downstream/Midstream
    - PG&E: Part of HVAC QM and HVAC Tune-up programs; REA; DI/Downstream
    - All commercial building types
    - Climate zones: PG&E (CZ01-05, 11-13, 16); SCE (CZ06, 08-10, 13-16)
    - Norm Unit: Cap-Tons

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

Measure Consensus - 5.02 Economizer Repairs

- Savings
  - SCE
    - DEER 2005 Measure: D03-060
  - PG&E
    - Modeled measure with a DEER basis
    - MASControl v3.00.20 and v3.00.27
    - Prototype varied depending upon building
      - Base models modified

Modeled Faults	Fault Weight
Non-Functional Economizer, Dampers Failed Closed	0.25
Non-Functional Economizer, Dampers Failed Partially Open	0.75

      - Measure models – unmodified prototype models
    - Damper Leakage assumptions:
      - A minimum outside air fraction of 20% was used instead of 0 that indicates closed damper leakage for packaged HVAC systems are higher than previously thought.
      - A maximum outside air fraction of 70% was used instead of 100% due to emerging research (was not yet published) that indicates return air damper leakage and exhaust air re-entrainment for packaged HVAC systems are higher than previously thought, leading to inability of most systems to provide 100% outside air.
  - Question: What is the relationship between Economizer Repair and Economizer Controls? Noted that savings are mutually exclusive, so both can be installed without double-counting savings.
  - Question: How can we extend savings to SDG&E? – Planned with updated workpaper.

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

Measure Consensus - 5.02 Economizer Repairs

- Delivery
  - SCE = Midstream
  - PG&E = Direct Install
- Building Types
  - Mix
  - Majority in Retail, Multi-Story

			kWh	
Name	DeliveryType	BldgType	PGE	SCE
Economizer Repair	NonUpStrr	Asm		10,157
		EPr		306,780
		ESe		169,457
		EUn		23,712
		Gro		39,862
		OfL		51,222
		OfS		13,117
		RFF		7,286
		RSD		14,818
		Rt3		1,299,781
		RtL		87,829
	PreRebDI	Asm	30,537	
		EPr	53,334	
		ESe	3,244	
		Gro	60	
		MLI	24,560	
		OfL	232,716	
		OfS	24,653	
		RFF	35,678	
		RSD	8,001	
		RtL	190,252	
		RtS	76,963	

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

Measure Consensus – 5.30, Refrigerant Charge Adjustment

- Offering
  - Workpaper (PGE3PHVC160 R2, Oct 2015)
  - Base Case:
    - Refrigerant charge does not meet manufacturer specifications (AC with Gas Heat, AC only, HP)
  - Measure Case:
    - Adjust refrigerant charge to meet manufacturer specifications

	kWh		
Name	PGE	SCE	SDGE
Refrigerant Charge	164,420	732,081	536,566

  - Offerings
    - REA; Direct Install (PG&E)
    - All commercial building types; multiple system types
    - Climate zones: PG&E (CZ01-05, 11-13, 16)
    - Norm Unit: Cap-Tons

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

Measure Consensus – 5.30, Refrigerant Charge Adjustment

- Offering
  - All commercial building types; multiple system types
    - AC Unit with Gas Heat
      - RCA on Single Stage
      - RCA on First Stage of Multi-Stage
      - RCA on Second or Higher Stage of Multi-Stage
      - RCA on First Stg and Sec or Higher Stg of Multi-Stg
    - AC Only Unit
      - RCA on Single Stage
      - RCA on First Stage of Multi-Stage
      - RCA on Second or Higher Stage of Multi-Stage
      - RCA on First Stg and Sec or Higher Stg of Multi-Stg
    - Heat Pump
      - RCA on Single Stage
      - RCA on First Stage of Multi-Stage
      - RCA on Second or Higher Stage of Multi-Stage
      - RCA on First Stg and Sec or Higher Stg of Multi-Stg
    - Variable Volume AC Unit with Gas Heat
      - RCA on Single Stage
      - RCA on First Stage of Multi-Stage
      - RCA on Second or Higher Stage of Multi-Stage
      - RCA on First Stg and Sec or Higher Stg of Multi-Stg

	kWh	
BldgType	PGE	SCE
Asm	12,954	55,430
DMo		
EPr	53,024	198,018
ERC		1,302
ESe	4,815	152,585
EUn		3,313
Gro	811	142,886
Hsp		16,805
MFm		
Mtl	1,970	
Nrs		652
OfL	15,173	27,765
OfS	2,678	9,904
RFF	1,990	214
RSD	4,890	4,201
Rt3		63,660
RtL	60,735	53,943
RtS	5,381	1,402
SFm		

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

Measure Consensus – 5.30, Refrigerant Charge Adjustment

- Offering
  - All commercial building types; multiple system types
    - AC Unit with Gas Heat
      - RCA on Single Stage
      - RCA on First Stage of Multi-Stage
      - RCA on Second or Higher Stage of Multi-Stage
      - RCA on First Stg and Sec or Higher Stg of Multi-Stg
    - AC Only Unit
      - RCA on Single Stage
      - RCA on First Stage of Multi-Stage
      - RCA on Second or Higher Stage of Multi-Stage
      - RCA on First Stg and Sec or Higher Stg of Multi-Stg
    - Heat Pump
      - RCA on Single Stage
      - RCA on First Stage of Multi-Stage
      - RCA on Second or Higher Stage of Multi-Stage
      - RCA on First Stg and Sec or Higher Stg of Multi-Stg
    - Variable Volume AC Unit with Gas Heat
      - RCA on Single Stage
      - RCA on First Stage of Multi-Stage
      - RCA on Second or Higher Stage of Multi-Stage
      - RCA on First Stg and Sec or Higher Stg of Multi-Stg

MeasCode	MeasDescription	PGE	SCE	SDGE
420090	Residential refrigerant charge and airflow adjustment			298
421026	AC Diagnostic, Repair and Tune-up 1995-2005			536,268
AC-11706	Refrigerant Charge Adjustment on Single Stage AC Unit with Gas Heat		275,337	
AC-11732	Refrigerant Charge Adjustment First Stage of Multi-Stage AC Unit with Gas Heat		35,454	
AC-11737	Refrigerant Charge Adjustment on Second or Higher Stage of Multi-Stage AC Unit with Gas Heat		6,357	
AC-11750	Refrigerant Charge Adjustment First Stage and Second or Higher Stage of Multi-Stage AC Unit with Gas Heat		184,453	
AC-11770	Refrigerant Charge Adjustment on Single Stage AC Only Unit		7,602	
AC-11803	Refrigerant Charge Adjustment First Stage of Multi-Stage AC Only Units		20,510	
AC-11835	Refrigerant Charge Adjustment on Second or Higher Stage of Multi-Stage AC Only Unit		1,721	
AC-11838	Refrigerant Charge Adjustment First Stage and Second or Higher Stage of Multi-Stage AC Only Units		43,444	
AC-11846	Refrigerant Charge Adjustment on Single Stage Heat Pump		101,354	
AC-11848	Refrigerant Charge Adjustment First Stage of Multi-Stage Heat Pump		21,843	
AC-11863	Refrigerant Charge Adjustment on Second or Higher Stage of Multi-Stage Heat Pump		4,762	
AC-11893	Refrigerant Charge Adjustment First Stage and Second or Higher Stage of Multi-Stage Heat Pump		29,244	
HV318	Refrigerant Charge Adjustment on First Stage of Multi-Stage AC Only Unit	164,420		

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

Measure Consensus - 5.30, Refrigerant Charge Adjustment

- Savings
  - Modeled measure with a DEER basis
  - MASControl v3.00.20 and v3.00.27
  - Prototype varied depending upon building
    - Base models modified

Modeled Faults	eQUEST Keyword	DEER Value	Modified Baseline Value	Fault Weight
RCA 0-20%	SYSTEM:COOLING-EIR	Varies	Existing COOLING-EIR * 1.152 Where 1.152 is the DEER RCA EIR adjustment factor	0.95
RCA > 20%	SYSTEM:COOLING-EIR	Varies	Existing COOLING-EIR * 1.358 Where 1.358 is the DEER RCA EIR adjustment factor	0.05

    - Measure models – unmodified prototype models
  - Damper Leakage assumptions:
    - A minimum outside air fraction of 20% was used instead of 0 that indicates closed damper leakage for packaged HVAC systems are higher than previously thought.
    - A maximum outside air fraction of 70% was used instead of 100% due to emerging research (was not yet published) that indicates return air damper leakage and exhaust air re-entrainment for packaged HVAC systems are higher than previously thought, leading to inability of most systems to provide 100% outside air.

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

Measure Consensus – 5.30, Refrigerant Charge Adjustment

- Savings - Disposition
  - Gross Charge Adjustment = 40%
  - Question: Is this adjustment correct? – noted by Kelvin V. / SDG&E that this is a incidence factor. If installed separately, it should not be included.

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

Measure Consensus – 5.31, Evaporator Coil Cleaning

- Offering
  - Workpaper (PGE3PHVC158 R2, Oct 2015; WPSDGENRHC1010 R1, Jun 2016)
  - Base Case:
    - Uncleaned, functional evaporator coil (AC with Gas Heat, AC only, HP, Var Vol AC with Gas Heat)
  - Measure Case:
    - Clean evaporator coils on qualifying units

	kWh	
Name	PGE	SCE
Evaporator Coil Cleaning	33,246	243,625

  - Offerings
    - REA; Direct Install (PG&E) / Midstream (SCE / SDG&E)
    - All commercial building types
    - Climate zones: PG&E (CZ01-05, 11-13, 16); SCE (CZ06, 08-10, 13-16); SDG&E (CZ06-08, 10, 14-15)
    - Norm Unit: Cap-Tons

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

Measure Consensus – 5.31, Evaporator Coil Cleaning

- Savings - Disposition
  - 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
  - Measure savings = DEER values * 0.25 * 0.25
    - = DEER values * 0.0625

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

Measure Consensus – 5.32, Condenser Coil Cleaning, Commercial

- Offering
  - Workpaper (PGE3PHVC156 R2, Oct 2015; WPSDGENRHC1020 R1, Jun 2016; WPSDGENRHC1040 R0.1, June 2014)
  - Base Case:
    - Uncleaned, functional condenser coil (AC with Gas Heat, AC only, HP, Var Vol AC with Gas Heat)
  - Measure Case:
    - Clean condenser coils on qualifying units

		kWh		
Name	DeliveryType	PGE	SCE	SDGE
Commercial Condenser Coil Cleaning	NonUpStrm		490,331	
	PreRebDI	66,164		
	PreRebDown			1,482,943

  - Offerings
    - REA; Direct Install (PG&E) / Midstream (SCE) / Downstream (SDG&E)
    - All commercial building types
    - Climate zones: PG&E (CZ01-05, 11-13, 16); SCE (CZ06, 08-10, 13-16); SDG&E (CZ06-08, 10, 14-15)
    - Norm Unit: Cap-Tons

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

Measure Consensus – 5.32, Condenser Coil Cleaning, Commercial

- Savings - Disposition
  - 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
  - Measure savings = DEER values * 0.25 * 0.50
    - = DEER values * 0.125

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

Measure Consensus – 5.32, Condenser Coil Cleaning, Commercial

- Offering
  - Building Type variety

BldgType	kWh PGE	SCE	SDGE
Asm	6,851	19,714	42,437
EPr	14,435	72,609	328,228
ERC		1,300	
ESe	2,009	30,593	91,945
EUn		5,613	
Gro	268	81,735	
Hsp		4,005	
MBT			13,617
MLI	83		14,056
Mtl	535		
Nrs		2,041	6,368
OfL	4,490	19,034	408,395
OfS	760	5,994	94,817
RFF	1,003	2,123	
RSD	1,807	8,839	42,386
Rt3		195,390	
RtL	32,195	40,342	416,581
RtS	1,728	999	21,901
SCn			2,212

AC Unit with Gas Heat, CZ01

BldgType	KWh Electric Savings
Asm	4.47
EPr	1.14
ESe	1.06
ECC	1.54
EUn	2.46
Gro	0.15
Hsp	2.58
Nrs	0.20
Htl	22.85
Mtl	1.13
MBT	5.19
MLI	0.22
OfL	2.81
OfS	1.27
RSD	3.12
RFF	1.40
Rt3	2.50
RtL	6.80
RtS	1.71
SCn	(0.02)
WRf	3.04
ERC	1.26

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

Measure Consensus – 5.32, Condenser Coil Cleaning, Commercial

- Offering
  - Where are the biggest opportunities?
  - Should the measure be restructured to match SDG&E approach? – Hold due to new measure from PG&E.
    - Note that savings difference between types is small (0-2%, except for Hotels).

	kWh		
MeasDescription	PGE	SCE	SDGE
Commercial Coil Cleaning 3 to 5 tons			718,049
Commercial Coil Cleaning 6 tons and over			671,100
Commercial Coil Cleaning Less than 3 tons			93,794
Condenser Coil Cleaning AC Unit with Gas Heat		35,183	
Condenser Coil Cleaning Heat Pump		237,775	
Condenser Coil Cleaning AC Only Unit	66,164	217,374	

Measure Description	Bldg	Asm	ECC	EPr	ERC	ESe	EUn	Gro	Hsp	Htl	MBT	MiC	MLI	Mtl	Nrs	OfL	OfS	RFF	RSD	Rt3	RtL	RtS	SCn	WRf
Condenser Coil Cleaning on AC Only Unit	CZ10	48.4	35.5	24.0	25.9	24.2	38.7	22.6	45.4	142.5	50.1	19.6	29.1	35.4	34.0	39.9	38.7	46.7	54.3	55.5	52.3	47.7	19.6	49.1
Condenser Coil Cleaning on AC Unit with Gas Heat	CZ10	48.4	35.5	24.0	25.9	24.2	38.7	22.6	45.4	142.5	50.1	19.6	29.1	35.4	34.0	39.9	38.7	46.7	54.3	55.5	52.3	47.7	19.6	49.1
Condenser Coil Cleaning on Heat Pump	CZ10	47.3	34.7	23.3	26.9	23.6	37.8	22.0	47.3	92.6	50.6	20.3	29.1		32.6	39.8	38.8	45.1	55.1	55.2	51.2	49.7	20.3	52.5
Condenser Coil Cleaning on Variable Volume AC Unit	CZ10		40.0			27.7	43.8		73.5	94.8	45.5	27.7			60.0	42.7	38.6			54.9				

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

Measure Consensus – 5.15 Unoccupied Supply Fan Control

- Offering
  - Workpaper (PGE3PHVC157 R2, Oct 2015)
  - Base Case:
    - Existing HVAC equipment with the supply fan operating continuously during unoccupied periods (AC with Gas Heat, AC only, HP)
  - Measure Case:
    - Set supply fan to "Auto" or intermittent during unoccupied periods

	kWh	
Name	PGE	SCE
Unoccupied Supply Fan Control	2,113,409	924,697

  - Offerings
    - REA; Direct Install (PG&E) / Midstream (SCE / SDG&E)
    - All commercial building types
    - Climate zones: PG&E (CZ01-05, 11-13, 16); SCE (CZ06, 08-10, 13-16); SDG&E (CZ06-08, 10, 14-15)
    - Norm Unit: Cap-Tons
  - Question: How is this measure included in the disposition (part of airflow adjustment)? – Note that airflow workpaper is separate.

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

Measure Consensus - 5.15 Unoccupied Supply Fan Control

- Savings
  - Modeled measure with a DEER basis
  - MASControl v3.00.20 and v3.00.27
  - Prototype varied depending upon building
    - Base models modified

Modeled Faults	eQUEST Keyword	DEER Value	Modified Baseline Value
24/7 Continuous Supply Fan Operation	SYSTEM:FAN-SCHEDULE	Varies	Hourly Report Schedule
	SYSTEM:INDOOR-FAN-MODE	CONTINUOUS	CONTINUOUS

    - Measure models – unmodified prototype models
  - Damper Leakage assumptions:
    - A minimum outside air fraction of 20% was used instead of 0 that indicates closed damper leakage for packaged HVAC systems are higher than previously thought.
    - A maximum outside air fraction of 70% was used instead of 100% due to emerging research (was not yet published) that indicates return air damper leakage and exhaust air re-entrainment for packaged HVAC systems are higher than previously thought, leading to inability of most systems to provide 100% outside air.
  - 24/7 facilities generate zero savings: hospitals (Hsp), motels (Mtl), nursing homes (Nrs), and conditioned storage (SCn)

	kWh	
BldgType	PGE	SCE
Asm	189,304	12,241
EPr	422,863	276,044
ERC		1,133
ESe	23,010	51,957
EUn		36,925
Gro		451,118
Hsp		-
MLI	143,708	
OfL	476,765	54,318
OfS	68,754	26,063
RFF	95,865	2,417
RSD	12,383	7,317
RtL	436,130	5,164
RtS	244,627	

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

Measure Consensus – 5.46, Programmable Thermostat, Com

- Offering
  - Workpaper (PGE3PHVC153 R3, July 2015; SCE17HC049 R0, Oct 2017 (savings methodology *same as PG&E*))
  - Base Case:
    - Existing non-programmable thermostat installed on split and packaged dx cooling systems with or without an economizer
  - Measure Case:
    - Replace non-programmable thermostat and set supply fan to Auto in unoccupied periods for split and packaged dx cooling units with and without economizers

	kWh	
MeasDescription	PGE	SDGE
Programmable Communicating Thermostat		14,508
Programmable Thermostat	1,218,918	

	kWh	
BldgType	PGE	SDGE
Asm	607,804	
EPr	293,841	
ESe	93,900	
Gro	8,854	1,688
MLI	5,755	
Mtl	3,312	
OfL	109,496	
OfS	28,791	1,888
RFF		938
RSD	23,928	8,658
RtL	25,303	
RtS	14,203	1,336
SCn	3,732	

  - Offerings
    - Direct Install
    - (PG&E) RC; (SDG&E) ER
    - All commercial building types
    - Climate zones: PG&E (CZ01-05, 11-13, 16)
    - Norm Unit: Cap-Tons

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

Measure Consensus – 5.46, Programmable Thermostat, Com

- Savings – Disposition *(taken from disposition)*
  - Gross values adjusted from WP values to account for inappropriate baseline.
  - Adjustment for **thermostat reprogramming** savings = 0.50
    - Accounts for negative impact to systems whose fans were previously programmed for intermittent operation
    - There are potential negative impacts where reprogramming causes additional night-time setback/setup operation
  - Adjustment for **thermostat replacement** savings = 0.25
    - Uncontrolled HBAC system operation is uncommon and users often manually control their systems
    - There are potential negative impacts where reprogramming causes additional night-time setback/setup operation
  - Are these adjustment correct/appropriate? Is there data to support them?

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

Measure Consensus – 5.46, Programmable Thermostat, Com

- Offering
  - Workpaper (WPSDGENRHC026 Rev3, Jun 2016)
  - Base Case:
    - Existing non-programmable, non-communicating manual thermostat
  - Measure Case:
    - Programmable communicating thermostat capable of responding to automated setback demand response to control packaged AC/ heat pump applications

	kWh	
MeasDescription	PGE	SDGE
Programmable Communicating Thermostat		14,508
Programmable Thermostat	1,218,918	

	kWh	
BldgType	PGE	SDGE
Asm	607,804	
EPr	293,841	
ESe	93,900	
Gro	8,854	1,688
MLI	5,755	
Mtl	3,312	
OfL	109,496	
OfS	28,791	1,888
RFF		938
RSD	23,928	8,658
RtL	25,303	
RtS	14,203	1,336
SCn	3,732	

  - Offerings
    - Direct Install
    - (SDG&E) ER
    - All commercial building types
    - Climate zones: SDG&E (CZ06-08, 10, 14-15)
    - Norm Unit: 1,000 sq ft

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

Measure Consensus – 5.46, Programmable Thermostat, Com

- Savings
  - Workpaper (WPSDGENRHC026 Rev3, Jun 2016)
  - eQUEST / DOE2.2 modeled result

Unoccupied Setpoints	
Heating	55°F
Cooling	85°F

Building Types
Asm – Assembly
EPr – Education Primary
ESe – Education Secondary
Htl – Hotel
Mtl – Motel
RtS – Small Retail

Vintage	Weighting Factors
1975	58.08%
1985	15.07%
1996	15.50%
2003	11.35%

Building type	Building Vintage	Climate Zone	Baseline Hours of Operation (hrs/yr)	Proposed Hours of Operation (hrs/yr)
Asm – Assembly	EX	7,10,14,15	8,760	4,296
EPr – Education Primary	EX	7,10,14,15	8,760	1,496
ESe – Education Secondary	EX	7,10,14,15	8,760	TBD
Htl – Hotel	EX	7,10,14,15	8,760	TBD
Mtl – Motel	EX	7,10,14,15	8,760	TBD
RtS – Small Retail	EX	7,10,14,15	8,760	3,938

    - Savings weighted by vintage
    - Gross savings adjustment (25%) applied – per disposition
  - How should communicating DR thermostat be integrated with standard programable thermostat measure (ie, separate offering)?
  - Is the 25% GSA still appropriate?

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

Measure Consensus – 5.06 Demand Controlled Ventilation for Single Zone Packaged HVAC

- Offering
  - Workpaper (PGECOHVC168 R1, Apr 2016*; SCE13HC061.0, Nov 2014; SCE13CS011, Jan 2013 – no claims*)
  - Base Case:
    - (PG&E & SCE) Fixed position ventilation corresponding to Title 24 2013 requirement or 20% of supply air, whichever is greater; (AC with Gas Heat, AC only, HP)
  - Measure Case:
    - Add Demand Controlled Ventilation (DCV) to an existing packaged single zone direct expansion (DX) HVAC unit with an economizer ; option of adding Advanced Digital Economizer Controller (ADEC)

	kWh	
Name	PGE	SCE
Demand Controlled Ventilation for Single Zone Packaged HVAC	210,666	478,081

  - Offerings
    - REA; Direct Install / Downstream / Midstream
    - All commercial building types
    - Climate zones: PG&E (CZ01-05, 11-13, 16); SCE (CZ06, 08-10, 13-16)
      - Can this be extended to SDG&E CZ07?
    - Norm Unit: Cap-Tons

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

Measure Consensus - 5.06 Demand Controlled Ventilation for Single Zone Packaged HVAC

- Savings
  - Modeled measure with a DEER basis
  - MASControl v3.00.19
  - Prototype varied depending upon building
    - Base models modified

Measure	DEER Prototype Tech ID
Add ADEC and CO2 Sensor to AC unit with Gas Heat	D08-NE-HVAC-airAC-SpltPkg-110to134kBtuh-11p5eer
Add CO2 Sensor to AC unit with Gas Heat with ADEC	D08-NE-HVAC-airAC-SpltPkg-110to134kBtuh-11p5eer
Add ADEC and CO2 Sensor to AC only unit	*D08-NE-HVAC-airAC-SpltPkg-110to134kBtuh-11p5eer
Add CO2 Sensor to AC only unit with ADEC	*D08-NE-HVAC-airAC-SpltPkg-110to134kBtuh-11p5eer
Add ADEC and CO2 Sensor to HP	D08-NE-HVAC-airHP-SpltPkg-110to134kBtuh-11p5eer-3p4cop
Add CO2 Sensor to HP with ADEC	D08-NE-HVAC-airHP-SpltPkg-110to134kBtuh-11p5eer-3p4cop

    - Measure models – unmodified prototype models
  - Modeling assumptions:
    - A minimum outside air fraction of 20% was used instead of 0 that indicates closed damper leakage for packaged HVAC systems are higher than previously thought.
    - A maximum outside air fraction of 70% was used instead of 100% due to emerging research (was not yet published) that indicates return air damper leakage and exhaust air re-entrainment for packaged HVAC systems are higher than previously thought, leading to inability of most systems to provide 100% outside air.
    - Hourly occupancy as a percentage of peak design occupancy was reduced to 90% in cases where the DEER occupancy schedule exceeded 90%. DCV savings are sensitive to occupancy, and work paper authors and other collaborators recognized that most buildings do not reach 100% occupancy on a typical day. Parties involved came to the consensus that an average daily maximum occupancy percentage of 90% would be appropriate in these cases. The existing default DEER peak occupant densities were retained.
    - Economizer dry-bulb changeover temperatures were set in accordance with Title 24 2013 Table 140.4B

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

Measure Consensus – 5.06 Demand Controlled Ventilation for Single Zone Packaged HVAC

- Offering
  - Workpaper (*SCE13CS011, Jan 2013 – no claims*)
  - Base Case:
    - The base case mechanical (HVAC) systems are single zone packaged DX-cooling/gas heating (PSZ-AC) constant volume mechanical systems that does not utilize DCV or fan cycling controls
  - Measure Case:
    - Adds (a) demand controlled ventilation (DCV) and (b) fan cycling controls to mechanical systems in buildings
  - Offerings
    - REA
    - Building types: Assembly (Fitness Center)
    - Norm Unit: Cap-Tons
  - Question: Is this measure still active?

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

Measure Consensus - 5.03 – Space Heating Boilers

- Offering
  - Workpaper (PGECOHVC101 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		

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

Measure Consensus - 5.03 – Space Heating Boilers

- 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

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

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?)

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

Measure Consensus - 5.22 – Variable Refrigerant Flow - NonRes

- 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
      - >= 65 kBtu/hr Variable Refrigerant Flow Heat Pump DX Equipment
      - >= 65 kBtu/hr Variable Refrigerant Flow Heat Recovery DX Equipment

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

Measure Consensus - 5.41 – Water Source Heat Pumps

- Offering
  - Workpapers (two methodologies are consistent)
    - SCE13HC048 R5, Sept 2015; PGECOHVC162 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	

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

- 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 <u>and</u> 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 <u>and</u> 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

- 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

- 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

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

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

- **DEER MeasureID**
  - NE-HVAC-airAC-Pkg-lt55kBtuh-15p0seer
  - Look at CZ10, CZ13, CZ16

Row Labels	Any	SCE	SCG	SDG
CZ10	**305**	**332**	**332**	**325**
OfS	**305**	**332**	**332**	**325**
1975	321			
1985	327			
1996	309			
2003	524			
2007	241			
2011	243			
2014	235			
Ex		332	332	325
New	239			

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

Row Labels	Any	PGE	SCE	SCG
CZ16	**246**	**262**	**264**	**264**
OfS	**246**	**262**	**264**	**264**
1975	254			
1985	271			
1996	246			
2003	403			
2007	203			
2011	205			
2014	189			
Ex		262	264	264
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

- Look at, CZ13, Office Small

Row Labels	Any	PGE	SCE	SCG
CZ13	310	338	336	336
OfS	310	338	336	336
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

- 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 REQU

Equipment Type	Size Category	Path A Efficiency [a,b]	Path B Efficiency [a,b]
Water Cooled, Electrically Operated Positive Displacement	< 75 Tons	≤0.750kW/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
	≥ 150 tons and < 300 tons	≤ 0.660 kW/ton ≤ 0.540 IPLV	≤ 0.680 kW/ton ≤ 0.440 IPLV
	≥ 300 Tons and < 600 tons	≤ 0.610kW/ton ≤ 0.520 IPLV	≤ 0.625 kW/ton ≤ 0.410 IPLV
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV

		≤ 0.610 kW/ton ≤ 0.550IPLV	≤ 0.695 kW/ton ≤ 0.440 IPLV
		≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.635 kW/ton ≤ 0.400 IPLV
		≤ 0.560 kW/ton ≤ 0.520 IPLV	≤ 0.595 kW/ton ≤ 0.390 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

- Cost Methodology
  - SCE approach (only option)

	Capacity Range	New Data: Baseline Cost	New Data: Tier 1 IMC	New Data: Tier 2 IMC	New Data: Size Category	Tier 1 GMC	Tier 2 GMC
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)

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

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

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

Measure Consensus - 5.39 – Air Cooled Chiller

- 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		

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

Measure Consensus - 5.39 – Air Cooled Chiller

- 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

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

- 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

- 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

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

- 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”

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

- 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

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

- Offering (no claims in 2017, Q1-Q3)
  - Workpaper (SCE13HC005.2, PGECOHVC134 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)

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

- 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

- 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?

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

Measure Consensus - 5.18 – High Efficiency Furnaces, Residential

- Offering
  - Workpaper (PGECOHVC145 R3, PGECOHVC147 R3, WPSCGREHC130115A-Rev04)
  - Common Offerings
    - Res-GasFurnace-AFUE95 (AFUE ≥ 95% & < 96%)
    - Res-GasFurnace-AFUE97 (AFUE ≥ 97%)
  - PG&E Specific Offerings
    - Furnace with variable speed motor (VFD or ECM), only CZ11, 12, 13
  - SCG Specific Offerings
    - Res-GasFurnace-AFUE92 (AFUE ≥ 92% & < 95%)
    - Res-GasFurnace-AFUE96 (AFUE ≥ 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

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

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 (PGECOHVC139)
    - Calculates kWh, kW, and negative gas impact

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

Measure Consensus - 5.18 – High Efficiency Furnaces

- Stage 1 Issues
  - Offering:
    - SCG uses additional tiers

(source 2017, Q1-Q3 IOU Claims Data)		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.

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

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

- Offering
  - Workpaper (PGECOHVC128 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

(source 2017, Q1-Q3 IOU Claims Data)		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 ≥65 kBTU/hr

- Cost
  - SDG&E adopted all DEER ID costs
  - PG&E methodology; SCE adopting PG&E methodology
    - Workpaper (PGECOHVC128 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.

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

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

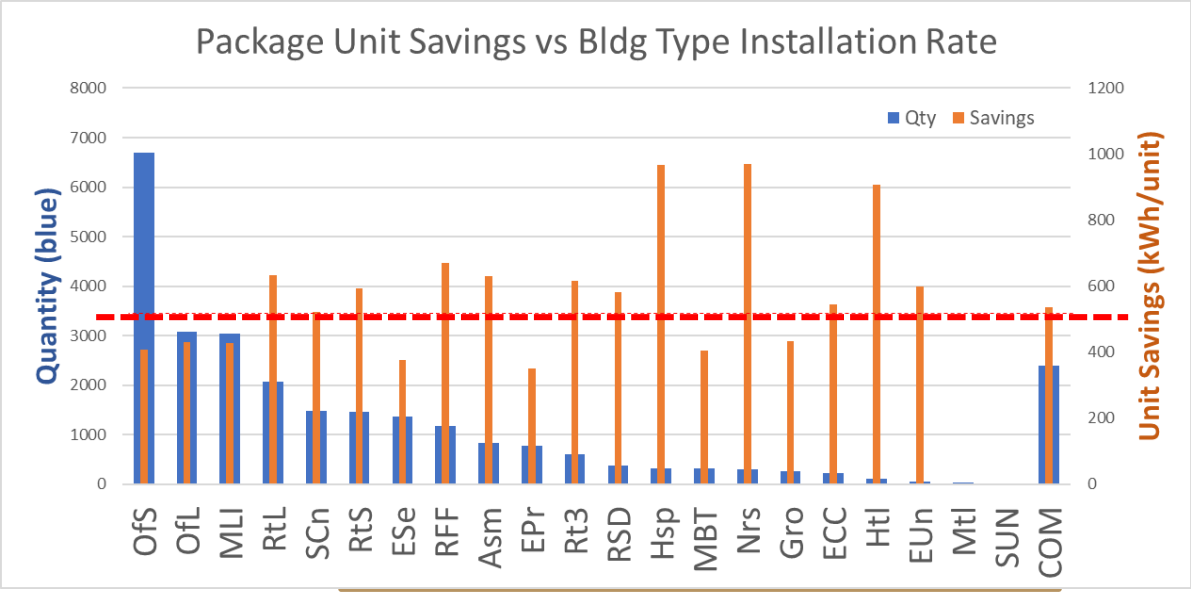
- Cost
  - PG&E methodology; SCE adopting PG&E methodology

	2016 Proposed Tiers				Market IMC $/ton									
Capacity Range	Tier	EER		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
Italics text = Item that has not been completed

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

- 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 very 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

- Offering
  - Workpaper (PGECOHVC126 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
Packaged Air Conditioner	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
Split System Air Conditioner	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
Packaged Air Cooled Heat Pump	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
Split System Air Cooled Heat Pump	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

- 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)

- Offering
  - Workpaper (PGECOHVC114 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 (<=24kBtu/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	≤ 7,000 Btu/hr	9.41	9.31	11.29	11.17
	> 7,000 and ≤ 15,000 Btu/hr	8.56	8.46	10.27	10.15
	>15,000 Btu/hr	7.71	7.61	9.25	9.13
NEW	≤ 7,000 Btu/hr	11.9	11.9	14.28	14.28
	> 7,000 and ≤ 15,000 Btu/hr	10.7	10.7	12.84	12.84
	>15,000 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
	Residential Multi-family (Dwelling)
Lodging - Motel	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

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)

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

- 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)

(source 2017, Q1-Q3 IOU Claims Data)		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

- Offering
  - Workpaper (PGECOHVC166 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

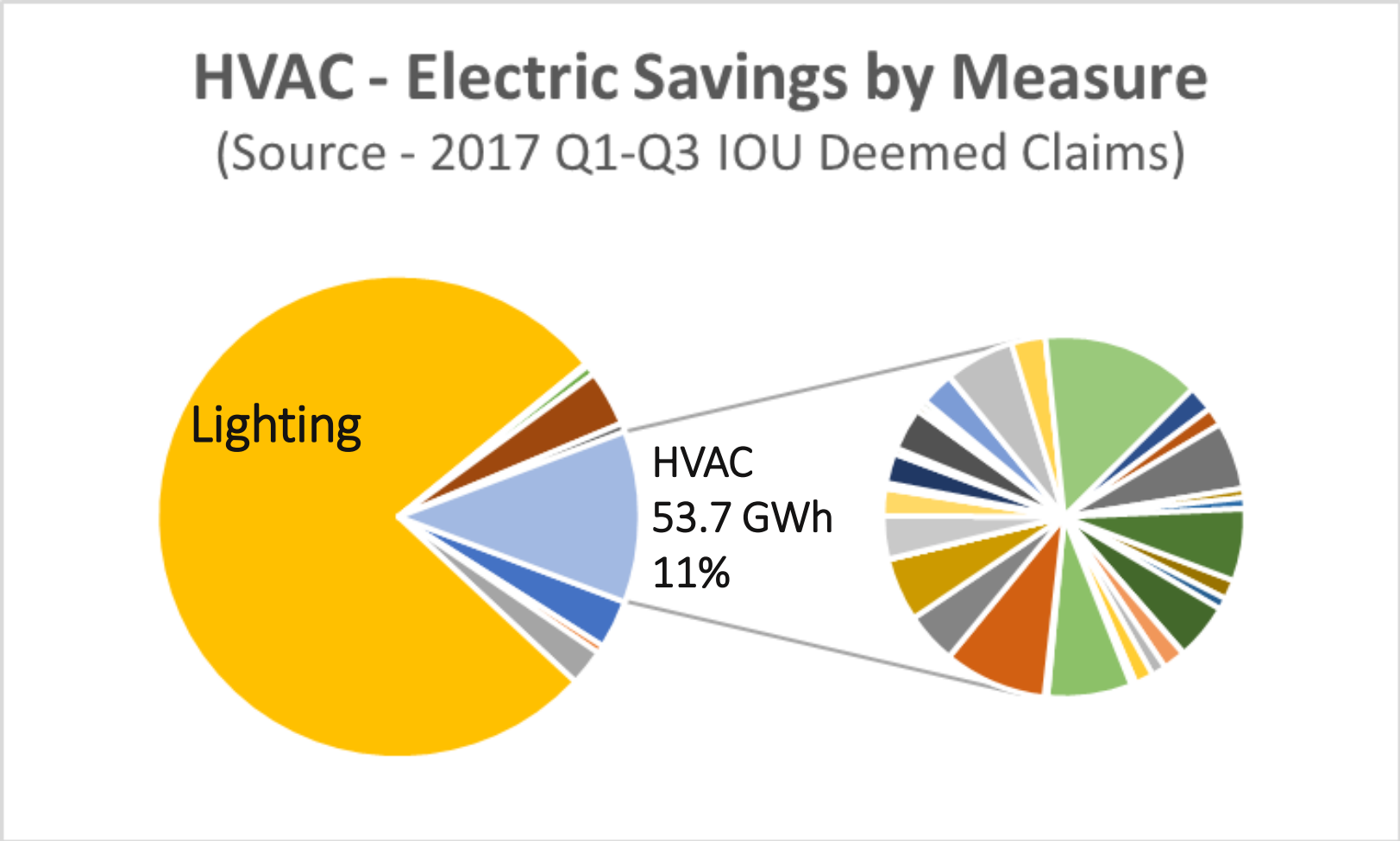
  - Building Types: Residential
  - Delivery: Upstream; ROB
  - Climate Zones: 1-16, IOU
  - Question: Pull out overlapping measures. Any concerns?

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

Review “Measure Summary Template”

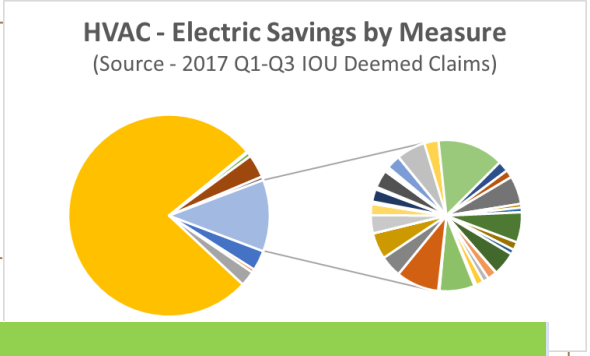
Back-up…

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



HVAC Electric Savings

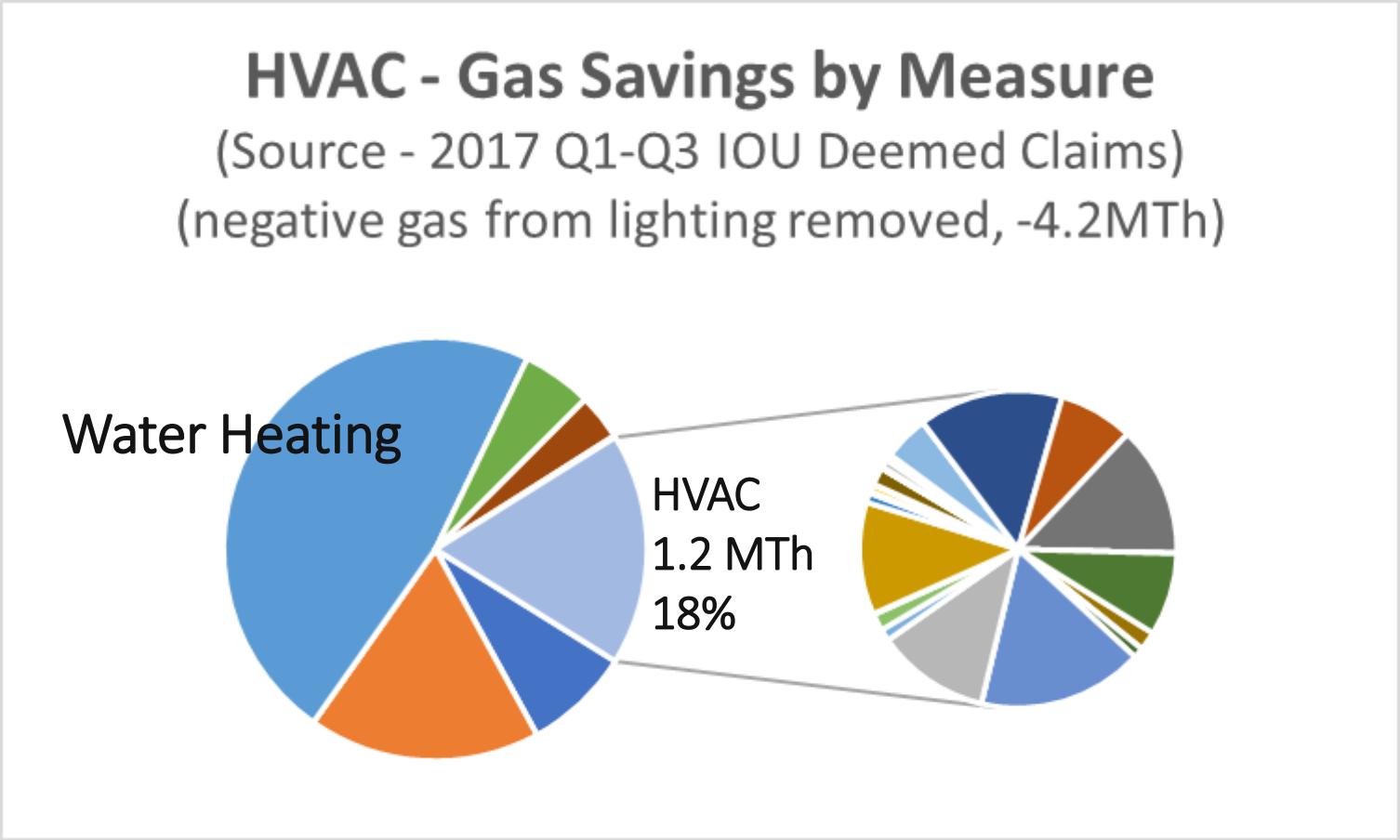
(Source – 2017 Q1-Q3, IOU Claims Data)



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 kBtuh	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.

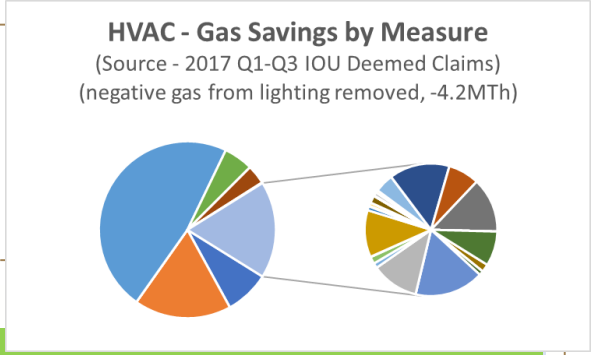
HVAC Gas Savings (Source – 2017 Q1-Q3, IOU Claims Data)



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)



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

- 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

- 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

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