HVAC - Commercial Controls Measures

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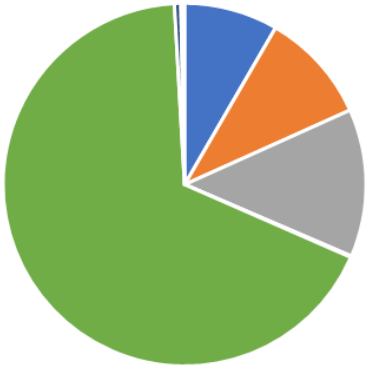
APRIL 2019

HVAC Measure Breakdown

- HVAC Measures (53 measures total)
  - Commercial (29 measures total)
    - Service / Quality Installation (6 measures)
    - HVAC Units (12 measures)
    - HVAC Controls (11 measures)
  - Residential (24 measures total)
    - Service (6 measures)
    - HVAC Units (5 measures)
    - HVAC Controls (5 measures)
    - Evaporative Units (4 measures)
    - Gas Units (3 measures)
  - Total Savings (2018, Q1-Q3)
    - 63.4M kWh, 2.5M therms

IOU Claims Data: 2018, Q1-Q3: Gross kWh

IOU Claims Data: 2018, Q1-Q3: Gross Therms



Commercial HVAC Measures

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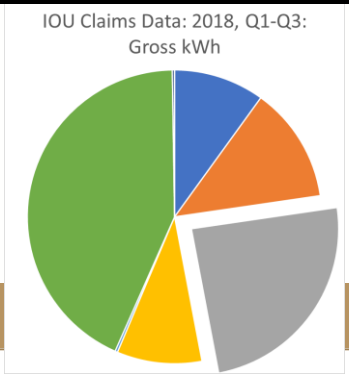
Service / Quality Installation (6 measures)

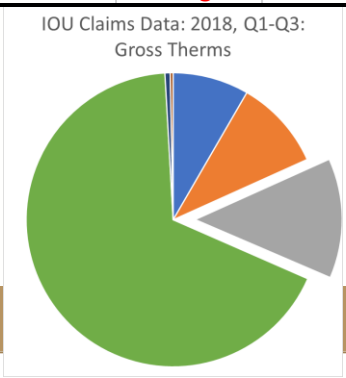
Ref No	Description							2018 (Q1-Q3) Number of Units	First Year Gross kWh	First Year Gross Therm
5.30	Refrigerant Charge, Commercial							5,562	247,572	840
5.31	Evaporator Coil Cleaning, Commercial							21,499	147,374	(7)
5.32	Condenser Coil Cleaning, Commercial							22,968	1,242,174	-
5.01	Economizer Controls, Commercial							5,016	344,322	(12)
5.02	Economizer Repair, Commercial							5,232	517,665	8,545
5.15	Supply Fan Controls, Commercial							9,174	3,773,278	154,966
5.05	Water-cooled Chiller	13,210	9,612,875	-	9,860	-	-	9,685	742,000	-
5.39	Air-cooled Packaged Chiller	8,739	4,211,173	-	13,939	3,159,548	-	2,363	178,896	-
5.03	Space Heating Boiler, Commercial	290,316	(61,230)	194,180	432,358	(90)	288,297	360,467	(63,626)	219,138
5.19	Furnace, Commercial				73	6,962	3,659	45	11,196	4,103
5.24	Unitary Air-Cooled Air Conditioner, Over 65 kBtu/h, Commercial	48,352	6,165,477	(6,910)	46,703	3,096,491	-	31,194	2,067,917	-
5.25	Unitary Air Cooled AC or Heat Pump, Under 65 kBtu/h, Commercial	19,270	4,178,238	(15,847)	15,026	2,605,029	(18,275)	12,480	4,050,967	(28,597)
5.26	Evaporative Condenser, Commercial	577	9,770	-	1,858	38,049	-	1,683	36,862	-
5.28	Ductless Air Conditioner, < 24 kBtu/h, Commercial	522	210,781	(12)						
5.53	Ductless Air Conditioner, Under 60 kBtu/hr	227	1,940,409	281,025						
5.56	Single Package Vertical Heat Pump, K-12 and Community Colleges							80	24,480	-
5.22	Variable Refrig Flow for HP or Heat Recovery System > 65kBtu/h, Com	7,622	6,707,935	85,901	29	6,462	14			
5.51	Water Source Heat Pump, Commercial	1,402	556,370	(72)	2,411	870,658	(152)	2,663	971,111	(168)
5.06	Demand Controlled Ventilation for Single Zone Packaged HVAC	10,122	1,019,973	113,100	11,536	1,138,104	167,514	5,044	340,241	76,408
5.49	Enhanced Ventilation for Pkg HVAC with Gas Heating or Packaged HP	7,855	5,112,333	41,004	12,442	7,651,626	317,884	4,966	3,450,032	111,024
5.41	VSD for HVAC Fan Controls, Commercial	3,813	4,224,925	(5,266)	6,716	6,911,865	(18,268)	2,467	3,836,290	(13,683)
5.44	Adaptive Climate Controller for Guest Room PTAC or PTHP	126	-	-	94	64,392	-	72	49,322	-
5.45	Energy Management System for Guest Room PTAC or PTHP	9,949	10,379,730	-	12,151	13,029,818	-	6,060	6,489,883	-
5.46	Programmable Communicating T-stat for Demand Response, Com	3,048	1,170,548	178,615	6,377	1,621,598	233,240	2,239	562,574	85,174
5.50	Cogged V-Belt for HVAC Fan, Commercial	20,237	381,719	-	28,158	635,744	-	1,811	25,793	-
5.16	Variable Speed Motor for Air Handler, Commercial	877	989,643	(1,229)						
5.21	HVAC Occupancy Sensor, Classroom	1,474	345,050	5,159						
5.14	VFD Retrofit for Central Plant System	4,158	9,677,289	(21)	2,960	6,772,088	-	270	573,113	-
5.07	VFD Demand Control System Retrofit to Parking Structure Exhaust Fan	539	1,587,184	-	162	886,648	-			
	Totals:		**85,610,000**	**1,050,000**		**63,640,000**	**1,160,000**		**29,620,000**	**620,000**

Subsequent slides will be larger; broken up into 3 segment.
Visualize savings over three years; Note that savings decreasing.

Commercial HVAC Measures

No	Description	Modeled	Submittal	IOU Lead	Rigor	2018 (Q1-Q3) Number of Units	First Year Gross kWh	First Year Gross Therm
5.06	Demand Controlled Ventilation for Single Zone Packaged HVAC	eQUEST	Jun	PG&E	Low	5,044	340,241	76,408
5.49	Enhanced Ventilation for Pkg HVAC with Gas Heating or Packaged HP	eQUEST	Jun	PG&E	Low	4,966	3,450,032	111,024
5.41	VSD for HVAC Fan Controls, Commercial	DEER 2005	Jun	PG&E	Medium	2,467	3,836,290	(13,683)
5.44	Adaptive Climate Controller for Guest Room PTAC or PTHP	Modified DEER 2005	Jun	0	Low	72	49,322	-
5.45	Energy Management System for Guest Room PTAC or PTHP	eQUEST / scaled	Aug	POU	Low	6,060	6,489,883	-
5.46	Programmable Communicating T-stat for Demand Response, Com	eQUEST	Jun	0	Medium	2,239	562,574	85,174
5.50	Cogged V-Belt for HVAC Fan, Commercial	DEER	Jun	SCE	Low	1,811	25,793	-
5.16	Variable Speed Motor for Air Handler, Commercial	Excel	Jun	0	Low			
5.21	HVAC Occupancy Sensor, Classroom	eQUEST	Jun	SCE	Low			
5.14	VFD Retrofit for Central Plant System	eQUEST	Jun	SCE	Low	270	573,113	-
5.07	VFD Demand Control System Retrofit to Parking Structure Exhaust Fan	Excel	Aug	POU	Low			





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

Low

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- Offering
  - Implementation: AOE
  - Building Types:
    - Asm,EPr,ERC,ESe,EUn,MBT,
    - OfS, RFF,RSD,Rt3,RtL,RtS
  - Climate zones: CZ01-CZ16
  - Norm Unit: Cap-Tons
  - Offerings include:
    - ADEC / No ADEC or CO2 Sensor; DX only / DX Furnace / Heat Pump

Add ADEC and CO2 sensor	DX Furnace	Offering A
	DX only	Offering B
	Heat Pump	Offering C
Add CO2 sensor	DX Furnace	Offering D
	DX only	Offering E
	Heat Pump	Offering F

- Stage 1 Issues
  - Measure updated to include portable classrooms and CZ07 permutations
  - *Must update savings using the latest building prototypes and new Peak Period*
  - Savings from 2018 (next slide)
- Measure Extension
  - Add POUs, PG&E and SDG&E
- Stage 2 Issues
  - *None.*

Black text = Current state of the consolidated measure
Blue text = Changing and / or first time item is mentioned
Italics text = Item that has not been completed

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

- Stage 1 Issues
  - Savings from Q1-Q3 2018
    - Mix of building types

Add ADEC and CO2 sensor	DX Furnace	Offering A
	DX only	Offering B
	Heat Pump	Offering C
Add CO2 sensor	DX Furnace	Offering D
	DX only	Offering E
	Heat Pump	Offering F

Offering	PA	Sum of First Year Gross kWh	Sum of First Year Gross Therm
Offering A	PGE	30,520	32,809
	SCE	1,527	778
Offering B	PGE	4,314	-
Offering C	PGE	62,802	1
Offering D	PGE	3,623	15,007
	SCE	55,467	27,810
Offering E	PGE	144	-
	SCE	3,459	-
Offering F	SCE	178,385	5
Grand Total		**340,241**	**76,408**

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

- 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)
- Savings *(updated in late 2018; not yet using latest prototypes)*
  - 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

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

- Measure Permutations

Measure Data Field	Measure Value	Measure Data Field			
		PG&E	SCE	SDG&E	SCG
MeasureAppType	AOE	REA	REA	No Value	No Value
BldgType	Asm,EPr,ERC,ESe,EUn,MBT,OfS,RFF,RSD,Rt3,RtL,RtS	Asm,EPr,ERC,ESe,EUn,MBT,OfS,RFF,RSD,Rt3,RtL,RtS	Asm,EPr,ERC,ESe,EUn,MBT,OfS,RFF,RSD,Rt3,RtL,RtS	No Value	No Value
BldgVintage	Ex	Ex	Ex	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16	CZ01,CZ02,CZ03,CZ04,CZ05,CZ11,CZ12,CZ13,CZ16	No Value	No Value	No Value
NormUnit	Cap-Tons	Cap-Tons	No Value	No Value	No Value
EUL ID	HVAC-VSD-DCV	HVAC-VSD-DCV	No Value	No Value	No Value
RUL ID		HVAC-VSD-DCV	No Value	No Value	No Value
NTGR	Com-Default>2yrs	Com-Default>2yrs	Com-Default>2yrs	No Value	No Value
DeliveryType	DnDeemDI, DnDeemed	DirInstall,PreRebDown	PreRebDown	No Value	No Value
GSIA	Def-GSIA	Com-AC-PGE	Def-GSIA	No Value	No Value
Electric Load Shape		PGE:COMMERCIAL:3 = Commercial HVAC	No Value	No Value	No Value
Gas Load Shape	Annual	Annual	No Value	No Value	No Value
Sector	Com	Com	Com	No Value	No Value
PA/POU	All				
BldgHVAC	cWtd,cDXGF,cDXHP	cWtd,cDXGF,cDXHP	No Value	No Value	No Value
HOU					
IE Factor	None	No value			
IETableName	None	(blank)			
Use Category	HVAC	HVAC	HVAC	No Value	No Value
SubUseCategory	HeatCool	HeatCool	No Value	No Value	No Value
TechGroup	HV_Tech	HV_Tech	No Value	No Value	No Value
TechType	CO2sens	CO2sens	No Value	No Value	No Value
Cost Adjustment Type	None	None	No Value	No Value	No Value
EnImpCalcType	Standard	(blank)	No Value	No Value	No Value
MeasImpactType	Deem-WP	IOU-Deemed	No Value	No Value	No Value
MeasQualifierGroup		(blank)	No Value	No Value	No Value
Upstream Flag	FALSE	No value	No value	No value	No value

Measure Consensus
5.49 - Enhanced Ventilation for Packaged HVAC with Gas Heating or Packaged Heat Pump, Commercial

- Offering
  - Implementation: AOE
  - Building Types: Asm,ECC,EPr,ESe,EUn,Htl,Hsp,MBT,Nrs,OfL,OfS, RFF,RSD,Rt3,RtL,RtS,SCn
  - Climate zones: CZ01-CZ16
  - Norm Unit: Cap-Tons
  - Offerings include: 24 offerings
    - ADEC / No ADEC or CO2 Sensor; DX only / DX Furnace / Heat Pump
- Stage 1 Issues
  - Measure updated to include portable classrooms and CZ07 permutations
  - *Must update savings using the latest building prototypes and new Peak Period*
  - Significant savings for Q1-Q3 2018
- Measure Extension
  - Add POUs, PG&E and SDG&E
- Stage 2 Issues
  - *None.*

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Measure Consensus
5.49 - Enhanced Ventilation for Packaged HVAC with Gas Heating or Packaged Heat Pump, Commercial

- Offering

ADEC	VFD	Enhanced Vent	CO2	System	Motor	Savings (kWh)	Savings (therms)
ADEC Existing	VFD	No	No	AC unit with Gas Heat	Induction Motor	17,421	26
					NEMA	812,570	1,684
					PMM		
				AC unit only	Induction Motor		
					NEMA	75,713	-
					PMM		
				Heat Pump	Induction Motor	4,633	-
					NEMA	402,800	-
					PMM		
ADEC				AC unit with Gas Heat	Induction Motor		
					NEMA	33,717	(261)
					PMM		
				AC unit only	Induction Motor		
					NEMA		
					PMM		
				Heat Pump	Induction Motor	8,810	-
					NEMA		
					PMM		
		HVAC Enhanced Vent	CO2 Sensor	AC unit with Gas Heat	Induction Motor	901,420	97,990
					NEMA	702,963	10,344
					PMM		
				Heat Pump	Induction Motor	482,665	1
					NEMA		
					PMM		
						3,442,712	109,784

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Measure Consensus
5.49 - Enhanced Ventilation for Packaged HVAC with Gas Heating or Packaged Heat Pump, Commercial

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	AOE	REA		No Value	No Value
BldgType	Asm,ECC,EPr,ESe,EUn,Htl,Hsp,MBT,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL,RtS,SCn	Asm,ECC,EPr,ESe,EUn,Htl,Hsp,MBT,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL,RtS,SCn		No Value	No Value
BldgVintage	Ex	Ex		No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16	CZ01,CZ02,CZ03,CZ04,CZ05,CZ11,CZ12,CZ13,CZ16		No Value	No Value
NormUnit	Cap-Tons	Cap-Tons		No Value	No Value
EUL ID	HVAC-VSD-DCV	HVAC-VSD-DCV		No Value	No Value
RUL ID	HVAC-VSD-DCV	HVAC-VSD-DCV		No Value	No Value
NTGR	Com-Default>2yrs	Com-Default>2yrs		No Value	No Value
DeliveryType	DnDeemed	DirInstall,PreRebDown		No Value	No Value
GSIA	Def-GSIA	Def-GSIA		No Value	No Value
Electric Load Shape		PGE:COMMERCIAL:3 = Commercial HVAC		No Value	No Value
Gas Load Shape	Annual	Annual		No Value	No Value
Sector	Com	Com		No Value	No Value
PA/POU	All				
BldgHVAC	cWtd,cDXGF,cDXHP	cDXGF		No Value	No Value
Use Category	HVAC	HVAC		No Value	No Value
SubUseCategory	HeatCool	HeatCool		No Value	No Value
TechGroup	HV_AirDist	HV_AirDist		No Value	No Value
TechType	VentFanMtr	VentFanMtr		No Value	No Value
Cost Adjustment Type	None	None		No Value	No Value
EnImpCalcType	Standard	Standard		No Value	No Value
MeasImpactType	Deem-WP	IOU-Deemed		No Value	No Value

Measure Consensus – 5.41, VSD for HVAC Fan Controls, Commercial

Medium

- Offering
  - Implementation: AOE
  - Building Types: ECC,Ese,Eun,Hsp,Htl,Nrs,OfL,Rt3,RtL
    - Savings focused on bold building types
  - CZ01-16 (taken from DEER D03-051)
  - Norm Unit: Rated-HP
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (not developed with current prototypes)*
  - Should be extended to SDG&E
- Measure Extension
  - Add POUs
  - Add SDG&E
- Stage 2 Issues
  - *Measure is based upon a 2005 MASControl measure (D03-051); potentially not available*
    - *Measure being remodeled by PG&E (timing tbd)*
  - *Cost documentation comes from WO017 and is dated*
  - *Include evaluation results*

	2016	2017	2018
PA	Sum of First Year Gross kWh	Sum of First Year Gross kWh	Sum of First Year Gross kWh
PGE	3,516,710	2,920,079	1,700,965
SCE	708,215	3,991,786	2,135,325
	4,224,925	**6,911,865**	**3,836,290**

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

- 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.
- 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

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

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- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	AOE	REA	REA	No Value	No Value
BldgType	ECC,ESe,EUn,Hsp,Htl,Nrs,OfL,OTR,Rt3	ECC,ESe,EUn,Hsp,Htl,Nrs,OfL,OTR,Rt3	ECC,ESe,EUn,Hsp,Htl,Nrs,OfL,Rt3	No Value	No Value
BldgVintage	Ex	Ex,New	Any	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16	CZ01,CZ02,CZ03,CZ04,CZ05,CZ11,CZ12,CZ13,CZ16,IOU	CZ06,CZ08,CZ09,CZ10,CZ13,CZ14,CZ15,CZ16	No Value	No Value
NormUnit	Rated-HP	Rated-HP	Rated-HP	No Value	No Value
EUL ID	HVAC-VSDSupFan	HVAC-VSDSupFan	HVAC-VSDSupFan	No Value	No Value
RUL ID	(HVAC motor)	HVAC-VSDSupFan	HVAC-VSDSupFan	No Value	No Value
NTGR	Com-Default>2yrs Ind-Default>2yrs Ag-Default>2yrs	Com-Default>2yrs	Com-Default>2yrs	No Value	No Value
DeliveryType	DirInstall, PreRebDown	DirInstall PreRebDown	DirInstall PreRebDown	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	Def-GSIA	No Value	No Value
Electric Load Shape	*(use existing)*	PGE:COMMERCIAL:3 = Commercial HVAC	SCE:NON_RES:DEER:HVAC_Sp	No Value	No Value
Gas Load Shape	Annual	Annual	Annual	No Value	No Value
Sector	Com Ag Ind	Com	Com Ag Ind	No Value	No Value
PA/POU	Any				
BldgHVAC	cWtd	cWtd	Any	No Value	No Value
HOU					
IE Factor	FALSE	0	FALSE		
IETableName	None	(blank)	(blank)		
Use Category	HVAC	HVAC	HVAC	No Value	No Value
SubUseCategory	VentAirDist	VentAirDist	VentAirDist	No Value	No Value
TechGroup	HV_AirDist	HV_AirDist	HV_AirDist	No Value	No Value
TechType	VentFanMtr	VentFanMtr	SupFanMtr	No Value	No Value
Cost Adjustment Type	None	None	HVAC50	No Value	No Value
EnImpCalcType	Standard	(blank)	Standard	No Value	No Value
MeasImpactType	DEER	DEER	Standard	No Value	No Value

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

Low

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Planned to sunset.

- Offering
  - Implementation: AOE
  - Building Types: Htl, Mtl, Com
  - CZ06-08, CZ10, CZ14-15, IOU (SDG&E CZ only)
  - Norm Unit: Cap-Tons
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (not developed with vintage prototypes)*
- Measure Extension
  - Add POUs
  - *Add PG&E, SCE*
- Stage 2 Issues
  - *Savings claims need additional documentation*
    - *Measure extension should include additional documentation for savings*
  - *Cost documentation should be reviewed*
  - *Measure based upon building usage taken from D03-099, -101 (DEER 2005 models)*

PA	Sum of Number of Units	Sum of First Year Gross kWh	Sum of First Year Gross kW	Sum of First Year Gross Therm
SDGE	72	49,321.5	18.0	-

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

- Offering
  - Workpaper (WPSDGENRHC1051 Rev 1, Sept 2016)
  - Base Case:
    - Existing PTAC or PTHP units.
    - Based upon building usage taken from D03-099, -101 (DEER 2005 models)
  - 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.
  - Savings
    - Based upon 30% improvement from Environmental Testing Labs 8/2007 study taken from DEER building prototype usage.

Input Consensus
5.44, Adaptive Climate Controller for Guest Room PTAC or PTHP

CALIFORNIA TECHNICAL FORUM

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	AOE	No Value	No Value	No Value	No Value
BldgType	Htl,Mtl	No Value	No Value	Com,Htl,Mtl	No Value
BldgVintage	Ex	No Value	No Value	Ex	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16	No Value	No Value	IOU,CZ06,CZ07,CZ08,CZ10,CZ14,CZ15	No Value
NormUnit	Cap-Tons	No Value	No Value	Cap-Tons	No Value
EUL ID	HVAC-PTACCtrl	No Value	No Value	HVAC-PTACCtrl	No Value
RUL ID	HVAC-PTAC	No Value	No Value	No Value	No Value
NTGR	Com-Default>2	No Value	No Value	No Value	No Value
DeliveryType	DirInstall	No Value	No Value	No Value	No Value
GSIA	Def-GSIA	No Value	No Value	No Value	No Value
Electric Load Shape	*(use existing)*	No Value	No Value	SDGE:DEER:Com:HVAC_Split-Package_AC,SDGE:NON_res:DEER:HVAC_Split-Package_HP	No Value
Gas Load Shape	Annual	No Value	No Value	WinterOnly	No Value
Sector	Com	No Value	No Value	No Value	No Value
PA/POU	Any				
BldgHVAC	cPTAC cPTHP	No Value	No Value	cPTAC cPTHP	No Value
HOU					
IE Factor	FALSE			No value	
IETableName	None				
Use Category	HVAC	No Value	No Value	HVAC	No Value
SubUseCategory	SpaceCool	No Value	No Value	SpaceCool	No Value
TechGroup	HV_Tech	No Value	No Value	HV_Tech	No Value
TechType	TStat	No Value	No Value	TStat	No Value
Cost Adjustment Type	None	No Value	No Value	No value	No Value
EnImpCalcType	Standard	No Value	No Value	Standard	No Value
MeasImpactType	IOU-Deemed	No Value	No Value	Deemed	No Value

Measure Consensus – 5.45, Energy Management System for Guest Room PTAC or PTHP

Low

CALIFORNIA TECHNICAL FORUM

Planned to sunset.

- Offering
  - Implementation: AOE
  - Building Types: Htl, Mtl
  - CZ07, CZ10 (SDG&E CZ only)
  - Norm Unit: Cap-Tons
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (developed with vintage prototypes)*
- Measure Extension
  - POU only measure (assumed to be ISP)
  - Add SCE, SDG&E
- Stage 2 Issues
  - *Measure considered ISP by IOUs, but no study is available; based upon custom project feedback*
    - *Is there an opportunity to make this measure a targeted, to-code measure?*
    - *Is the measure truly ISP?*
    - *Consider looking at small versus large hotels/motels to distinguish ISP*
    - *Determine code trigger*
  - *POU considerations in moving to a statewide measure*

	2016	2017	2018
PA	Sum of First Year Gross kWh	Sum of First Year Gross kWh	Sum of First Year Gross kWh
MCE		26,850	
PGE	10,379,730	13,002,968	6,489,883
SDGE	-		
	10,379,730	**13,029,818**	**6,489,883**

Black text = Current state of the consolidated measure
Blue text = Changing and / or first time 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
  - 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.
  - 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)

Input Consensus – 5.45, Energy Management System for Guest Room PTAC or PTHP

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	AOE	REA	No Value	No Value	No Value
BldgType	Htl,Mtl	Htl,Mtl	No Value	No Value	No Value
BldgVintage	Ex	Any	No Value	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06, CZ07,CZ08,CZ09,CZ10,CZ11,CZ12, CZ13,CZ14,CZ15,CZ16	CZ01,CZ02,CZ03,CZ04,CZ05,CZ11,CZ12,CZ13,CZ16	No Value	No Value	No Value
NormUnit	Cap-Tons	Cap-Tons	No Value	No Value	No Value
EUL ID	HVAC-PTACCtrl	HVAC-PTACCtrl	No Value	No Value	No Value
RUL ID	HVAC-PTAC	HVAC-PTACCtrl	No Value	No Value	No Value
NTGR	Com-Default>2yrs	Com-Default>2yrs	No Value	No Value	No Value
DeliveryType	DirInstall, PreRebDown	DirInstall, PreRebDown	No Value	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	No Value	No Value	No Value
Electric Load Shape	*(use existing)*	PGE:COMMERCIAL:3 = Commercial HVAC	No Value	No Value	No Value
Gas Load Shape	Annual	Annual	No Value	No Value	No Value
Sector	Com	Com	No Value	No Value	No Value
PA/POU	POU				
BldgHVAC	cPTAC cPTHP	cPTAC	No Value	No Value	No Value
HOU					
IE Factor	FALSE	0			
IETableName	None	(blank)			
Use Category	HVAC	HVAC	No Value	No Value	No Value
SubUseCategory	HeatCool	HeatCool	No Value	No Value	No Value
TechGroup	HV_Tech	HV_Tech	No Value	No Value	No Value
TechType	TStat	TStat	No Value	No Value	No Value
Cost Adjustment Type	None	None	No Value	No Value	No Value
EnImpCalcType	Standard	(blank)	No Value	No Value	No Value
MeasImpactType	IOU-Deemed	NonDEER	No Value	No Value	No Value

Measure Consensus – 5.46, Programmable Communicating Thermostat for Demand Response, Commercial

Medium

CALIFORNIA TECHNICAL FORUM

Planned to sunset. SDG&E reviewing.

- Offering
  - Implementation: (PG&E) BRO-RCx; (SDG&E) AR
  - Building Types: All commercial types
  - Climate zones: PG&E (CZ01-05, 11-13, 16)
  - Norm Unit: Cap-Tons
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (Excel-based model)*
  - Integrating communicating DR thermostat with standard programable thermostat measure
- Measure Extension
  - Potentially – POU only measure (not confirmed)
- Stage 2 Issues
  - Back-up documentation for baseline
  - Appears to be included in Title 24 2016, Section 120.2; 2017 ESPI concern for like-for-like replacements
  - Cost updates recommended; based upon 2014 RSMeans

Measure Consensus – 5.46, Programmable Thermostat, Com

- 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
- Savings
  - Adjustment for **thermostat reprogramming** savings = 0.50
    - Accounts for negative impact to systems whose fans previously programmed for intermittent operation
    - Potential negative impacts where reprogramming causes additional night-time setback/setup operation
  - Adjustment for **thermostat replacement** savings = 0.25
    - Uncontrolled HVAC 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
  - 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

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Input Consensus – 5.46, Programmable Communicating Thermostat for Demand Response, Commercial

- Measure Permutations

Building Type	2016 Sum of Number of Units	2016 Sum of First Year Gross kWh	2016 Sum of First Year Gross Therm	2017 Sum of Number of Units	2017 Sum of First Year Gross kWh	2017 Sum of First Year Gross Therm	2018 Sum of Number of Units	2018 Sum of First Year Gross kWh	2018 Sum of First Year Gross Therm
Assembly	272	56,349	24,294	3,080	725,760	109,250	309	71,636	11,119
Education - Primary School	1,094	364,181	56,023	1,653	441,632	65,377	1,040	278,661	41,168
Education - Relocatable Classroom				3	22,260	(1)			
Education - Secondary School	18	9,275	1,470	613	146,825	24,155	658	154,910	26,058
Grocery	5	6,384	617	66	17,923	1,992			
Health/Medical - Hospital	22	19,828	2,529						
Health/Medical - Nursing Home	5	2,853	405	50	4,793	-	21	2,244	-
Lodging - Motel				31	3,312	-			
Manufacturing Biotech	14	4,737	480						
Manufacturing Light Industrial	191	35,942	4,444	25	5,755	728	8	1,700	216
Office - Large	222	341,913	52,027	372	118,521	12,663	34	10,160	1,083
Office - Small	337	109,995	11,024	100	30,678	3,853	27	8,151	1,091
Restaurant - Fast-Food	212	45,392	4,558	1	938	-			
Restaurant - Sit-Down	64	21,762	6,421	163	46,387	8,269	28	6,866	1,042
Retail - Multistory Large	102	23,125	3,677						
Retail - Single-Story Large	240	54,751	4,354	100	25,303	2,914	104	25,136	2,993
Retail - Small	239	71,429	5,962	108	27,777	3,630	12	3,109	403
Storage - Conditioned	12	2,607	331	15	3,732	411			
Warehouse - Refrigerated	2	25	0						
	3,048	**1,170,548**	**178,615**	**6,377**	**1,621,598**	**233,240**	**2,239**	**562,574**	**85,174**

Measure Consensus – 5.50, Cogged V-Belt for HVAC Fan, Commercial

Low

CALIFORNIA TECHNICAL FORUM

- Offering
  - Implementation: AOE
  - HVAC System: Gas Packs, Heat Pumps, Unitary AC-Only
  - 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)
  - EUL = 24,000 hours / annual hours of operation (per building type)
  - Norm Unit: Cap-Tons
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (developed with vintage prototypes)*
  - Maintain HVAC system for savings
- Measure Extension
  - Add POUs
  - Add SDG&E and PG&E
- Stage 2 Issues
  - *Confirm that three HVAC system type offerings required (low … has different savings)*
  - *Missing references*
  - *Consider extending building types*
  - *Consider Synchronous Belt offering*
  - *Consider if this measure is standard practice; review COM evaluation*

	2016	2017	2018
PA	Sum of First Year Gross kWh	Sum of First Year Gross kWh	Sum of First Year Gross kWh
PGE	183,159	42,531	
SCE	198,560	593,213	25,793
	381,719	635,744	25,793

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

- 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.
- Savings
  - PG&E uses 3 system types; SCE uses Gas Pack only
    - Gas Packs (SA13), Heat Pumps (SA14), Unitary AC-Only (SA15)
  - eQUEST/DOE2.2 models
    - Measure Case SYSTEM:SUPPLY-KW/FLOW = Base Case SYSTEM:SUPPLY-KW/FLOW * 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

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Input Consensus – 5.50, Cogged V-Belt for HVAC Fan, Commercial

CALIFORNIA TECHNICAL FORUM

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	NR	ROB	RobNc	No Value	No Value
BldgType	Asm,ECC,EPr,ERC,ESe,EUn,Hsp,Htl,MBT,MLI,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL,RtS,SCn	Asm,ECC,EPr,ERC,ESe,EUn,Hsp,Htl,MBT,MLI,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL,RtS,SCn	Asm,ECC,EPr,ERC,ESe,EUn,**Gro**,Hsp,Htl,MBT,MLI,**Mtl**,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL,RtS,SCn	No Value	No Value
BldgVintage	Ex	Ex	Any	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16	CZ01,CZ02,CZ03,CZ04,CZ05,CZ11,CZ12,CZ13,CZ16	CZ06,CZ08,CZ09,CZ10,CZ13,CZ14,CZ15,CZ16	No Value	No Value
NormUnit	Cap-Tons	Cap-Tons	Cap-Tons	No Value	No Value
EUL ID	HV-CoggedBelt	HV-CoggedBelt	HV-CoggedBelt	No Value	No Value
RUL ID	HVAC-airAC HVAC-airHP	(blank)	HV-CoggedBelt	No Value	No Value
NTGR	Com-Default>2yrs	Com-Default-HTR-di Com-Default>2yrs	Com-Default>2yrs	No Value	No Value
DeliveryType	DirInstall, PreRebDown, PreRebUp	DirInstall PreRebDown	PreRebDown PreRebUp	No Value	No Value
GSIA	Def-GSIA	Com-AC-PGE	Def-GSIA	No Value	No Value
Electric Load Shape	*(use existing)*	PGE:DEER:Com:HVAC_Split-Package_AC	SCE:NON_RES:DEER:HVAC_Sp	No Value	No Value
Gas Load Shape	Annual	Annual	Annual	No Value	No Value
Sector	Com	Com	Com	No Value	No Value
PA/POU					
BldgHVAC	cWtd	cWtd	Any	No Value	No Value
HOU					
IE Factor	No value	No value	FALSE		
IETableName	(blank)	(blank)	(blank)		
Use Category	HVAC	HVAC	HVAC	No Value	No Value
SubUseCategory	VentAirDist	VentAirDist	VentAirDist	No Value	No Value
TechGroup	HV_AirDist	HV_AirDist	HV_AirDist	No Value	No Value
TechType	VentFanMtr	VentFanMtr	VentFanMtr	No Value	No Value
Cost Adjustment Type	None	None	HVAC50	No Value	No Value
EnImpCalcType	Standard	(blank)	Standard	No Value	No Value
MeasImpactType	IOU-Deemed	IOU-Deemed	Standard	No Value	No Value

Measure Consensus – 5.16, Variable Speed Motor for Air Handler, Commercial

Planned to sunset. SDG&E reviewing.

- Offering
  - Implementation: NR
  - Building Types: Any
  - Climate Zones: CZ06, CZ08-16
  - Norm Unit: Each
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (Excel-based model)*
  - Needs the other climate zones added – specifically needs confirmation that no additional parameters will change within the bin-calculations (for added climate zones)
  - Long-term, this methodology should be consistent with ECM for high efficiency furnace measures
- Measure Extension
  - No Claims in 2017 or 2018
- Stage 2 Issues
  - *Missing calculation to claim savings of CZ01-05 and 07*
  - *Consider changing to report savings per HP rather than Each*
    - *Understand the target market since calculations based upon ½-hp, but up to 10-hp allowed*

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Measure Consensus – 5.16, Air Handler Variable Speed Motor

- 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.
- 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.

Input Consensus – 5.16, Variable Speed Motor for Air Handler, Commercial

CALIFORNIA TECHNICAL FORUM

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	NR	ROB	RobNc	No Value	No Value
BldgType	Any	Any	Asm,ECC,EPr,ESe,EUn,Htl,MBT,MLI,Mtl,OfL,OfS,Rt3,RtL,RtS,SCn,WRf	No Value	No Value
BldgVintage	Ex	Ex	Any	No Value	No Value
BldgLoc	CZ06,CZ07,CZ08,CZ09,CZ10,CZ11,CZ12,CZ13,CZ14,CZ15,CZ16	CZ11,CZ12,CZ13,CZ16	CZ06,CZ08,CZ09,CZ10,CZ13,CZ14,CZ15,CZ16	No Value	No Value
NormUnit	Each	Each	Each	No Value	No Value
EUL ID	Motors-fan	Motors-fan	Motors-fan	No Value	No Value
RUL ID	N/A	(blank)	Motors-fan	No Value	No Value
NTGR	Com-Default>2yrs	Com-Default>2yrs	Com-Default>2yrs	No Value	No Value
DeliveryType	PreRebDown	PreRebDown	PreRebDown	No Value	No Value
GSIA	Def-GSIA	No Value	No Value	No Value	No Value
Electric Load Shape	*Use existing*	PGE:DEER:Com:HVAC_Split-Package_AC	SCE:NON_RES:DEER:HVAC_Split-Package_AC	No Value	No Value
Gas Load Shape	Annual	Annual	Annual	No Value	No Value
Sector	Com	No Value	No Value	No Value	No Value
PA/POU	Any				
BldgHVAC	cWtd	cWtd	Any	No Value	No Value
HOU					
IE Factor	FALSE	0	FALSE		
IETableName	(blank)	(blank)	(blank)		
Use Category	HVAC	HVAC	HVAC	No Value	No Value
SubUseCategory	VentAirDist	VentAirDist	HeatCool	No Value	No Value
TechGroup	HV_AirDist	HV_AirDist	Motor	No Value	No Value
TechType	SupFanMtr	SupFanMtr	GenPurpose	No Value	No Value
Cost Adjustment Type	None	None	HVAC50	No Value	No Value
EnImpCalcType	(blank)	(blank)	Standard	No Value	No Value
MeasImpactType	IOU-Deemed	IOU-Deemed	Standard	No Value	No Value

Measure Consensus – 5.21, Classroom HVAC Occupancy Sensor

CALIFORNIA TECHNICAL FORUM

- Offering
  - Implementation: NR
  - System Type: Heat Pump / DX Furnace
  - Building Types: ERC
  - Norm Unit: Cap-Ton
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (not developed with vintage prototypes)*
- Measure Extension
  - No Claims – 2017 or 2018
- Stage 2 Issues
  - *Cost documentation should be reviewed*

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Measure Consensus – 5.21, Classroom HVAC Occupancy Sensor

- Base Case:
  - A programmable thermostat without occupancy sensor controlling Packaged HVAC unit serving classrooms. This thermostat has unoccupied setback temperature control during closed hours (evenings, weekends, furlough days and holidays).
- Measure Case:
  - Thermostat with occupancy sensor controlling packaged HVAC systems.
  - Energy Savings from this measure are a result of reduced run time of the HVAC system (fans, compressors, furnaces) due to the temperature setpoints setback to unoccupied mode when there is no occupancy during the school hours. The unoccupied mode temperature set points are 86F for cooling and 62F for heating.
- Savings
  - Workpaper (SCE17HC060.1, Aug 2018)
  - MAS Control v3.00.27
    - Prototypes: ERC, Ese, Epr (2003)
  - Coefficient of variation analysis to collapse permutations (<8% in CZ08 and CZ09)

Building Type	Setback Hours
ERC	Monday to Friday: 2PM to 4PM (close hour)
	Saturday: Noon to 4PM (close hour)
Ese and EPr	Monday to Friday: 5PM to 7PM (close hour)
	Saturday: 1PM to 5PM (close hour)

Blue text = Changing and first time that item is mentioned
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Input Consensus
5.21, Classroom HVAC Occupancy Sensor

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	AOE	No Value	REA	No Value	No Value
BldgType	EPr,ERC,ESe	No Value	ECC,EPr,ERC,ESe,EUn	No Value	No Value
BldgVintage	Ex	No Value	Any	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05, CZ06,CZ07,CZ08,CZ09,CZ10, CZ11,CZ12,CZ13,CZ14,CZ15, CZ16	No Value	CZ06,CZ08,CZ09,CZ10,CZ13,CZ14,CZ15,CZ16	No Value	No Value
NormUnit	Cap-Tons	No Value	Each	No Value	No Value
EUL ID	HVAC-Timeclocks	No Value	HVAC-Timeclocks	No Value	No Value
RUL ID	N/A	No Value	HVAC-Timeclocks	No Value	No Value
NTGR	Com-Default>2yrs	No Value	Com-Default>2yrs	No Value	No Value
DeliveryType	DirInstall	No Value	DirInstall PreRebDown	No Value	No Value
GSIA	Def-GSIA	No Value	Def-GSIA	No Value	No Value
Electric Load Shape	*use existing*	No Value	SCE:K_thru_12_School:Occupar	No Value	No Value
Gas Load Shape	Annual	No Value	Annual	No Value	No Value
Sector	Com	No Value	Com	No Value	No Value
PA/POU	Any				
BldgHVAC	cDXGF cDXEH	No Value	Any	No Value	No Value
HOU					
IE Factor	FALSE		FALSE		
IETableName	None		(blank)		
Use Category	HVAC	No Value	HVAC	No Value	No Value
SubUseCategory	HeatCool	No Value	HeatCool	No Value	No Value
TechGroup	HV_Tech	No Value	HV_Tech	No Value	No Value
TechType	MoveSensor	No Value	MoveSensor	No Value	No Value
Cost Adjustment Type	None	No Value	HVAC50	No Value	No Value
EnImpCalcType	Standard	No Value	Standard	No Value	No Value
MeasImpactType	IOU-Deemed	No Value	Standard	No Value	No Value

Measure Consensus – 5.14, VFD Retrofit to Central Plant System

CALIFORNIA TECHNICAL FORUM

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- Offering
  - Implementation: Chilled Water Pump (AOE); Condenser Water Pump (AOE, NC)
  - Building Types:
    - ECC, ESe, EUn, Hsp, Htl, Nrs, MBT, OfL, OfS, Rt3
  - Norm Unit: Rated-HP
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (not developed with vintage prototypes)*
- Measure Extension
  - Add POUs
  - Add PG&E, SDG&E

		2016	2017	2018
PA	Measure Description	Sum of First Year Gross kWh	Sum of First Year Gross kWh	Sum of First Year Gross kWh
SCE	Variable Speed Drive on Cooling Tower Fan Control		52,984	
	Variable Speed Drive on Chilled Water Pump Control	5,315,506	4,147,675	362,379
	Variable Speed Drive on Condenser Water Pump Control	4,128,853	2,560,407	210,734
	Variable Speed Drive on Cooling Tower Fan Control	52,370	11,022	
SDGE	Variable Flow Chilled Water Loop	20,400		
	VSD Chilled Water Loop Pump	157,250		
	VSD Hot Water Loop Pump	2,910		
		9,677,289	**6,772,088**	**573,113**

- Stage 2 Issues
  - *Review cost for NC installation; Full measure cost seems to be used.*
  - *Offerings removed due to codes changes on earlier cycles*
    - *Consider re-adding offering for VFD on cooling tower; depends upon code trigger and market*

Black text = Current state of the consolidated measure
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Measure Consensus – 5.14, VFD Retrofit to Central Plant System

- Base Case:
  - Existing Customer Equipment or applicable Title-24 based on vintage
    - CHWP Control – Single speed for REA Program Type
    - CWP Control – Single speed for REA and NEW Program Type
- Measure Case:
  - Installing variable speed drives (VSD) on Chilled Water Pumps (CHWPs) and Condenser Water Pumps (CWPs) in water cooled central plant applications.
- Savings
  - Modeled: DOE-2, eQUEST v3.65
    - DEER2017 chiller models: WCChlrBase
  - CWP 1996, 03, 07, 11, 14 vintages
  - CHWP 96, 03 (limited by code at the upper end and RUL at the lower end)
  - Building Type
    - ECC. ESe, **EUn, Hsp**, Htl, Nrs, MBT, **OfL, OfS**, Rt3
  - Keyword changes:

	kWh
BldgType	SCE
Asm	4,411
ESe	76,607
EUn	487,893
Hsp	999,407
Htl	187,896
MLI	119,043
OfL	306,468
OfS	302,953

Vintage(s)	Keyword	Baseline Design Value (Defaulted)	Measure Design Value
CHW* Loop Pump EEM**			
96,03	PUMP:CAP-CTRL	ONE-SPEED-PUMP	VAR-SPEED-PUMP
96,03	SYSTEM:CHW-VALVE-TYPE	THREE-WAY	TWO-WAY
CW* Loop Pump EEM**			
96,03,07,11,14	PUMP:CAP-CTRL	N/A	VAR-SPEED-PUMP
96,03,07,11,14	CHILLER:CW-FLOW-CTRL	CONSTANT-FLOW	VARIABLE-FLOW
96,03,07,11,14	CHILLER:CW-MIN-FLOW	N/A	0.70 (ratio)
96,03,07,11,14	CHILLER:MAX-COND-T	N/A	85.0 (degF)

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Input Consensus
5.14, VFD Retrofit to Central Plant System

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	AOE, NC	No Value	REA,RobNc	No Value	No Value
BldgType	ECC,ESe,EUn,Hsp,Htl,MBT, OfL,Rt3,Nrs,OfS	No Value	Asm,ESe,EUn,Hsp,Htl,MBT, MLI,OfL,Rt3,WRf,Nrs,OfS	No Value	No Value
BldgVintage	Ex	No Value	Any	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06, CZ07,CZ08,CZ09,CZ10,CZ11,CZ12, CZ13,CZ14,CZ15,CZ16	No Value	CZ06,CZ08,CZ09,CZ10,CZ13, CZ14,CZ15,CZ16	No Value	No Value
NormUnit	Rated-HP	No Value	Rated-HP	No Value	No Value
EUL ID	HVAC-VSD-pump	No Value	HVAC-VSD-pump HVAC-VSDSupFan	No Value	No Value
RUL ID	Motors-Pump	No Value	HVAC-VSD-pump HVAC-VSDSupFan	No Value	No Value
NTGR	Com-Default>2yrs	No Value	Com-Default>2yrs	No Value	No Value
DeliveryType	DnDeemDI	No Value	PreRebDown	No Value	No Value
GSIA	Def-GSIA	No Value	Def-GSIA	No Value	No Value
Electric Load Shape	*(use existing)*	No Value	SCE:NON_RES:DEER:HVAC_Chillers	No Value	No Value
Gas Load Shape	Annual	No Value	Annual	No Value	No Value
Sector	Com	No Value	Com	No Value	No Value
PA/POU	Any				
BldgHVAC	cWtd	No Value	Any	No Value	No Value
Use Category	HVAC	No Value	HVAC	No Value	No Value
SubUseCategory	Controls	No Value	SpaceCool, HtRej	No Value	No Value
TechGroup	LiquidCirc	No Value	LiquidCirc, HeatReject	No Value	No Value
TechType	FlowCtrl	No Value	TwrFanCtrl	No Value	No Value
Cost Adjustment Type	None	No Value	HVAC50	No Value	No Value
EnImpCalcType	Standard	No Value	Standard	No Value	No Value
MeasImpactType	Deem-WP	No Value	Standard	No Value	No Value
MeasQualifierGroup	None	No Value	None	No Value	No Value

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

Low

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Planned to sunset.

- Offering
  - Implementation: AOE
  - Motor Rated HP: <10 HP, 10-40 HP, 41-100 HP
  - Building Types:
    - High Hours (ECC,Eun,GsR,Hsp,Htl,Mtl,Nrs,Rt3,RtL)
    - Low Hours (Epr,Ese,MFm,OfL,OfS)
  - Norm Unit: Rated HP
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (Excel-based model)*
  - Updates for consistency: Annual hours methodology between offerings, affinity law exponent, demand calculation
- Measure Extension
  - POU only measure (assumed to be ISP)
- Stage 2 Issues
  - *Is there an opportunity to make this measure a targeted, to-code measure for IOUs?*
    - *Consider re-adding offering with POE requirement; depends upon code trigger and market*
  - *Consider combining Rated-HP bins; savings variation is less than 2%*

		kWh
BldgType	MeasAppType	SCE
Htl	REA	886,648

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

- 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.
- 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

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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%

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

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	AOE	No Value	REA	No Value	No Value
BldgType	ECC,EPr,ESe,EUn,Gst,Hsp,Htl,MFm,Mtl,Nrs,OfL,Rt3,RtL,OfS	No Value	ECC,EPr,ESe,EUn,Gst,Hsp,Htl,MFm,Mtl,Nrs,OfL,Rt3,RtL,OfS	No Value	No Value
BldgVintage	Any	No Value	Any	No Value	No Value
BldgLoc	Any	No Value	CZ06,CZ08,CZ09,CZ10,CZ13,CZ14,CZ15,CZ16	No Value	No Value
NormUnit	Rated-HP	No Value	Rated-HP	No Value	No Value
EUL ID	HVAC-RedcOverVent	No Value	HVAC-RedcOverVent	No Value	No Value
RUL ID	Motors-Fan	No Value	HVAC-RedcOverVent	No Value	No Value
NTGR	Com-Default>2yrs Res-Default>2yrs	No Value	Com-Default>2yrs Res-Default>2yrs	No Value	No Value
DeliveryType	PreRebDown	No Value	PreRebDown	No Value	No Value
GSIA	Def-GSIA	No Value	Def-GSIA	No Value	No Value
Electric Load Shape	*Use existing*	No Value	SCE:College_University:Reduce_Cooling_Load-Ret SCE:Small_Office:Reduce_Cooling_Load-Ret SCE:Hotel_Motel:Reduce_Cooling_Load-Ret SCE:Misc._Commercial:Reduce_Cooling_Load-Ret SCE:Large_Office:Reduce_Cooling_Load-Ret SCE:Large_Retail_Store:Reduce_Cooling_Load-Ret SCE:NON_RES:Reduce_Cooling_Load-Ret	No Value	No Value
Gas Load Shape	Annual	No Value	Annual	No Value	No Value
Sector	Ag Com Ind Res	No Value	Ag Com Ind Res	No Value	No Value
PA/POU	POU				
BldgHVAC	Any	No Value	Any	No Value	No Value
HOU					
IE Factor	FALSE		FALSE		
IETableName	(blank)		(blank)		
Use Category	HVAC	No Value	HVAC	No Value	No Value
SubUseCategory	VentAirDist	No Value	VentAirDist	No Value	No Value
TechGroup	HV_AirDist	No Value	HV_AirDist	No Value	No Value
TechType	OxyDemCtrl	No Value	OxyDemCtrl	No Value	No Value
Cost Adjustment Type	None	No Value	EL50	No Value	No Value
EnImpCalcType	Standard	No Value	Standard	No Value	No Value
MeasImpactType	IOU-Deemed	No Value	Standard	No Value	No Value

Back-up Slides