HVAC - Commercial Service Measures

AYAD AL-SHAIKH

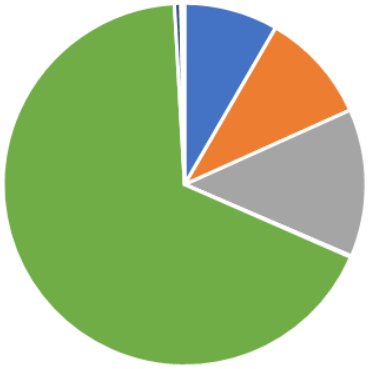
APRIL 2019

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 / Q1-Q4)
    - 63.4M / 102.2M kWh, 2.5M / 3.7M therms

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

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



Commercial HVAC Measures

CALIFORNIA TECHNICAL FORUM

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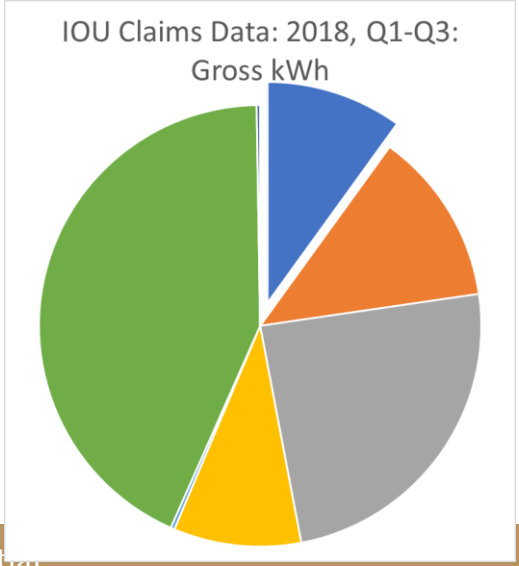
Service / Quality Installation (6 measures)

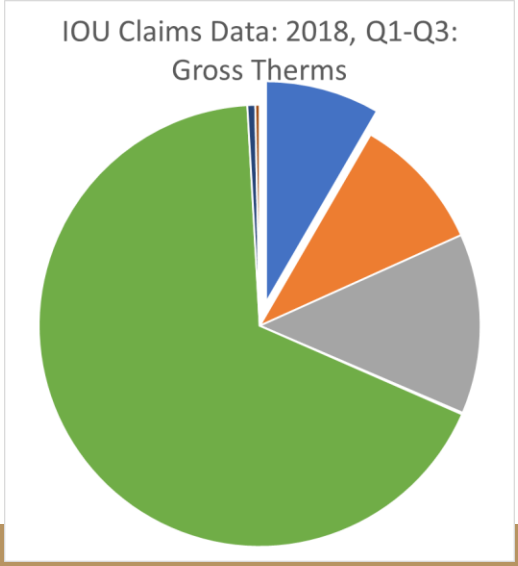
Ref No	Description							2018 (Q1-Q3) Number of Units	First Year Gross kWh	First Year Gross Therm
5.30	Refrigerant Charge, Commercial							5,562	247,572	840
5.31	Evaporator Coil Cleaning, Commercial							21,499	147,374	(7)
5.32	Condenser Coil Cleaning, Commercial							22,968	1,242,174	-
5.01	Economizer 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.

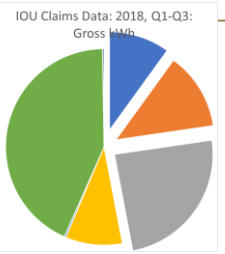
Commercial HVAC Measures

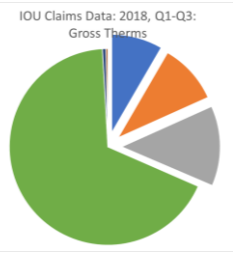
No	Description	Affirmation?	Short Status	2018 (Q1-Q3) Num of Units	Gross kWh	Gross Therms
5.30	Refrigerant Charge, Commercial	No	New workpaper end of 2018	5,562	247,572	840
5.31	Evaporator Coil Cleaning, Commercial	No	New workpaper end of 2018	21,499	147,374	(7)
5.32	Condenser Coil Cleaning, Commercial	No	New workpaper end of 2018	22,968	1,242,174	-
5.01	Economizer Controls, Commercial	Yes	Consolidated	5,016	344,322	(12)
5.02	Economizer Repair, Commercial	Yes	Consolidated	5,232	517,665	8,545
5.15	Supply Fan Controls, Commercial	Yes	Consolidated	9,174	3,773,278	154,966





Commercial HVAC Measures





Ref No	Description	2016 Number of Units	2016 First Year Gross kWh	2016 First Year Gross Therm	2017 Number of Units	2017 First Year Gross kWh	2017 First Year Gross Therm	2018 (Q1-Q3) Number of Units	2018 (Q1-Q3) First Year Gross kWh	2018 (Q1-Q3) First Year Gross Therm
5.30	Refrigerant Charge, Commercial	60,060	4,443,350	(504)	38,127	2,674,236	(597)	5,562	247,572	840
5.31	Evaporator Coil Cleaning, Commercial	24,443	215,470	-	56,477	444,542	(8)	21,499	147,374	(7)
5.32	Condenser Coil Cleaning, Commercial	52,492	2,967,760	(84,930)	74,533	3,692,907	-	22,968	1,242,174	-
5.01	Economizer Controls, Commercial	18,499	1,002,300	(4,327)	12,864	838,729	(77)	5,016	344,322	(12)
5.02	Economizer Repair, Commercial	27,402	2,875,707	5,721	32,160	3,518,941	18,368	5,232	517,665	8,545
5.15	Supply Fan Controls, Commercial	20,180	5,687,064	264,419	13,916	3,980,416	171,663	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)
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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
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	Totals:		**85,610,000**	**1,050,000**		**63,640,000**	**1,160,000**		**29,620,000**	**620,000**

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Commercial HVAC Measures

No	Description	Modeled	Submittal	IOU Lead	Rigor	2018 (Q1-Q3) Number of Units	First Year Gross kWh	First Year Gross Therm
5.30	Refrigerant Charge, Commercial	DEER	Apr	SDG&E	Low	5,562	247,572	840
5.31	Evaporator Coil Cleaning, Commercial	DEER	Apr	SDG&E	Low	21,499	147,374	(7)
5.32	Condenser Coil Cleaning, Commercial	DEER	Apr	SDG&E	Low	22,968	1,242,174	-
5.01	Economizer Controls, Commercial	eQUEST	Jun	PG&E	Low	5,016	344,322	(12)
5.02	Economizer Repair, Commercial	eQUEST	Jun	PG&E	Low	5,232	517,665	8,545
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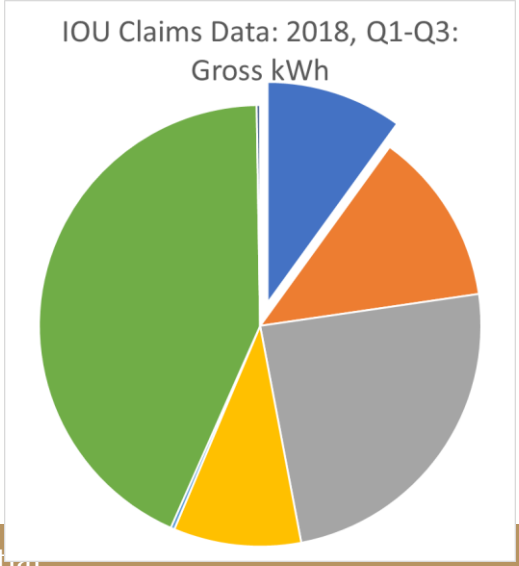

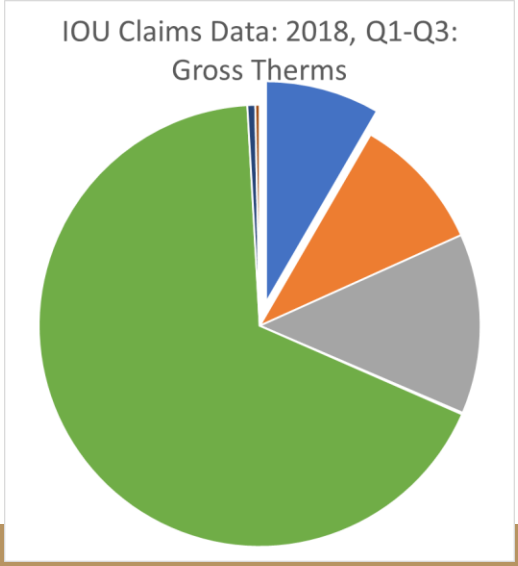

Measure Consensus
5.30 - Refrigerant Charge, Commercial

Low

CALIFORNIA TECHNICAL FORUM

- Offering
  - Implementation: BRO-RCx
  - Building Types: Asm,Com,ECC,EPr,ERC,ESe,EUn,Hsp,Htl,MBT,MLI,Nrs,OfL, OfS,RFF,RSD,Rt3,RtL,RtS,SCn
  - Climate zones: CZ01-CZ16
  - Norm Unit: Cap-Tons
  - Offerings include:
    - With TXV / With No TXV; Increase or Decrease of Refrigerant Charge
    - High / typical
- Stage 1 Issues
  - *DEER 2020 Updates: Values come from DEER*
- Measure Extension
  - Add POUs
- Stage 2 Issues
  - *None.*

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Measure Consensus - 5.30, Refrigerant Charge Adjustment

- Savings (*methodology not confirmed with latest MC*)
  - 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.

Refrigerant Charge, Condenser Coil Cleaning, and Evaporator Coil Cleaning, Commercial

- Savings (2018, Q1-Q3)

Sum of First Ref No	Description	Offering	PA PGE	SCE	SDGE
5.30	Refrigerant Charge	AC Only Unit	6,513	6,374	
		AC Unit with Gas Heat	105,206	18,895	
		Heat Pump	24,034	22,289	
		Other			64,260
	Refrigerant Charge Total		**135,753**	**47,559**	**64,260**
5.30 Total			**135,753**	**47,559**	**64,260**
5.31	Evaporator Coil Clear	AC Only Unit	3,244	7,013	
		AC Unit with Gas Heat	62,446	12,660	
		Heat Pump	16,721	10,103	
		Other			35,186
	Evaporator Coil Cleaning Total		**82,412**	**29,776**	**35,186**
5.30 Total			**82,412**	**29,776**	**35,186**
5.32	Commercial Conden	AC Only Unit	6,489	25,320	
		AC Unit with Gas Heat	124,892	14,025	
		Heat Pump	33,443	21,105	
		Other			1,016,900
	Commercial Condenser Coil Cleaning Total		**164,824**	**60,450**	**1,016,900**
5.30 Total			**164,824**	**60,450**	**1,016,900**
Grand Total			**382,989**	**137,785**	**1,116,346**

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Measure Consensus
5.30 - Refrigerant Charge, Commercial

CALIFORNIA TECHNICAL FORUM

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	BRO-RCx	RCx	No Value	No Value	No Value
BldgType	Asm,Com,ECC,EPr,ERC,ESe,EUn, Hsp,Htl,MBT,MLI,Nrs,OfL,OfS, RFF,RSD,Rt3,RtL,RtS,SCn	Asm,Com,ECC,EPr,ERC,ESe,EUn, Hsp,Htl,MBT,MLI,Nrs,OfL,OfS, RFF,RSD,Rt3,RtL,RtS,SCn	No Value	No Value	No Value
BldgVintage	Ex	Ex	No Value	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06, CZ07,CZ08,CZ09,CZ10,CZ11,CZ12, CZ13,CZ14,CZ15,CZ16		No Value	No Value	No Value
NormUnit	Cap-Tons	Cap-Tons	No Value	No Value	No Value
EUL ID	HVAC-RefChg	HVAC-RefChg	No Value	No Value	No Value
RUL ID	HVAC-RefChg	HVAC-RefChg	No Value	No Value	No Value
NTGR	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA	No Value	No Value	No Value
DeliveryType	DnDeemDI	DnDeemDI	No Value	No Value	No Value
GSIA	Com-RCA-All	Com-RCA-SCE	No Value	No Value	No Value
Electric Load Shape	*Com:HVAC_Split-Package_AC*	Com:HVAC_Split-Package_AC	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	All	All			
BldgHVAC	cDXGF	cDXGF	No Value	No Value	No Value
Use Category	HVAC	HVAC	No Value	No Value	No Value
SubUseCategory	SpaceCool	SpaceCool	No Value	No Value	No Value
TechGroup	dxAC_equip	dxAC_equip	No Value	No Value	No Value
TechType	pckSEER	pckSEER	No Value	No Value	No Value
Cost Adjustment Type	None	None	No Value	No Value	No Value
EnImpCalcType	Standard	Standard	No Value	No Value	No Value
MeasImpactType	Deem-DEER	DEER	No Value	No Value	No Value

Measure Consensus
5.31 - Evaporator Coil Cleaning, Commercial

CALIFORNIA TECHNICAL FORUM

- Offering
  - Implementation: BRO-RCx
  - Building Types: Asm,Com,ECC,EPr,ERC,ESe,EUn,Hsp,Htl,MBT,MLI,Nrs,OfL, OfS,RFF,RSD,Rt3,RtL,RtS,SCn
  - Climate zones: CZ01-CZ16
  - Norm Unit: Cap-Tons
  - Offerings include:
    - With TXV / With No TXV; Increase or Decrease of Refrigerant Charge
- Stage 1 Issues
  - *DEER 2020 Updates: RCA Values come from DEER*
    - 25% of Refrigerant Charge Adjustment savings from DEER are non-RCA
    - 25% of non-RCA are Evaporator Coil Cleaning
- Measure Extension
  - Add POUs
- Stage 2 Issues
  - *None.*

Black text = Current state of the consolidated measure
Blue text = Changing and / or first time item is mentioned
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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

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Measure Consensus
5.31 - Evaporator Coil Cleaning, Commercial

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	BRO-RCx	RCx	No Value	No Value	No Value
BldgType	Asm,Com,ECC,EPr,ERC,ESe,EUn, Hsp,Htl,MBT,MLI,Nrs,OfL,OfS, RFF,RSD,Rt3,RtL,RtS,SCn	Asm,Com,ECC,EPr,ERC,ESe,EUn, Hsp,Htl,MBT,MLI,Nrs,OfL,OfS, RFF,RSD,Rt3,RtL,RtS,SCn	No Value	No Value	No Value
BldgVintage	Ex	Ex	No Value	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06, CZ07,CZ08,CZ09,CZ10,CZ11,CZ12, CZ13,CZ14,CZ15,CZ16		No Value	No Value	No Value
NormUnit	Cap-Tons	Cap-Tons	No Value	No Value	No Value
EUL ID	HVAC-RefChg	HVAC-RefChg	No Value	No Value	No Value
RUL ID	HVAC-RefChg	HVAC-RefChg	No Value	No Value	No Value
NTGR	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA	No Value	No Value	No Value
DeliveryType	DnDeemDI	DnDeemDI	No Value	No Value	No Value
GSIA	Com-RCA-All	Com-RCA-SCE	No Value	No Value	No Value
Electric Load Shape	*Com:HVAC_Split-Package_AC*	Com:HVAC_Split-Package_AC	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	All	All			
BldgHVAC	cDXGF	cDXGF	No Value	No Value	No Value
Use Category	HVAC	HVAC	No Value	No Value	No Value
SubUseCategory	SpaceCool	SpaceCool	No Value	No Value	No Value
TechGroup	dxAC_equip	dxAC_equip	No Value	No Value	No Value
TechType	pckSEER	pckSEER	No Value	No Value	No Value
Cost Adjustment Type	None	None	No Value	No Value	No Value
EnImpCalcType	Standard	Standard	No Value	No Value	No Value
MeasImpactType	Deem-DEER	DEER	No Value	No Value	No Value

Measure Consensus
5.32 - Condenser Coil Cleaning, Commercial

CALIFORNIA TECHNICAL FORUM

- Offering
  - Implementation: BRO-RCx
  - Building Types: Asm,Com,ECC,EPr,ERC,ESe,EUn,Hsp,Htl,MBT,MLI,Nrs,OfL, OfS,RFF,RSD,Rt3,RtL,RtS,SCn
  - Climate zones: CZ01-CZ16
  - Norm Unit: Cap-Tons
  - Offerings include:
    - With TXV / With No TXV; Increase or Decrease of Refrigerant Charge
- Stage 1 Issues
  - *DEER 2020 Updates: RCA Values come from DEER*
    - 25% of Refrigerant Charge Adjustment savings from DEER are non-RCA
    - 50% of non-RCA are Condenser Coil Cleaning
- Measure Extension
  - Add POUs
- Stage 2 Issues
  - *None.*

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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

Measure Consensus
5.32 - Condenser Coil Cleaning, Commercial

- Measure Permutations

		Measure Data Field			
Measure Data Field	Measure Value	PG&E	SCE	SDG&E	SCG
MeasureAppType	BRO-RCx	RCx	No Value	No Value	No Value
BldgType	Asm,Com,ECC,EPr,ERC,ESe,EUn, Hsp,Htl,MBT,MLI,Nrs,OfL,OfS, RFF,RSD,Rt3,RtL,RtS,SCn	Asm,Com,ECC,EPr,ERC,ESe,EUn, Hsp,Htl,MBT,MLI,Nrs,OfL,OfS, RFF,RSD,Rt3,RtL,RtS,SCn	No Value	No Value	No Value
BldgVintage	Ex	Ex	No Value	No Value	No Value
BldgLoc	CZ01,CZ02,CZ03,CZ04,CZ05,CZ06, CZ07,CZ08,CZ09,CZ10,CZ11,CZ12, CZ13,CZ14,CZ15,CZ16		No Value	No Value	No Value
NormUnit	Cap-Tons	Cap-Tons	No Value	No Value	No Value
EUL ID	HVAC-RefChg	HVAC-RefChg	No Value	No Value	No Value
RUL ID	HVAC-RefChg	HVAC-RefChg	No Value	No Value	No Value
NTGR	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA	No Value	No Value	No Value
DeliveryType	DnDeemDI	DnDeemDI	No Value	No Value	No Value
GSIA	Com-RCA-All	Com-RCA-SCE	No Value	No Value	No Value
Electric Load Shape	*Com:HVAC_Split-Package_AC*	Com:HVAC_Split-Package_AC	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	All	All			
BldgHVAC	cDXGF	cDXGF	No Value	No Value	No Value
Use Category	HVAC	HVAC	No Value	No Value	No Value
SubUseCategory	SpaceCool	SpaceCool	No Value	No Value	No Value
TechGroup	dxAC_equip	dxAC_equip	No Value	No Value	No Value
TechType	pckSEER	pckSEER	No Value	No Value	No Value
Cost Adjustment Type	None	None	No Value	No Value	No Value
EnImpCalcType	Standard	Standard	No Value	No Value	No Value
MeasImpactType	Deem-DEER	DEER	No Value	No Value	No Value

Measure Consensus – 5.01 - Economizer Controls, Commercial

Low

CALIFORNIA TECHNICAL FORUM

17

- Offering
  - Implementation: AOE
  - Building Types: All commercial types
  - Climate zones: PG&E (CZ01-05, 11-13, 16); SCE (CZ06, 08-10, 13-16) -> All CZ
  - Norm Unit: Cap-Tons
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (developed with vintage prototypes)*
  - Updated workpaper submitted end of 2018
    - Extend savings to CZ07 (SDG&E)
- Measure Extension
  - Add POUs
  - Add SDG&E
- Stage 2 Issues
  - *Convert PA-specific value to statewide*
  - *Supporting documentation requested*
  - *Ensure that enthalpy controls are considered*

	2016	2017	2018
PA	Sum of First Year Gross kWh	Sum of First Year Gross kWh	Sum of First Year Gross kWh
PGE	449,917	505,973	222,602
SCE	388,972	332,756	121,720
SDGE	163,410		
	1,002,300	**838,729**	**344,322**

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 - 5.01 - Economizer Controls

- 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
- 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.

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

Input Consensus – 5.01 - Economizer Controls, Commercial

CALIFORNIA TECHNICAL FORUM

- 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	Asm,ECC,EPr,ERC,ESe,EUn,Gro,Hsp,Htl,MBT,MLI,Mtl,Nrs,OfL,OfS,OTR,RFF,RSD,Rt3,RtL,RtS,SCnWRf	Asm,ECC,EPr,ERC,ESe,EUn,Gro,Hsp,Htl,MBT,MLI,Mtl,Nrs,OfL,OfS,OTR,RFF,RSD,Rt3,RtL,RtS,SCnWRf	Asm,ECC,EPr,ERC,ESe,Gro,Hsp,Htl,MBT,MLI,Nrs,OfS,RFF,RSD,RtL,RtS,SCn,WRf	Asm,ECC,EPr,ESe,MLI,Nrs,OfL,OfS,RFF,RSD,RtL,RtS	No Value
BldgVintage	Ex	Ex	Any	Any	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	CZ06,CZ07,CZ10	No Value
NormUnit	Cap-Tons	Cap-Tons	Cap-Tons	Cap-Tons	No Value
EUL ID	HVAC-RepEcono	HVAC-RepEcono	HVAC-airAC	HVAC-RepEcono	No Value
RUL ID	HVAC-airAC	HVAC-RepEcono	HVAC-airAC	No Value	No Value
NTGR	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA Com-Default>2yrs	No Value	No Value
DeliveryType	DnDeemedDI, DnDeemed	DirInstall PreRebDown	DirInstallm NonUpStrm PreRebDown	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	Def-GSIA	No Value	No Value
Electric Load Shape	*(use existing)*	PGE:DEER:Com:HVAC_Split-Package_AC	SCE:Large_Office:Economy_cycle-Ret SCE:College_University:Economy_cycle-Ret SCE:Small_Office:Economy_cycle-Ret SCE:Restaurant:Economy_cycle-Ret SCE:Large_Retail_Store:Economy_cycle-Ret SCE:Small_Retail_Store:Economy_cycle-Ret	SDGE:DEER:Com:HVAC_Split-Package_AC	No Value
Gas Load Shape	Annual	WinterOnly	Annual	WinterOnly	No Value
Sector	Com, Ag, Ind	Com	Com, Ag, Ind	No Value	No Value
PA/POU	Any				
BldgHVAC	cDXGF, cNCGF cDXHP, cPVVG	cDXGF, cNCGF cDXHP, cPVVG	Any	cDXGF	No Value
Use Category	HVAC	HVAC	HVAC	HVAC	No Value
SubUseCategory	SpaceCool	SpaceCool	SpaceCool	SpaceCool	No Value
TechGroup	HV_AirDist	HV_AirDist	HV_AirDist	dxAC_equip	No Value
TechType	AirEcono	AirEcono	AirEcono	spltEER	No Value
Cost Adjustment Type	None	None	HVAC50	No value	No Value
EnImpCalcType	Standard	(blank)	Standard	Standard	No Value
MeasImpactType	Deem-WP	IOU-Deemed	Standard	Deemed	No Value
MeasQualifierGroup	None	Beginning in 2016	None	None	No Value

Measure Consensus – 5.02, Economizer Repair, Commercial

Low

CALIFORNIA TECHNICAL FORUM

- Offering
  - Implementation: AOE
  - Building Types: All commercial types
  - Climate zones: PG&E (CZ01-05, 11-13, 16); SCE (CZ06, 08-10, 13-16) -> All CZ
  - Norm Unit: Cap-Tons
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (developed with vintage prototypes)*
  - Updated workpaper submitted end of 2018
    - Extend savings to CZ07 (SDG&E)
- Measure Extension
  - Add POUs
  - Add SDG&E
- Stage 2 Issues
  - *Convert PA-specific value to statewide*
  - *Document that modelled failures reflect typical failure modes*
  - *Evaluate that zone flow rates match reality*

	2016	2017	2018
PA	Sum of First Year Gross kWh	Sum of First Year Gross kWh	Sum of First Year Gross kWh
PGE	842,766	849,504	335,270
SCE	1,988,041	2,669,436	182,395
SDGE	44,899		
	2,875,707	**3,518,941**	**517,665**

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 - 5.02 Economizer Repairs

- 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)
- 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.

Input Consensus – 5.02 Economizer Repair, Commercial

- 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	Asm,ECC,EPr,ERC,ESe,EUn,Gro,Hsp,Htl,MBT,MLI,Mtl,Nrs,OfL,OfS,OTR,RFF,RSD,Rt3,RtL,RtS,SCnWRf	Asm,ECC,EPr,ERC,ESe,EUn,Gro,Hsp,Htl,MBT,MLI,Mtl,Nrs,OfL,OfS,OTR,RFF,RSD,Rt3,RtL,RtS,SCnWRf	Asm,ECC,ERC,ESe,EUn,Gro,Hsp,Htl,Mtl,Nrs,OfL,OfS,RFF,RSD,Rt3,RtL,RtS	Asm,ECC,EPr,ESe,MLI,Nrs,OfL,OfS,RFF,RSD,RtL,RtS	No Value
BldgVintage	Ex	Ex	Any	Any	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	CZ06,CZ07,CZ10	No Value
NormUnit	Cap-Tons	Cap-Tons	Cap-Tons	Cap-Tons	No Value
EUL ID	HVAC-RepEcono	HVAC-RepEcono	HVAC-RepEcono	HVAC-RepEcono	No Value
RUL ID	HVAC-airAC	HVAC-RepEcono	HVAC-RepEcono	No Value	No Value
NTGR	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA Com-Default>2yrs	No Value	No Value
DeliveryType	DnDeemedDI, DnDeemed	DirInstall PreRebDown	DirInstall, NonUpStrm PreRebDown	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	Def-GSIA, Com-AC-SCE	No Value	No Value
Electric Load Shape	*(use existing)*	PGE:DEER:Com:HVAC_Split-Package_AC	SCE:Large_Office:Economy_cycle-Ret SCE:College_University:Economy_cycle-Ret SCE:Small_Office:Economy_cycle-Ret SCE:Restaurant:Economy_cycle-Ret SCE:Large_Retail_Store:Economy_cycle-Ret SCE:Small_Retail_Store:Economy_cycle-Ret	SDGE:DEER:Com:HVAC_Split-Package_AC	No Value
Gas Load Shape	Annual	WinterOnly	Annual	WinterOnly	No Value
Sector	Com, Ag, Ind	Com	Com, Ag, Ind	No Value	No Value
PA/POU	Any				
BldgHVAC	cDXGF, cNCGF cDXHP, cPVVG	cDXGF, cNCGF cDXHP, cPVVG	Any	cDXGF	No Value
Use Category	HVAC	HVAC	HVAC	HVAC	No Value
SubUseCategory	SpaceCool	SpaceCool	HeatCool	SpaceCool	No Value
TechGroup	HV_AirDist	HV_AirDist	HV_AirDist	dxAC_equip	No Value
TechType	AirEcono	AirEcono	AirEcono	spltEER	No Value
Cost Adjustment Type	None	None	HVAC50	No value	No Value
EnImpCalcType	Standard	(blank)	Standard	Standard	No Value
MeasImpactType	Deem-WP	IOU-Deemed	Standard	Deemed	No Value
MeasQualifierGroup	None	Beginning in 2016	None	None	No Value

Measure Consensus – 5.15, Supply Fan Controls, Commercial

Low

CALIFORNIA TECHNICAL FORUM

- Offering
  - Implementation: AOE
  - Building Types: All commercial types
  - Climate zones: PG&E (CZ01-05, 11-13, 16);
    - SCE (CZ06, 08-10, 13-16); SDG&E (CZ06-08, 10, 14-15) -> All CZ
  - Norm Unit: Cap-Tons
- Stage 1 Issues
  - DEER2020 updates: *Peak Period*, Measure App Type, Delivery Type, *Vintage (developed with vintage prototypes)*
- Measure Extension
  - Add POUs
  - Add SDG&E, SCG

	2016		2017		2018	
PA	Sum of First Year Gross kWh	Sum of First Year Gross Therm	Sum of First Year Gross kWh	Sum of First Year Gross Therm	Sum of First Year Gross kWh	Sum of First Year Gross Therm
PGE	3,325,449	200,265	2,598,699	147,998	3,520,965	151,973
SCE	2,361,615	64,154	1,381,717	23,665	252,313	2,992
	5,687,064	**264,419**	**3,980,416**	**171,663**	**3,773,278**	**154,966**

- Stage 2 Issues
  - *Verify stand-alone programmable thermostat EUL*

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 - 5.15 Unoccupied Supply Fan Control

- Savings
  - 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 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)

Input Consensus – 5.15, Supply Fan Controls, Commercial

CALIFORNIA TECHNICAL FORUM

- 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	Asm,ECC,EPr,ERC,ESe,EUn,Gro,Hsp,Htl,MBT,MLI,Mtl,Nrs,OfL,OfS,OTR,RFF,RSD,Rt3,RtL,RtS,SCn,WRf	Asm,ECC,EPr,ERC,ESe,EUn,Gro,Htl,MBT,MLI,OfL,OfS,OTR,RFF,RSD,Rt3,RtL,RtS,SCn,WRf	No Value	No Value	No Value
BldgVintage	Ex	Ex	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,IOU	No Value	No Value	No Value
NormUnit	Cap-Tons	Cap-Tons	No Value	No Value	No Value
EUL ID	HVAC-RedcOverVent	HVAC-RedcOverVent	No Value	No Value	No Value
RUL ID	HVAC-airAC	HVAC-RedcOverVent	No Value	No Value	No Value
NTGR	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA	NonRes-sAll-mHVAC-RCA	No Value	No Value
DeliveryType	DirInstall, PreRebDown	DirInstall	DirInstall NonUpStrm PreRebDown	No Value	No Value
GSIA	Def-GSIA	Def-GSIA	Def-GSIA	No Value	No Value
Electric Load Shape	*(use existing)*	PGE:DEER:Com:HVAC_Split-Package_AC	No Value	No Value	No Value
Gas Load Shape	Annual	WinterOnly	No Value	No Value	No Value
Sector	Com	Com	Com	No Value	No Value
PA/POU	Any				
BldgHVAC	cDXGF cNCGF cDXHP cPVVG	cDXGF cNCGF cDXHP cPVVG	No Value	No Value	No Value
HOU					
IE Factor	FALSE	No value			
IETableName	None	(blank)			
Use Category	HVAC	HVAC	No Value	No Value	No Value
SubUseCategory	VentAirDist	VentAirDist	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	IOU-Deemed	No Value	No Value	No Value