

HVAC Category Subcommittee Meeting #1



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NOVEMBER 2017

Subcommittee Schedule

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	11-Sep	18-Sep	25-Sep	2-Oct	9-Oct	16-Oct	23-Oct	30-Oct	6-Nov	13-Nov	20-Nov	27-Nov	4-Dec	11-Dec	18-Dec	25-Dec	1-Jan	8-Jan	15-Jan	22-Jan	29-Jan	5-Feb	12-Feb	19-Feb	2017	2018
Cal TF Meeting			9/28				10/26			11/16				12/14						1/25				2/21-2/22		
Governance / TPP														2a												
Commercial Refrigeration			1																	2					20	0
Food Service			1				2a			2															15	0
Agriculture / Pumps							1																2		5	1
Lighting		TO	TC											1						2					11	42
HVAC														1									2		2	50
Water Heating														1									2		22	0
Appliance / Plug Load										1										2					10	12
Building Envelope																									0	4
Pools							1																2		1	5
Process																									0	7
Miscellaneous							1																2		2	4

Future HVAC Meetings will be held on Thursdays, but from 3 – 5 pm

HVAC 2017 Goals

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- Goals / Agenda

- Categorize the HVAC Issues

- ✦ What are they?
 - ✦ How do we organize to address them?

- Modelled measures will be challenging to validate.

- ✦ What should be the strategy for validation?
 - ✦ What does the Subcommittee believe should be part of a checklist for validation?

- Two test Measures for 2017:

- ✦ Ductless Mini-Split AC Units under 24 kBTU/hr
 - ✦ Ductless Mini-Split / Multi-Split AC / HP units under 65 kBTU/hr (*push to 2018*)

- Structure

- These questions will be sent out after the meeting (probably Friday) so that additional feedback can be collected

Categorize the HVAC Issues

What are they?

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- Modelling
 - Non-Res Prototype Models
 - Res Prototype Models
 - Model Calibration
 - DEER/DOE2.2 Questions
 - ✦ Performance curves for package unit and air-cooled chillers
 - ✦ Degradation factors
- Code / Specs
 - Requirement to meet both full- and part-load specs
 - ✦ Effect of 2016 Title 24 and Resolution E-4795
- CPUC Guidance
 - DEER 2017 Updates
 - Preponderance of Evidence (POE) for Early Retirement Offerings
 - Quality maintenance program dispositions
- Categorization
- **Question:** What else should be added?

Categorize the HVAC Issues

How do we organize to address them?

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- Measures in this category can be very diverse with respect to their technology, implementation, and issues
 - We will be handling topics that span
 - ✦ Modeling,
 - ✦ Code Requirements,
 - ✦ Quality Maintenance / Quality Installation (QM/QI),
 - ✦ Dispositions,
 - ✦ Preponderance of Evidence (POE), and
 - ✦ More
- **Question:** Should we sub-divide this Subcommittee to address these issues?

Modelled measures will be challenging to validate

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- **Question:** What should be the strategy for validation?
 - ❑ Short-term / Long-term
- **Question:** What does the Subcommittee believe should be part of a checklist for validation (*so that this Team can sign-off on a Measure*)?
- Consider:
 - ❑ Performance of equipment
 - ❑ Hours of Operation
 - ❑ How controlled / how used
 - ❑ Calibration with measured data

HVAC Measures for 2017

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Two Example Measures:

- Ductless Mini-Split AC Units under 24 kBTU/hr
- Ductless Mini-Split / Multi-Split AC / HP units under 65 kBTU/hr



Images are examples only; not product recommendation.

- Offering

- ❑ Units less than 24 kBTU/hr cooling (2 tons)
- ❑ Base case: SEER 14 -> Measure case: SEER 16 or SEER 19
- ❑ Upstream incentive to distributors, ROB/NR
- ❑ Only SCE - commercial only

- Stage 1 Issues

- ❑ Res/Com split air-conditioners have additional EER code requirements above and below 45 kBTU/hr – [What are these?](#)
- ❑ [Why no NEW – only ROB/NR?](#)
- ❑ Costs – base and labor from WO017; measure costs from www.nextag.com
- ❑ Scaling factor from SEER 18 to SEER 19 uses average of select CZs

- Measure Extension

- ❑ Added POU TRM measure
- ❑ Added Measure for PG&E and SDG&E

- Stage 2 Issues

- ❑ *Energy savings scaled for SEER 18 split systems (DEER 2015 – update)*
- ❑ *Ratio applied to Commercial (CPUC disposition)*
- ❑ *Savings do not include duct loss savings*

Measure Consensus

5.53 – Ductless Mini/Multi-Split AC /HP

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● Offering

Sector	Capacity	Type	Base Case	Measure Case
Commercial	<55 kBTU/hr	Mini-Split HP	SEER 14	SEER 16/19/22
		Multi-Split HP	SEER 14	SEER 16/19
	55-65 kBTU/hr	Mini-Split HP	SEER 14	SEER 16/19/22
		Multi-Split HP	SEER 14	SEER 16/19
Residential	<45 kBTU/hr	Mini-Split AC	SEER 14	SEER <17/<20/24
		Multi-Split AC	SEER 14	SEER <17/20
	45-65 kBTU/hr	Mini-Split AC	SEER 14	SEER <17/<20/24
		Multi-Split AC	SEER 14	SEER <17/20
	<65 kBTU/hr	Mini-Split HP	SEER 14	SEER <17/<20/24
		Multi-Split HP	SEER 14	SEER <17/20

- ❑ AC units require separate heating equipment unconnected to AC units
- ❑ Like for like – HPs to HPs. AC to AC.
- ❑ Upstream incentive to distributors Commercial; Downstream rebate to residential, ROB/NR.
- ❑ Only SCE reviewed.

● Stage 1 Issues

- ❑ Res/Com split air-conditioners have additional EER code requirements above and below 45 kBTU/hr – **What are these?**
- ❑ **Why no NEW – only ROB/NR?**
- ❑ Costs – base and labor from WO017 Ex Ante Measure Cost Study; measure costs from manufacturers and online retailers – labor costs same as 5.28 – measure costs and base costs somewhat higher
- ❑ Scaling factor derivation not clear

● Measure Extension

- ❑ Measure not yet approved

● Stage 2 Issues

- ❑ *Energy savings scaled for SEER 18 split systems*
 - ✦ *DEER 2015 – update*
- ❑ *Ratio applied to Commercial*
 - ✦ *2015 CPUC Prelim. Review – intended as temporary solution only*
- ❑ *Savings do not include duct loss savings*
 - ✦ *2015 CPUC Prelim. Review – recommends DOE2 – Energy Plus as split system savings are not ductless savings*

Questions

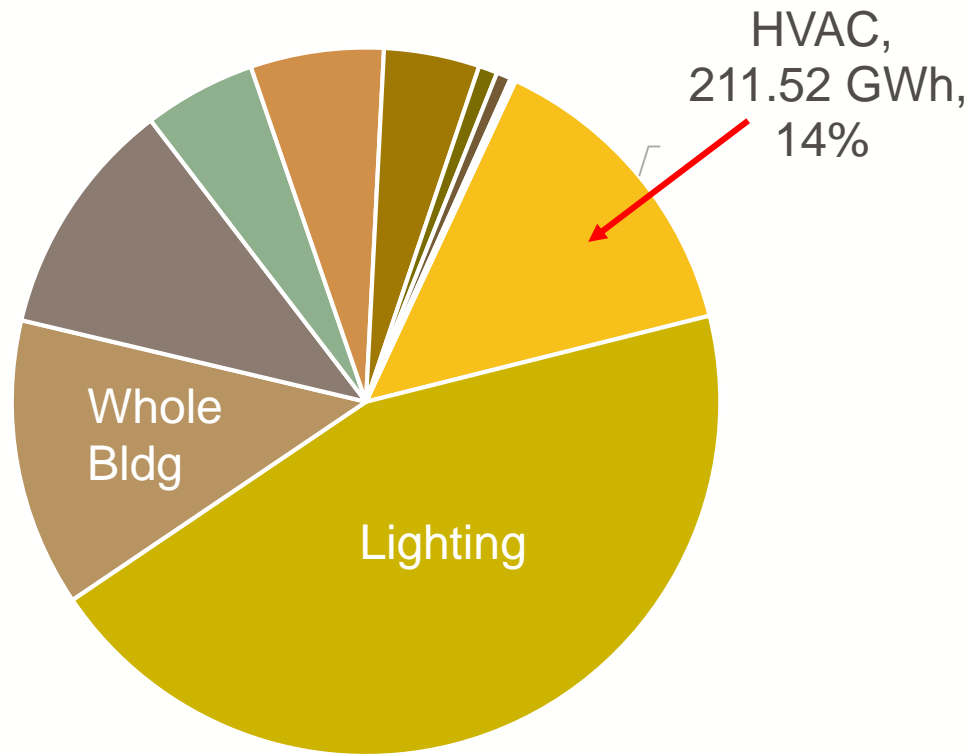
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2016: HVAC Savings Perspective

Portfolio Savings (deemed & custom)

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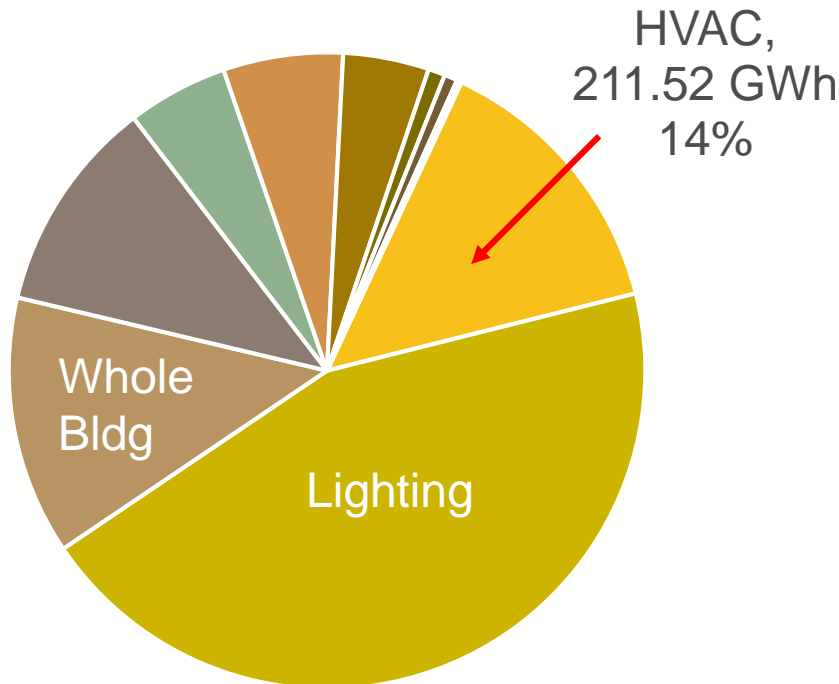
2016 - EESat Data
Total: 1,494.88 GWh



2016: HVAC Savings Perspective

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2016 - EESat Data
Total: 1,494.88 GWh



Note: Sorted by “GWh”, many categories removed to save room.

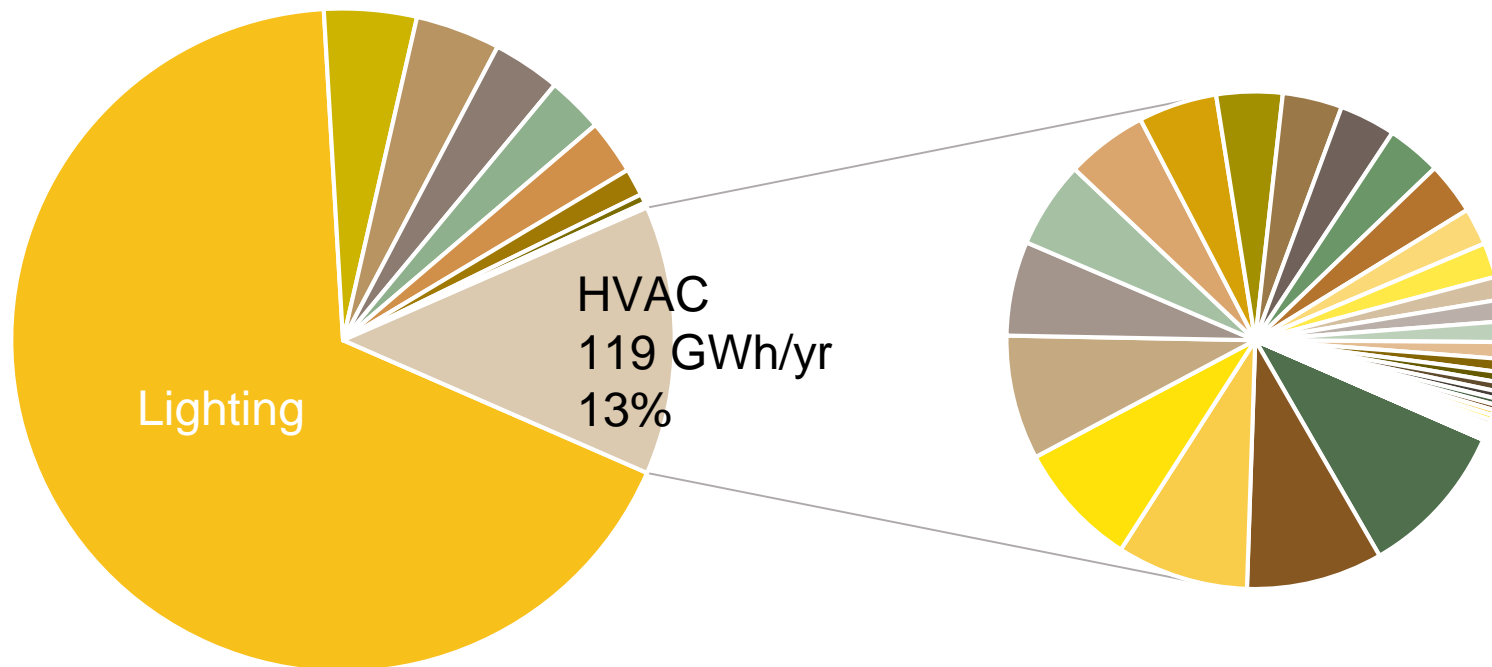
HVAC

	GWh	MW	MMTh
Retrocommissioning HVAC	27.261	2.504	0.834
HVAC Chiller Water Cooled	20.430	3.763	(0.000)
HVAC Pump VFD	15.319	2.006	(0.000)
HVAC Fan VFD	14.892	2.643	(0.004)
HVAC Rooftop Or Split System	14.591	7.580	0.179
HVAC EConomizer Water Side	12.418	0.539	(0.004)
HVAC Controls PTAC	10.626	3.531	-
HVAC Controls Fan	9.429	1.518	0.001
HVAC VRF/Mini Split	6.915	2.217	0.086
HVAC Motor Replacement	6.881	5.026	(0.069)
HVAC Chiller Air Cooled	5.379	0.676	-
HVAC Controls Time Delay Relay	5.096	3.693	-
HVAC Pump Replacement	5.051	1.209	-
HVAC RCA	4.508	3.673	(0.000)
HVAC Controls Other	3.867	(0.016)	0.655
HVAC Cooling Tower	3.756	0.387	0.007
HVAC Maintenance	3.756	3.794	-
HVAC Controls EMS	3.742	0.708	0.007
HVAC Controls Reset	3.371	0.264	0.000
HVAC Coil Cleaning	3.180	2.089	(0.073)
Retrocommissioning Process	2.236	0.341	-
HVAC VAV Conversion	2.099	0.140	0.252
HVAC Ventilation Other	2.051	0.164	0.001
HVAC EConomizer Addition	1.913	(0.008)	0.129
HVAC DCV	1.807	1.004	0.031
HVAC Other VFD	1.803	0.315	0.231
HVAC Duct Sealing	1.770	1.435	0.130
HVAC Controls Thermostat	1.722	(0.030)	0.224
HVAC Total	211.522	56.879	3.480

HVAC Deemed Electric Savings Perspective

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2016 CA Deemed Electric Savings (Total = 912 GWh/yr; Extracted from claims data)



Note that HVAC electric savings are distributed far more evenly amongst Measures than other categories.

2016: Deemed Electric HVAC Savings

(17 of 46 measures = >90% of savings)

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Ref No	Name	PGE	SCE	SCG	SDGE	Total kWh/yr
5.10	Residential HVAC Quality Maintenance and Motor Retrofit	7,586,601	4,086,613		369,008	12,042,221
5.45	Guest Room PTAC/PTHP Energy Management System	10,379,730			161,884	10,541,614
5.15	Unoccupied Supply Fan Control	3,325,447	6,849,605			10,175,052
5.14	VFD Retrofit to Central Plant Systems		9,496,731		180,560	9,677,291
5.05	Water-Cooled Chillers		9,612,875			9,612,875
5.13	Efficient Fan Controller for Residential Air Conditioners	5,096,009	1,833,891		366,453	7,296,353
5.22	Variable Refrig Flow Com HPs & Heat Recovery Systems >65kBtu/h	3,387,144	3,320,793			6,707,937
5.24	Unitary Air-Cooled Com AC & Heat Pumps >=65 kBtu/h	634,331	5,463,573		204,069	6,301,973
5.30	Refrigerant Charge	489,305	3,266,835		2,325,289	6,081,430
5.49	Enhanced Vent for Pckg HVAC Units with Gas Heating and Pckg HP	263,570	4,848,764			5,112,333
5.02	Economizer Repair	842,767	3,705,324		58,123	4,606,214
5.25	Unitary Air Cooled Com AC & Heat Pump Units Under 65 kBtuh	1,089,519	2,714,398		534,789	4,338,705
5.39	Air-Cooled Packaged Chiller	849,914	3,361,259			4,211,173
5.41	Variable Speed Drive on HVAC Fan Control	3,516,710	517,596			4,034,306
5.01	Economizer Controls	449,917	2,264,086		163,410	2,877,414
5.32	Commercial Condenser Coil Cleaning		464,422		2,205,882	2,670,304
5.52	Duct Leakage	353,879		1,411,772	2,645	1,768,296

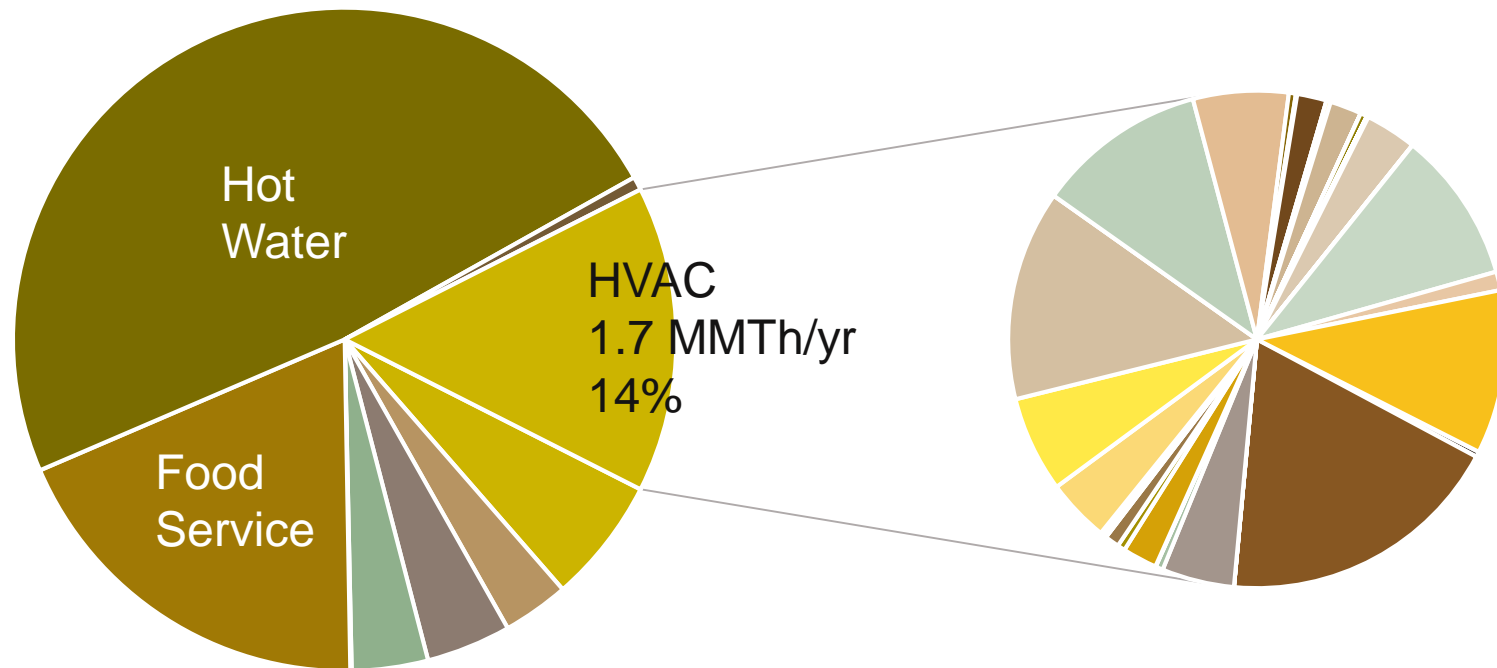
Note: Sorted by “kWh”.

- 29 other categories to compose the remaining 10% of savings.
-  = Potential opportunity for savings.

HVAC Deemed Gas Savings Perspective

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2016 CA Deemed Gas Savings (Total = 12 MMTh/yr)



2016: Deemed Gas HVAC Savings

(9 of 46 measures = >90% of savings)

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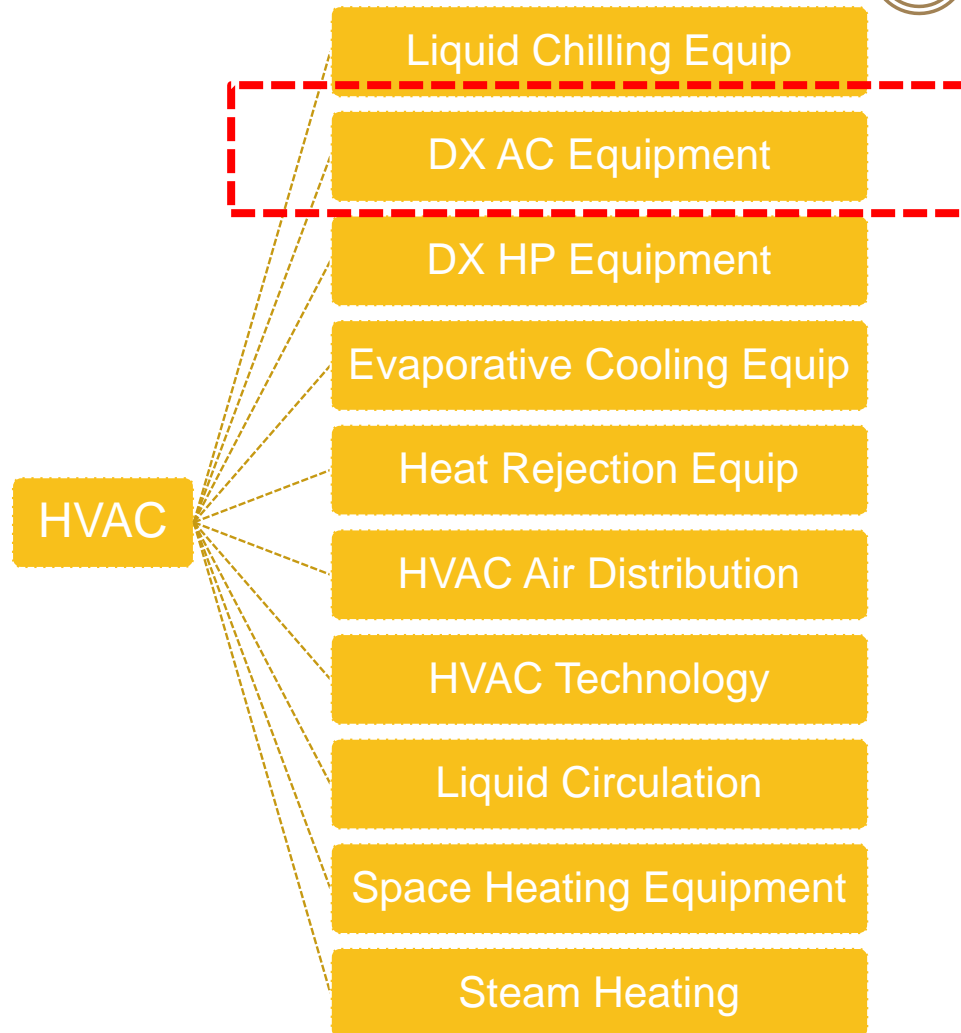
Ref No	Name	PGE	SCE	SCG	SDGE	Total th/yr
5.15	Unoccupied Supply Fan Control	200,265	139,992			340,257
5.53	DEER Other				249,357	249,357
5.46	Programmable Communicating Thermostat for Demand Response	83,857			117,818	201,675
5.03	Space Heating Boilers	110,086		80,290	3,804	194,180
5.43	Multifamily Domestic Hot Water Temperature Reset Controller			179,708		179,708
5.52	Duct Leakage	20,844		92,451	383	113,678
5.06	Demand Controlled Ventilation for Single Zone Packaged HVAC	27,270	85,830			113,100
5.22	Variable Refrig Flow Com HPs & Heat Recovery Systems >65kBtu/h	85,901	0			85,901
5.18	High Efficiency Furnaces - Residential			24,722	36,359	61,081
5.49	Enhanced Vent for Pckg HVAC Units with Gas Heating and Pckg HP	14,996	26,008			41,004
5.09	Res DuctTestSeal	30,573			6,947	37,520
5.47	Smart Thermostat			22,056		22,056
5.02	Economizer Repair	0	10,226		(1,113)	9,113
5.11	Quality Installation for Residential Split Systems		5,976		2,316	8,292
5.40	Upstream Residential HVAC	7,949				7,949
5.10	Residential HVAC Quality Maintenance and Motor Retrofit	(66,114)	75,762		(3,144)	6,504
5.21	Classroom HVAC Occupancy Sensor		5,159			5,159

Note: Sorted by “therms”.

- 13 HVAC measures have negative gas savings.
- = Potential opportunity for savings

Technology Group

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- Removed “Water Heating Equipment”
- “HVAC Technology” should be defined further
- Are we missing anything?
 - Retrocommissioning
 - Behavioral

Tech Group -> Tech Type (Existing Categories)

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TechGroupDesc	TechTypeDesc
Liquid Chilling Equipment	Centrifugal Water Chiller
	Gas Absorption Chiller
	Frictionless Centrifugal Water Chiller
	Frictionless Centrifugal Water Chilling Compressor
	Reciprocating Water Chiller
	Reciprocating Water Chilling Compressor
	Refrigerated Warehouse Cooling System
	★ Screw Water Chiller
	Scroll Water Chiller
	Tank Insulation
dX AC Equipment	★ EER Rated Package Rooftop AC
	★ EER Rated Split System AC
	EER Rated Vertical Self-Contained AC
	★ Package Terminal AC
	★ Room AC
	★ SEER Rated Package Rooftop AC
	★ SEER Rated Split System AC
Evaporative Cooling Equipment	★ Split or Packaged DX AC Refrigerant System
	Commercial Evaporative Cooler
	★ Residential Evaporative Cooler

**Primarily
Commercial**

**Primarily
Residential**

Tech Group -> Tech Type (Existing Categories)

(20)

TechGroupDesc	TechTypeDesc
dx HP Equipment	EER Rated Package Rooftop HP
	EER Rated Split System HP
	Package Terminal Heat Pump
	★ SEER Rated Package Rooftop HP
	★ SEER Rated Split System HP
	Variable Refrigerant Heat Pump
	Variable Refrigerant Heat Recovery
	Water Source Heat Pump
HVAC Air Distribution	★ Air Economizer
	Duct System Insulation - Commercial
	Duct System Insulation - Residential
	Duct System Integrity - Commercial
	★ Duct System Integrity - Residential
	Flow Control
	Heat Recovery
	HVAC Exhaust Fan - General Purpose Motor
	HVAC Return Fan - General Purpose Motor
	★ HVAC Supply Fan - General Purpose Motor
	★ HVAC Ventilation Fan - General Purpose Motor

Tech Group -> Tech Type (Existing Categories)

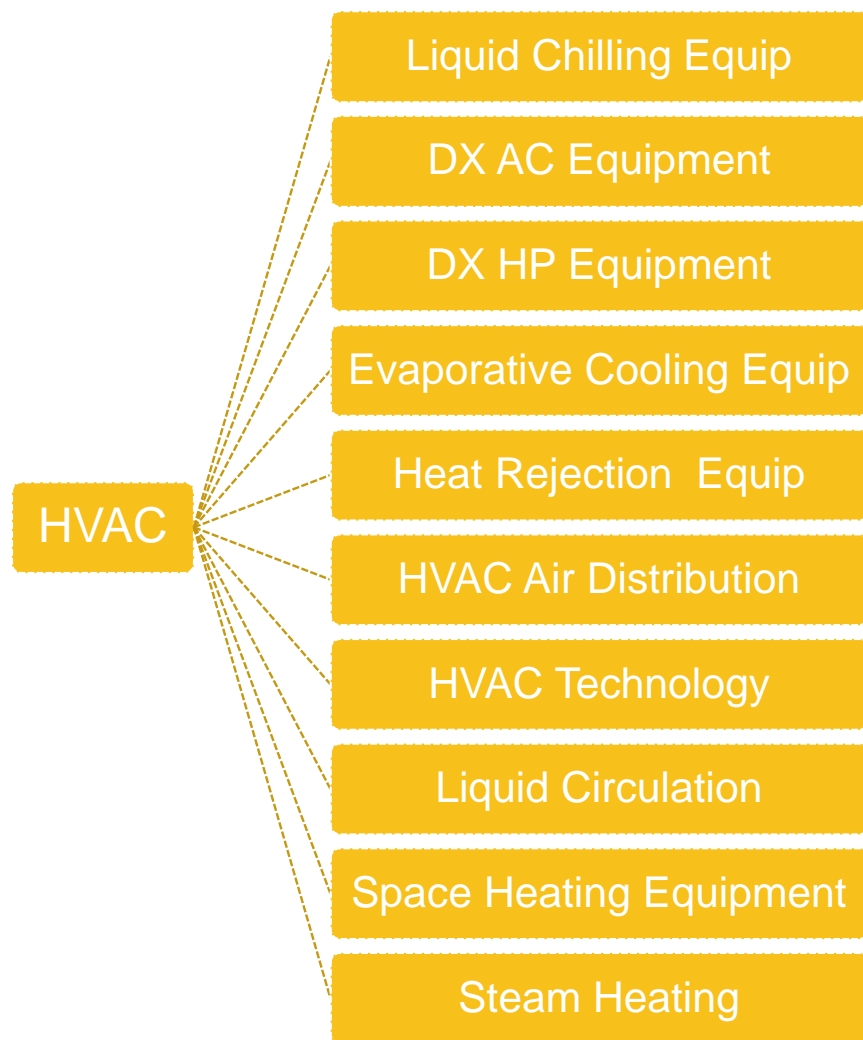
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TechGroupDesc	TechTypeDesc
Heat Exchanger	Plate Cooler
Heat Rejection Equipment	Cooling Tower Fan - General Purpose Motor
	★ Cooling Tower Fan Control
	Water Side Economizer
HVAC Technology	★ Carbon Dioxide Sensor
	D5 Thermostat
	EMS
	★ Thermostat
	Time Clock
	Whole House Fan
Liquid Circulation	Circulating Block Heater
	Flow Controls
	Flow Plus Temperature Controls
	Pipe Insulation
	Pump - General Purpose Motor
	★ Temperature Reset Control
	Time Clock
Space Heating Equipment	★ Gas Furnace
Steam Heating Equipment	★ AFUE Rated Boiler
	★ Et Rated Boiler

Should there be
additional categories in
this Tech Group?

Technology Group

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- Are we missing anything?
 - Retrocommissioning
 - Behavioral