

HVAC Technology Summary



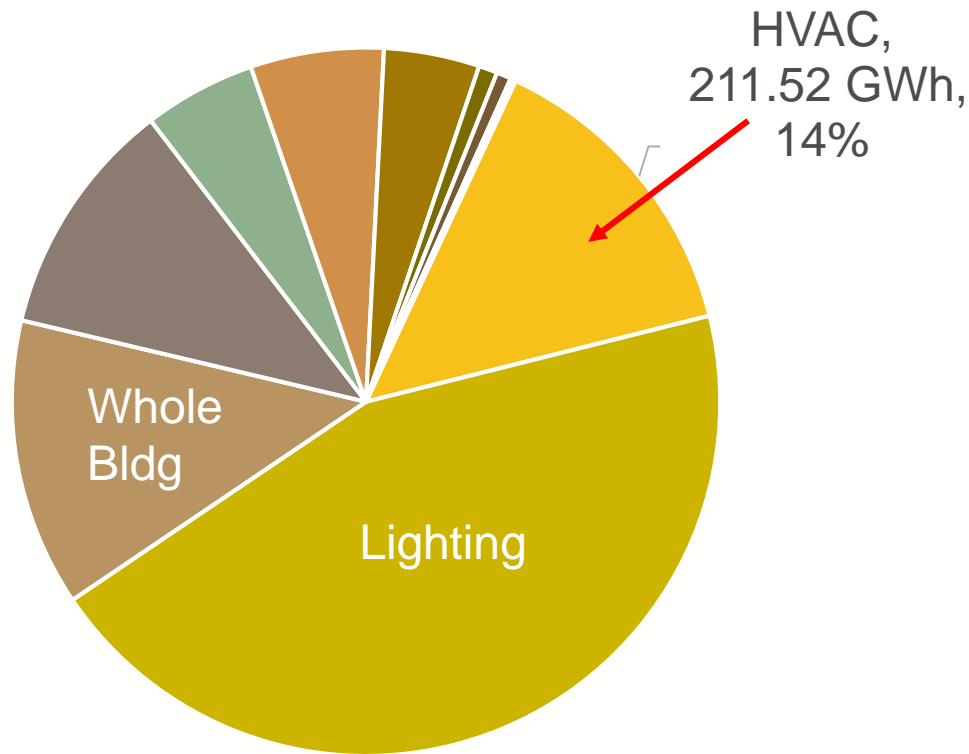
AYAD AL-SHAIKH
JUNE 2017

2016: HVAC Savings Perspective

Portfolio Savings (deemed & custom)

2

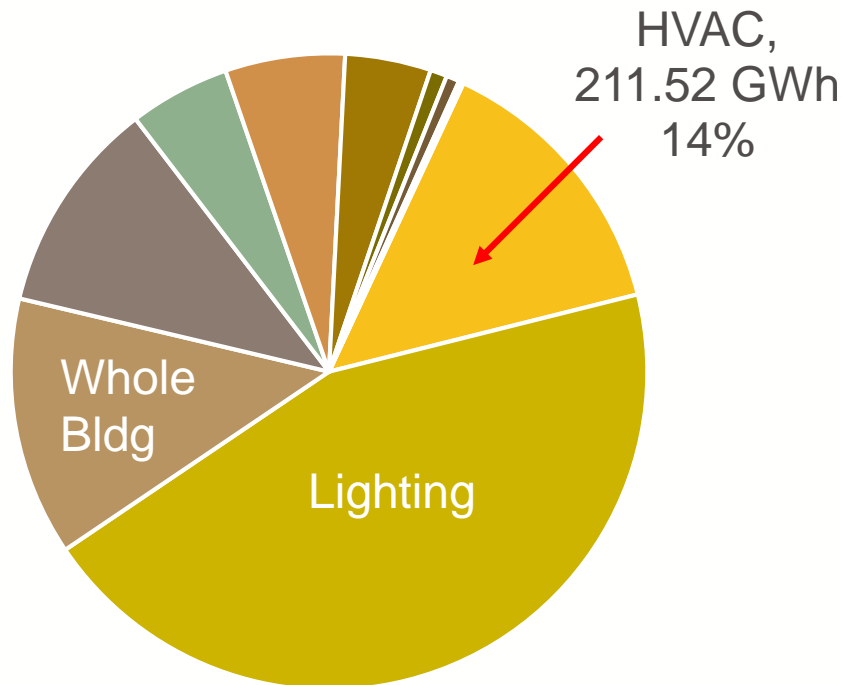
2016 - EESat Data
Total: 1,494.88 GWh



2016: HVAC Savings Perspective

3

2016 - EESat Data
Total: 1,494.88 GWh



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

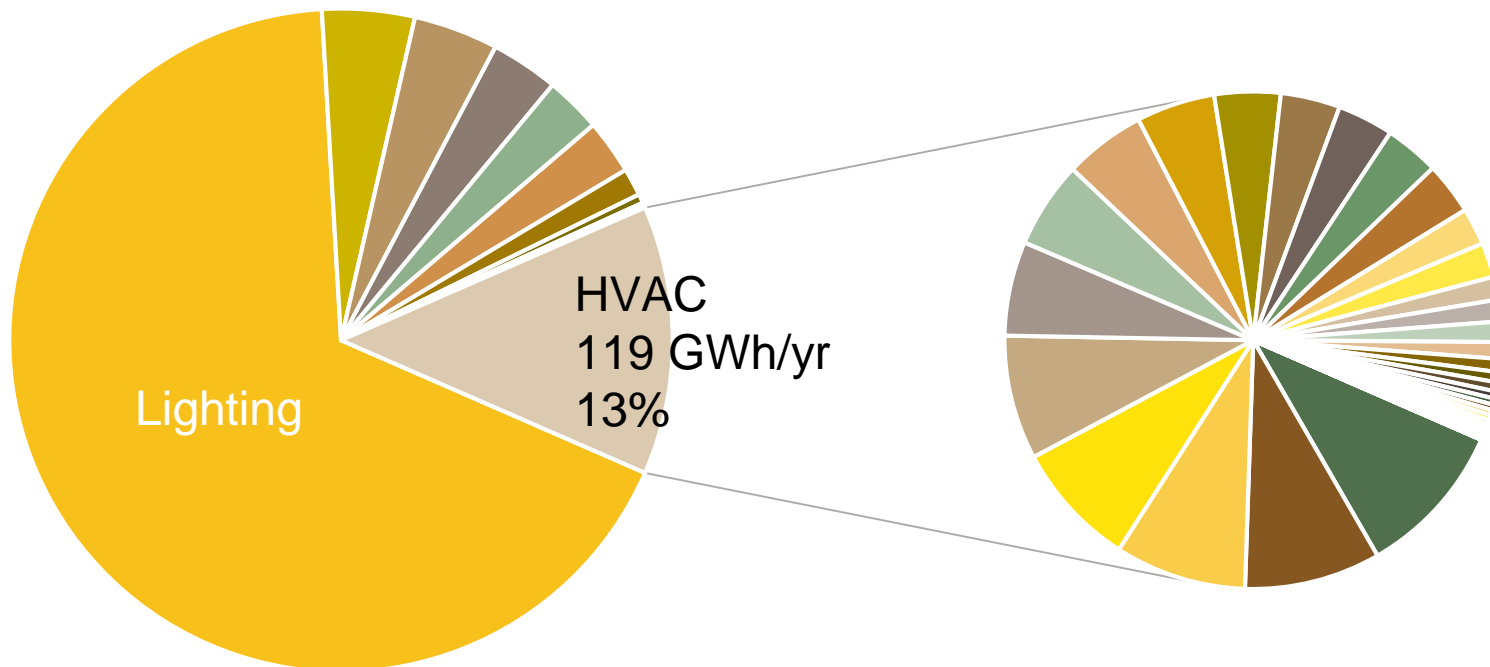
HVAC

	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

4

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)

5

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 kBtu/h	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

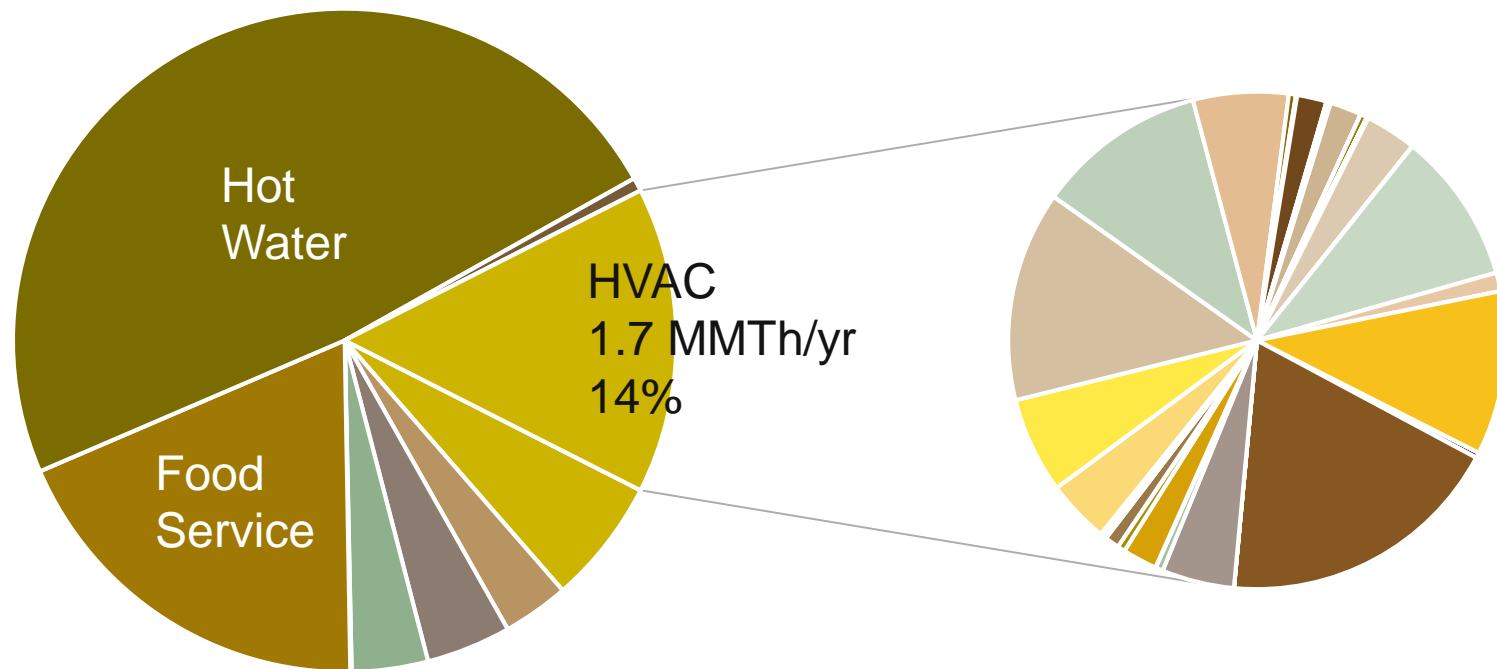
Note: Sorted by “kWh”.

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

HVAC Deemed Gas Savings Perspective

6

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




2016: Deemed Gas HVAC Savings

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

7

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

HVAC Measures for 2017

8

HVAC Measures for 2017

- 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.

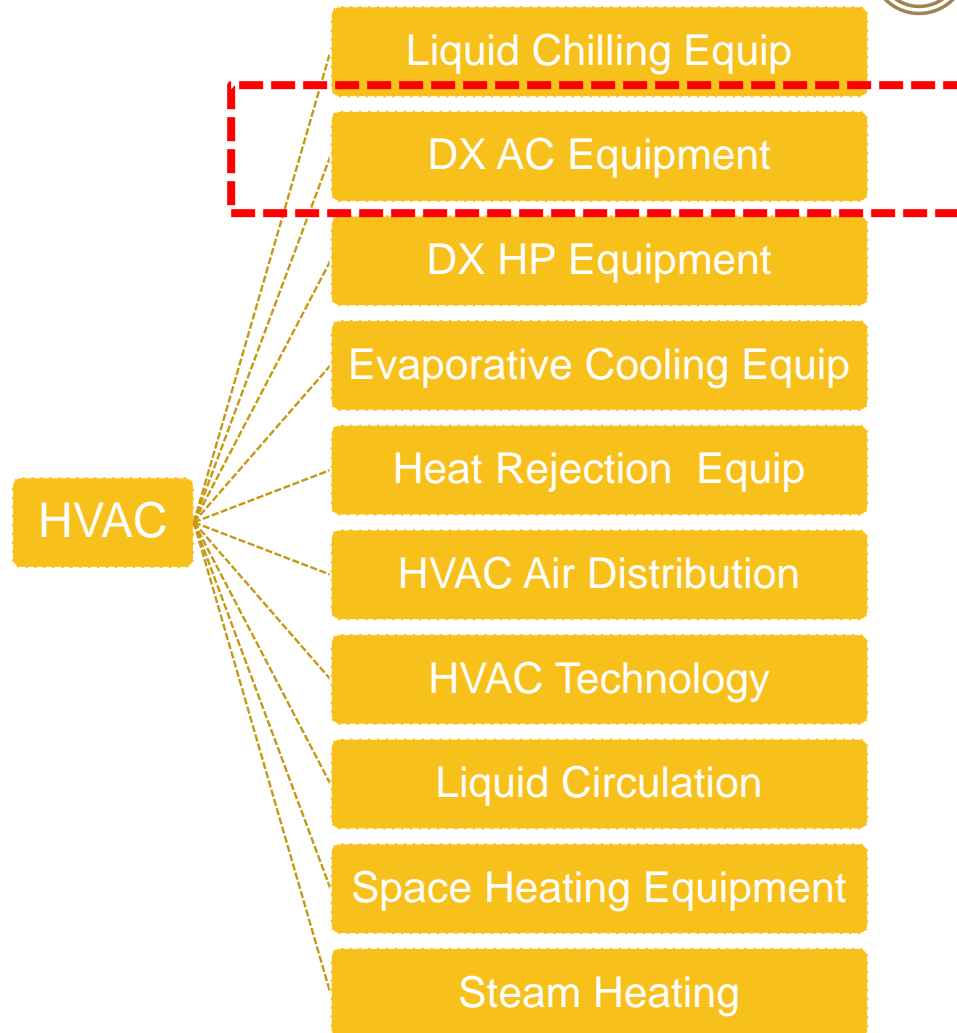
HVAC – Cross Cutting Issues

9

- Non-Res Prototype Models
- Res Prototype Models
- DEER/DOE2.2 Questions
 - ❑ Performance curves for package unit and air-cooled chillers
 - ❑ Degradation factors
- Requirement to meet both full- and part-load specs
 - ❑ Effect of 2016 Title 24 and Resolution E-4795
- POE for Early Retirement Offerings
- Quality maintenance program dispositions
- Categorization
 - ❑ Goal: Introduce you to what is used today... *Get feedback!*

Technology Group

10



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

Tech Group -> Tech Type (Existing Categories)

11

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 ★ Split or Packaged DX AC Refrigerant System
Evaporative Cooling Equipment	Commercial Evaporative Cooler ★ Residential Evaporative Cooler

**Primarily
Commercial**

**Primarily
Residential**

Tech Group -> Tech Type (Existing Categories)

12

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)

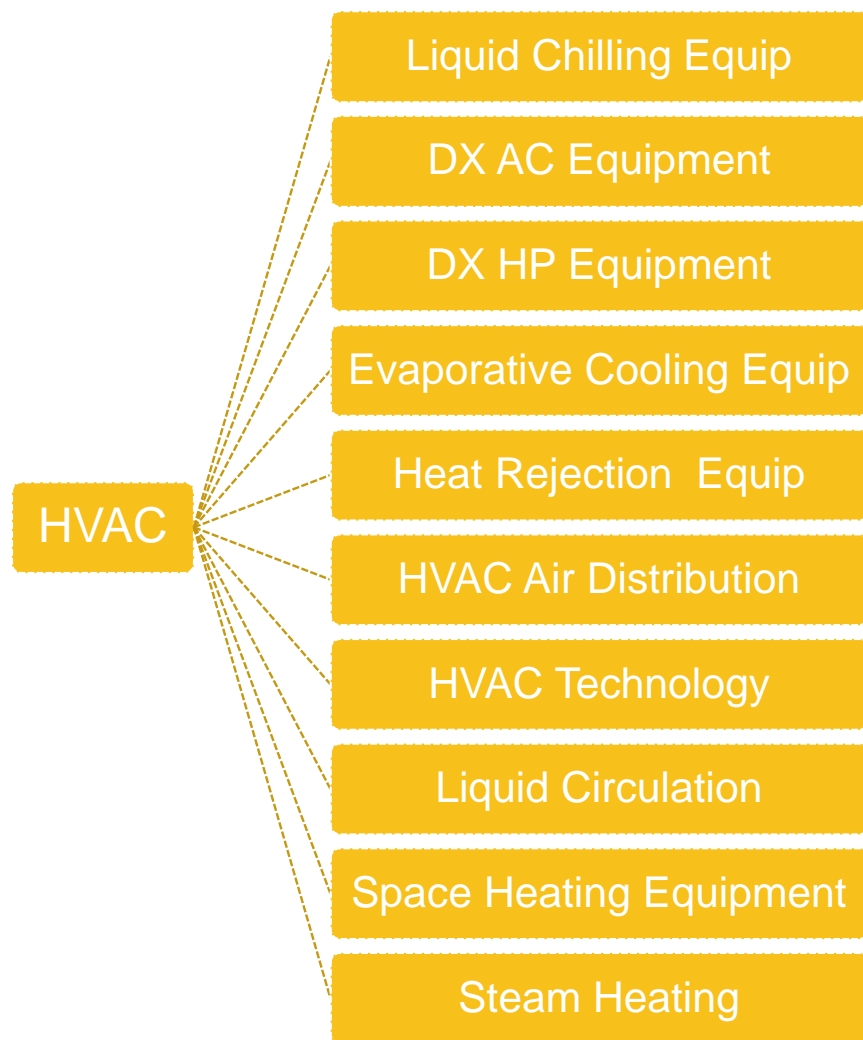
13

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

14



- Are we missing anything?
 - Retrocommissioning
 - Behavioral

Questions

15