

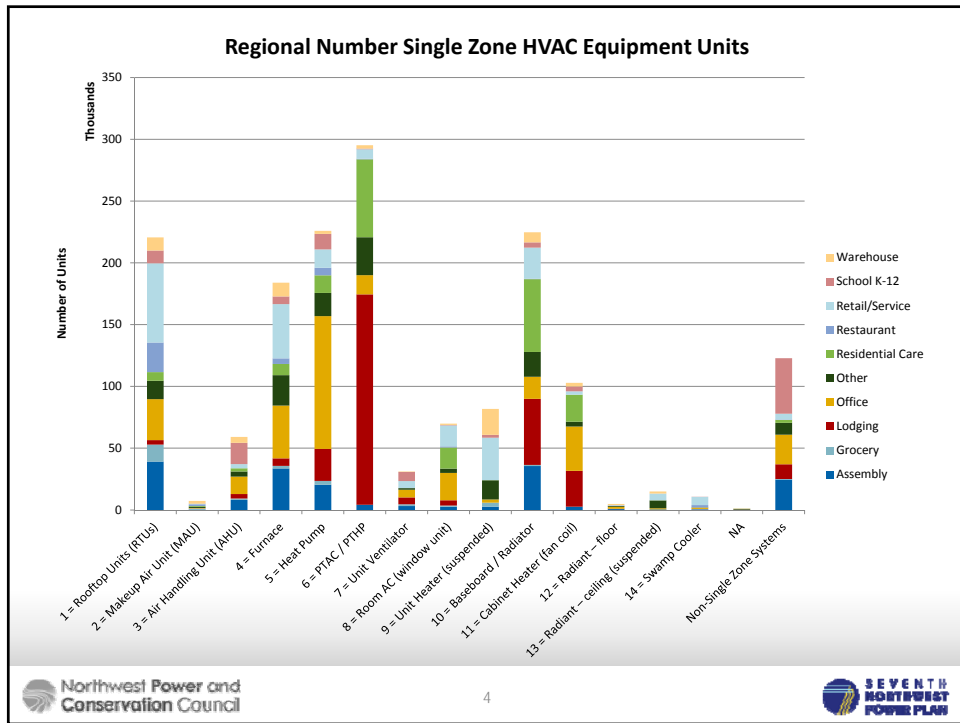
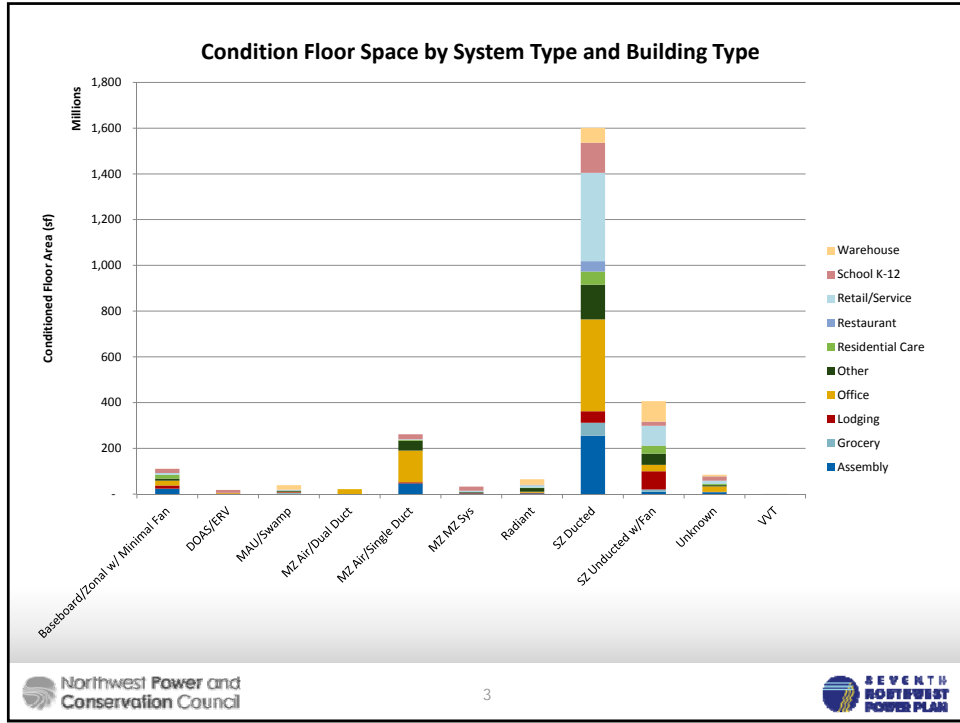


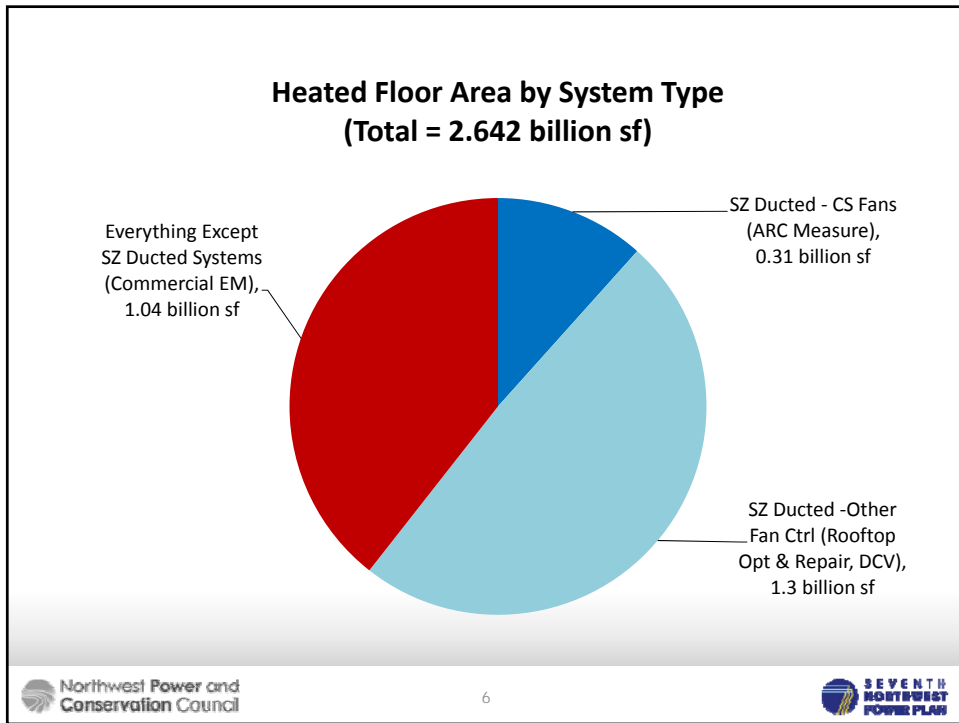
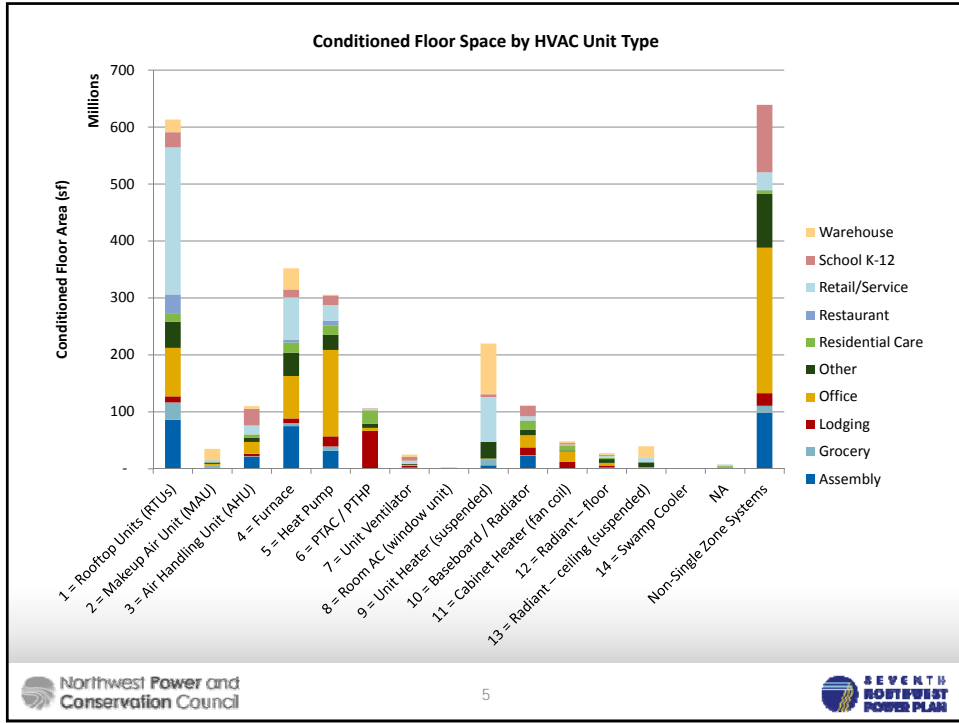
Commercial HVAC and Other Measures for 7P

Conservation Resource Advisory Committee
January 28, 2014

Outline

- **Commercial HVAC data from CBSA**
- **Overview of Commercial HVAC Measures**
- **A few other Commercial Measures**
 - **Variable Refrigerant Flow**
 - **Compressed Air**
 - **Smart Plug Power Strips**
 - **Packaged Refrigeration Equipment**





HVAC Measure Applicability (big picture)

HVAC System	Equipment	Conditioned Floor Area (Million SF)*	Measures
SZ, Ducted Const. Speed Fan	RTU, HP	300	ARC
All except Single Zone	Multiple	1,000	Com-EM
SZ, Other Fan Modes	RTU	1,300	Rooftop Optimization, DCV
VAV	Multiple	260	ECM-VAV, Com-EM
Chilled Water	Chiller	430	Chiller Retrofits

*Excludes hospitals and universities

HVAC Measures

Measure	Comments	6P Pot.	Prelim. 7P Achievable Potential	Cost (\$/MWh)
Advanced Rooftop Controller (ARC)	New in 7P	0	129	\$19 - \$73/MWh
Variable Refrigerant Flow (VRF)	New in 7P – currently limited to New Construction. Need to add some retrofit.	0	<i>120</i>	<i>\$30- \$67/MWh</i>
Commercial Energy Management	Revised from 6P Commissioning & Controls. High achievements since 6P	130	62 retro 21 new	\$15 - \$113/ MWh
Demand Control Ventilation (multiple)	Std Buildings, Parking Garage, Fume Hood, Kitchen Ventilation	50	30+	\$44/MWh
Premium HVAC Equipment	6P Potential now covered by standards	33	0 (did not complete)	\$900/ MWh

Gray, Italic text represent values under development and will likely change

HVAC Measures (cont.)

Measure	Comments	6P Potential	Prelim 7P Achievable Potential	Cost (\$/MWh)
ECM on VAV Boxes	Update of 6P Measure	11	TBD	\$25 - \$34/MWh
Windows/Glass	7P Measure is Interior Secondary Glazing System	31	15-26 aMW	\$70-\$300/MWh
Low Pressure Distribution	6P Measure, not much uptake	5	~5	\$100/MWh
Packaged Rooftop Optimization and Repair	Working out overlap with other measures	26	TBD	\$10 - \$50/MWh

Other Com HVAC Measures

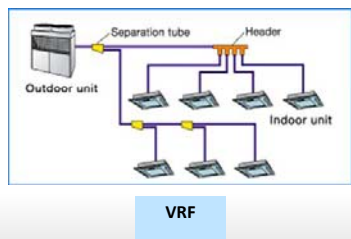
- **Other Commercial HVAC measures that are likely to be left out:**
 - Variable Speed Chiller (13 aMW in 6P)
 - Chiller retrofits
 - Circ Pump ECM and drive
 - School weatherization – RTF measure
- **Energy Recovery Ventilation**
 - High cost
- **Roof Insulation – 6P 25 aMW**
 - propose to remove per CBSA data
- **Evaporator Roof Top HVAC**
 - Custom product, high SEER, applicable in hot dry climates, limited product availability

Maybe in

Likely out

What is VRF?

- Variable Refrigerant Flow (VRF) Systems
 - One outdoor unit connects to multiple indoor units through refrigerant lines
 - VRF systems can adjust heating and cooling outputs by adjusting the refrigerant flow and variable speed compressor
- Separate ventilation system (e.g., DOAS)
- Energy savings from:
 - Part load efficiency
 - Eliminated duct losses
 - Reduced simultaneous heating/cooling
 - Better ventilation control
 - Heat recovery
 - Optimized building design (new construction)



Variable Refrigerant Flow

Preliminary values

Parameter	Sixth Plan	Seventh Plan (draft)
Average Savings at busbar	NOT IN SIXTH PLAN. New Measure	1.0 – 5.4 kWh/sf
Levelized Cost (\$/MWh)		\$30-\$67/MWh
Baseline EE Saturation		5%
Number of Units (20 years)		284 Million SF (Currently limited applicability)
Achievable Technical Potential (aMW over 20 years)		120 aMW

Air Compressor

- New measure for commercial in 7P
 - Projects are happening (6 going on 7)
 - Included in Industrial measure in 6P
- Three measures
 - Air Compressor- Demand Reduction
 - Air compressor pressure and flow reduction,
 - General O&M practices like changing filters, dryers regularly
 - Air Compressor- VFD and Controls
 - Add VFD, controls to optimize operation to load
 - Air Compressor – Equipment Upgrade
 - Retrofit equipment on air compressor such as new header/
install a new compressor

Air Compressor Data from CBSA

CBSA Data Extract			
Row Labels	Floor Area of Building Types with Air Compressors (SF)	Number of Air Compressors	Total Air Compressor Horsepower (HP)
Assembly	18,398,803	131	3,777
Grocery	9,392,605	639	2,122
Lodging	10,343,772	104	520
Office	18,986,710	2,264	14,519
Other	40,410,753	2,689	21,323
Residential Care	1,976,589	52	68
Food Service	1,677,027	341	341
Retail	128,451,712	8,695	108,395
School	9,191,740	55	808
Warehouse	144,161,759	3,530	90,228
Grand Total	382,991,470	18,500	242,101

Air Compressors

Parameter	Sixth Plan	Seventh Plan (draft)
Average Savings at busbar	NOT IN SIXTH PLAN for Com Sector	30 – 112 kWh/HP
Levelized Cost (\$/MWh)		\$7 - \$50/MWh
Baseline EE Saturation		10 - 45%
Number of Units (20 years)		18,500 Air Compressors 242,000 HP (+ growth, minus saturation)
Achievable Technical Potential (aMW over 20 years)		4 aMW

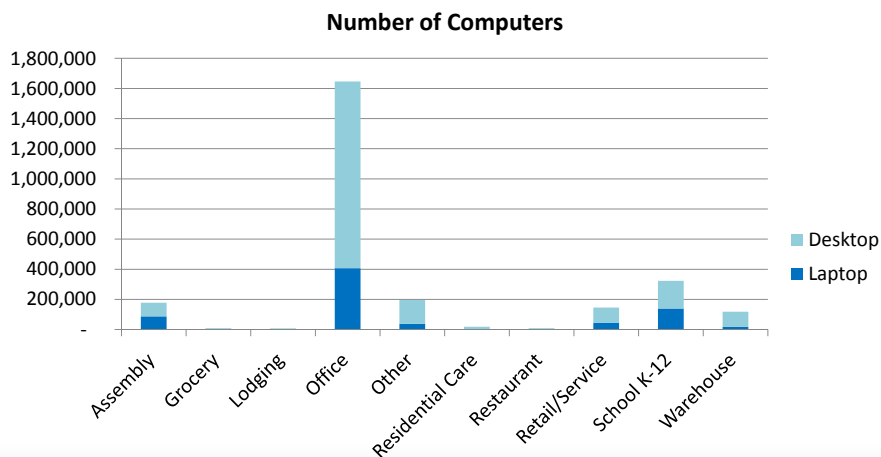
Smart Plug Power Strips

- Measure data from RTF
- Number of units based on office spaces, based on the number of computers from CBSA
 - Assume 1 computer ~ 1 office “space”
 - Include both desktops and laptops
- RTF Savings
 - Does not include computers
 - Covers other office space uses
- Saturation and applicability
 - Assume 10% saturation
 - Assume 90% applicability
- Achievability
 - Standard 85%

Smart Plug Power Strips

Parameter	Sixth Plan	Seventh Plan (draft)
Average Savings at busbar (kWh per Power Strip)	NOT IN SIXTH PLAN. New Measure	109
Levelized Cost (\$/MWh)		15
Baseline EE Saturation		10%
Number of Units (20 years)	This number will increase: new data anticipated	2.7 Million
Achievable Technical Potential (aMW over 20 years)		26

No. of Computers by B. Type



CBSA initial estimates for non-office computers is low. These are being revised with other sources.

Packaged Refrigeration Equipment

- Includes glass and solid door refrigerators and freezers
- DOE published a final rule regarding energy conservation standards for commercial refrigeration equipment. [79 FR 17725](#) (March 28, 2014)
 - The DOE analysis considers performance and cost of 25 different classes of refrigerators and freezers
- This analysis determined - for each class - which DOE Efficiency Level the Standards were ultimately set to and determines the incremental savings, incremental cost, and applicable portion of the market for each Efficiency Level more efficient than the Standards

Packaged Refrigeration Equipment

Parameter	Sixth Plan	Seventh Plan (draft)
Average Savings at busbar (kWh)	200 – 1500, depending on type	1 – 40, depending on measure
Levelized Cost (\$/MWh)	25	\$97 - \$3,000
Baseline EE Saturation	5%	TBD
Number of Units (20 years)	52,000	TBD
Achievable Technical Potential (aMW over 20 years)	49	TBD

Packaged Refrigeration Measure Data - FYI

Packaged Refrigeration Measure	Savings (kwh/yr)	Life (yrs)	Capital Cost	Annual O&M	Levelized Cost (\$/MWh)
SelfContCondense_LowTemp_Federal Standard to Tier 1	0.3	9.7	0.1	0.01	97.4
SelfContCondense_LowTemp_Tier 1 to Tier 2	1.0	9.7	0.6	0.03	113.5
RemoteCondense_MedTemp_Tier 1 to Tier 2	29.2	9.7	31.1	1.47	202.7
RemoteCondense_MedTemp_Federal Standard to Tier 1	23.4	9.7	25.7	1.29	213.6
SelfContCondense_LowTemp_Tier 2 to Tier 3	2.4	9.7	4.9	0.24	408.7
SelfContCondense_IceCream_Federal Standard to Tier 1	36.5	9.7	116.5	5.68	630.7
SelfContCondense_MedTemp_Tier 1 to Tier 2	5.7	9.7	21.9	0.91	732.2
SelfContCondense_LowTemp_Tier 3 to Tier 4	1.0	9.7	4.2	0.19	806.2
SelfContCondense_MedTemp_Tier 2 to Tier 3	1.2	9.7	7.8	0.30	1,241.7
RemoteCondense_LowTemp_Tier 2 to Tier 3	0.0	9.7	0.0	0.00	1,320.3
RemoteCondense_LowTemp_Tier 3 to Tier 4	0.0	9.7	0.0	0.00	1,320.3
SelfContCondense_IceCream_Tier 2 to Tier 3	0.0	9.7	0.0	0.00	1,320.3
SelfContCondense_IceCream_Tier 3 to Tier 4	0.0	9.7	0.0	0.00	1,320.3
SelfContCondense_IceCream_Tier 1 to Tier 2	0.0	9.7	0.0	0.00	1,320.3
SelfContCondense_MedTemp_Federal Standard to Tier 1	25.7	9.7	175.7	8.60	1,361.0
RemoteCondense_LowTemp_Federal Standard to Tier 1	49.0	9.7	347.2	15.73	1,386.2
RemoteCondense_LowTemp_Tier 1 to Tier 2	2.0	9.7	14.7	0.70	1,434.2
SelfContCondense_MedTemp_Tier 3 to Tier 4	6.0	9.7	68.3	2.68	2,149.7
RemoteCondense_MedTemp_Tier 3 to Tier 4	0.8	9.7	11.4	0.54	2,932.2
RemoteCondense_MedTemp_Tier 2 to Tier 3	12.0	9.7	188.6	8.83	3,117.7

Packaged Refrigeration Measure Status

- Good news: the standard achieved/will achieve this potential for us
- With the very high levelized costs, and relatively low potential above the standard, we put the development of this measure **on hold**
- The detailed workbook with analysis can be made available if anyone interested

Questions/Comments

