

Advanced Roof Top Unit Controller Pilot



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Commercial Energy Efficiency Programs

LIGHTENUP – existing buildings lighting retrofits and redesign

Electric Efficiency Program – new and existing buildings

Prescriptive: typically non-lighting upgrades

Custom Efficiency – based on kWh savings

Building Tune-up Program

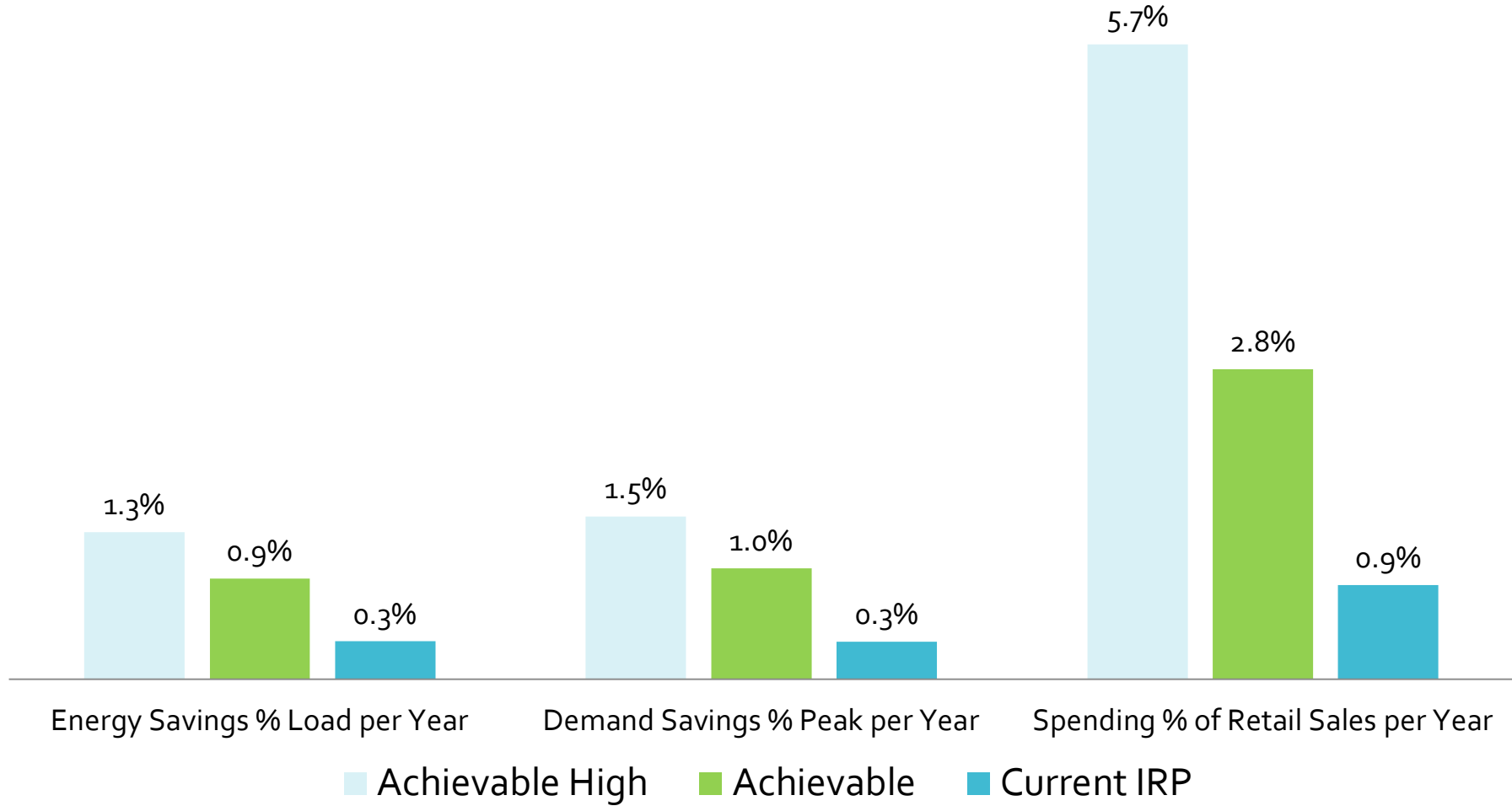
Retro-commissioning for existing buildings



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Energy Efficiency Potential Comparison



Selection Process

Key Factors in Equipment Selection

Range in applicability for RTU size and savings in Colorado climate

On-line access to view real time performance

Cost

Local trade ally presence

Communications protocol



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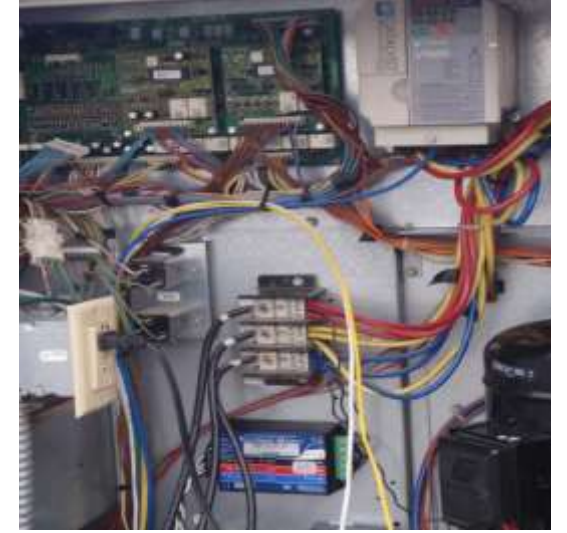
Local trade ally presence

Communications protocol



Customer Recruitment

RTU Survey
Multiple units
Various sizes of units
Targeted three sectors
Retail
Office
Public Assembly



Customer Recruitment

Customer characteristics

- Fairly close proximity to each other
- Had participated in previous programs
- ClimateWise Program partners
- Established relationships
- Potential for future sites



CATALYST Performance Results

CATALYST

The CATALYST converts constant volume RTUs into highly efficient single-zone VAV with Demand Control Ventilation and Advanced Economizer Control

- Proven track record of reducing overall energy use by 25%-40%
- Maintains comfort & assures indoor air quality
- Automatic air flow adjustments to protect equipment.
- Integrates with many existing Building Automation Systems
- Demand-Response Capability



Energy Saving Strategies

Integrated Economizer with Differential Changeover Control

Variable Speed Fan Control to Match the Needs of the Space Served

Elimination of Over-Ventilation via Demand Control Ventilation (DCV)

Remediation of Service and Operational Issues



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inSITE

Why stop at energy efficiency?

inSITE is a cloud based efficiency and performance visualization tool. Once an improvement measure is installed monitoring is key to make sure the savings last.

Web based platform

Real time connectivity

2 way communications

40 points of information

1 minute perpetual
history



How do we get meaningful results?

By itself a packaged unit does not use a lot of energy, but collectively they consume more than other types of HVAC systems

The key to packaged rooftop units is being able to move through a lot of units quickly

How do we extract the test results to other projects

How can we project annual energy savings

Are there any rules of thumbs



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Results All Sites

Estimated Annual Savings based on MV Trending									
Site	Install Date	# Units	Total Capacity (Tons)	Nominal Fan Power (HP)	Runtime		Annual Savings		
					Avg Daily (Hrs)	Annual (Hrs)	Total (kWh)	%	Normalized (kWh/Ton per 1,000 h)
Office	3/30/2013	1	6	2	5 AM-9:30 PM Mon-Sun	6,025	8,900	62%	246
Fitness Center	3/20/2013	1	15	3	24/7	8,760	25,000	68%	190
Retail ¹	7/27/2013	1	10	3	7 AM-11 PM Mon-Sun	5,840	9,300	88%	159
Composite		3	31	8		6,875	43,200	70%	203

¹Initially installed 3/20, but existing Stat was not functioning

²Results based on data collected from install to 9/26/2013



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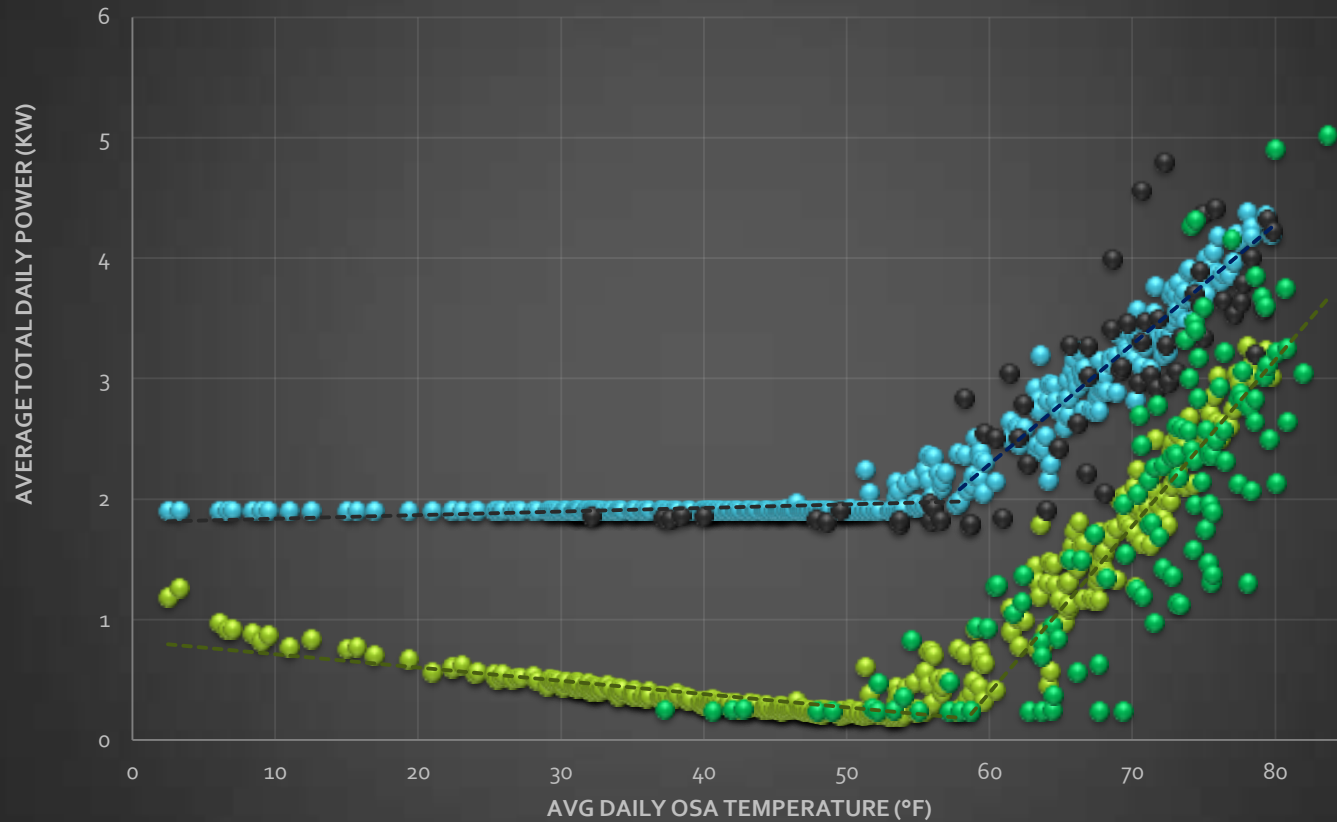
Office

ASHRAE 14 Change Point Model

Distinct difference between the performance curves.

Thermostat issue that caused comfort problems and inflated economizer savings.

Office Bldg Avg Daily HVAC Power vs Avg Daily OSA Temp



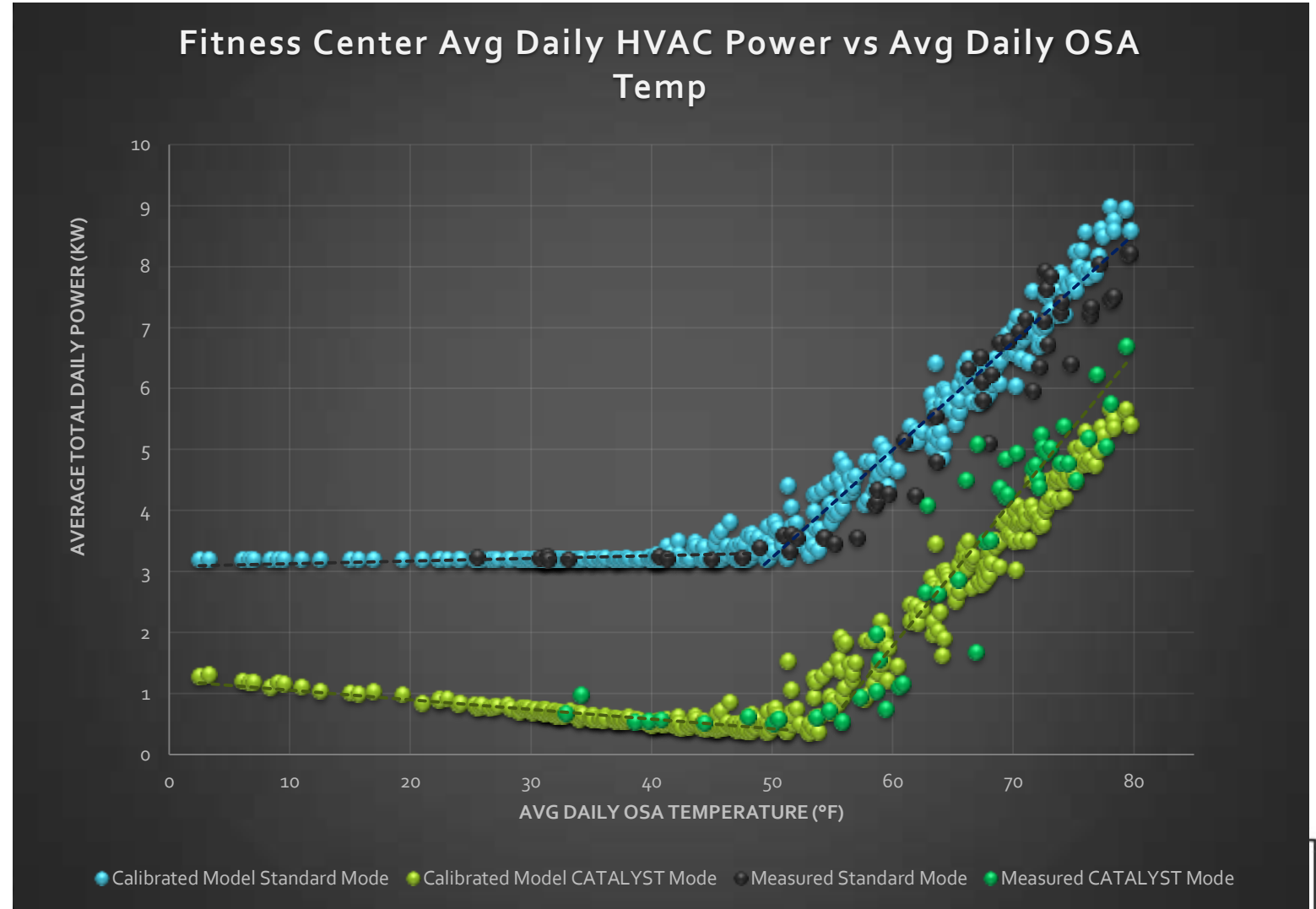
● Calibrated Model Standard Mode ● Calibrated Model CATALYST Mode ● Measured Standard Mode ● Measured CATALYST Mode

Fitness Center

ASHRAE 14 Change Point Model

Produced the greatest savings.
Longest runtime, largest equipment

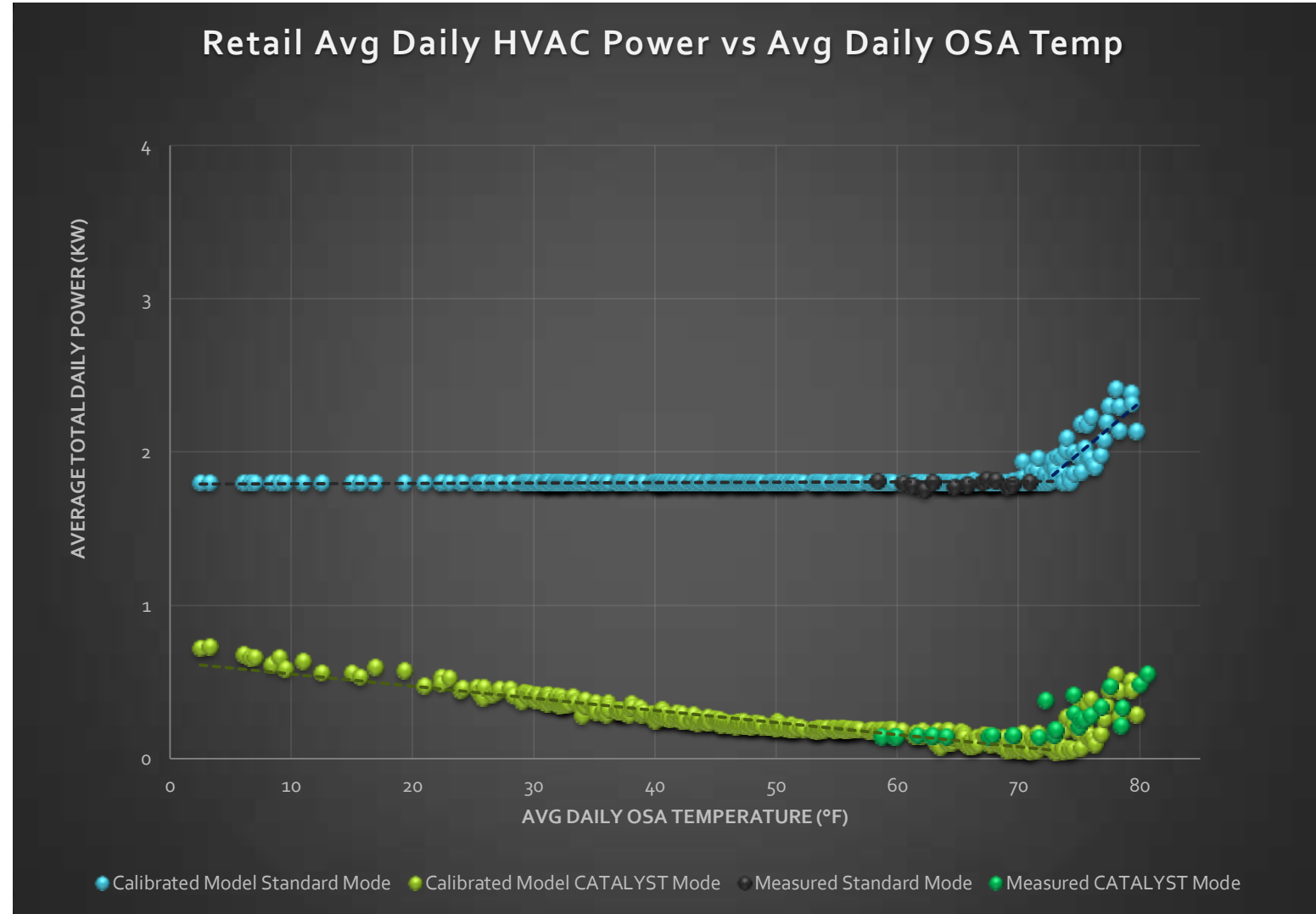
Higher base load than office lower
normalized savings



Retail

ASHRAE 14 Change Point Model

This unit served a location with refrigerated cases. The unit spent very little time in the cooling mode, all of the savings were fan savings.



Detailed Analysis

How the data is gathered

Evaluating each measure independently

Fan

Economizer

Demand Control ventilation

Removing operation changes to the site,
depending on the utility

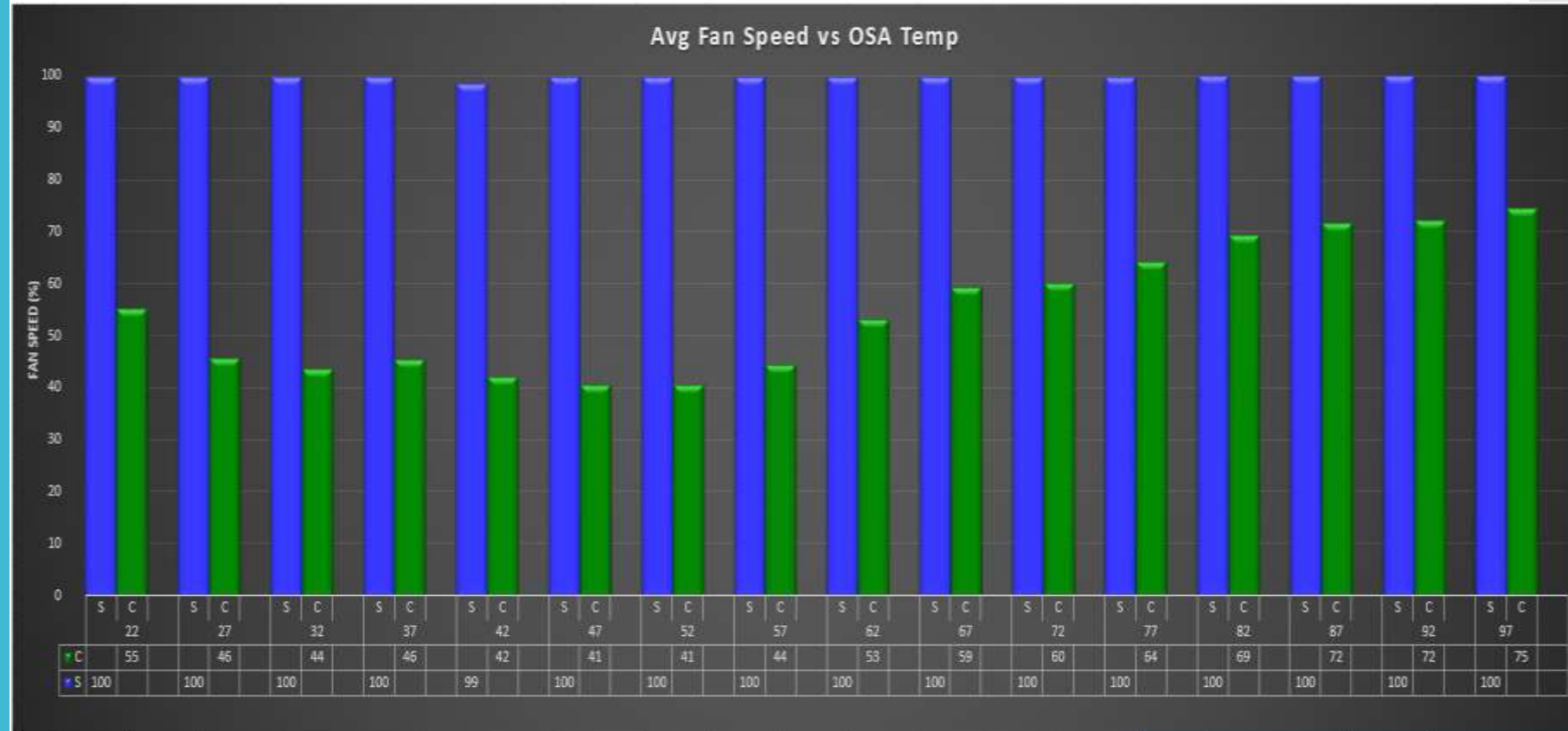
Projecting energy savings



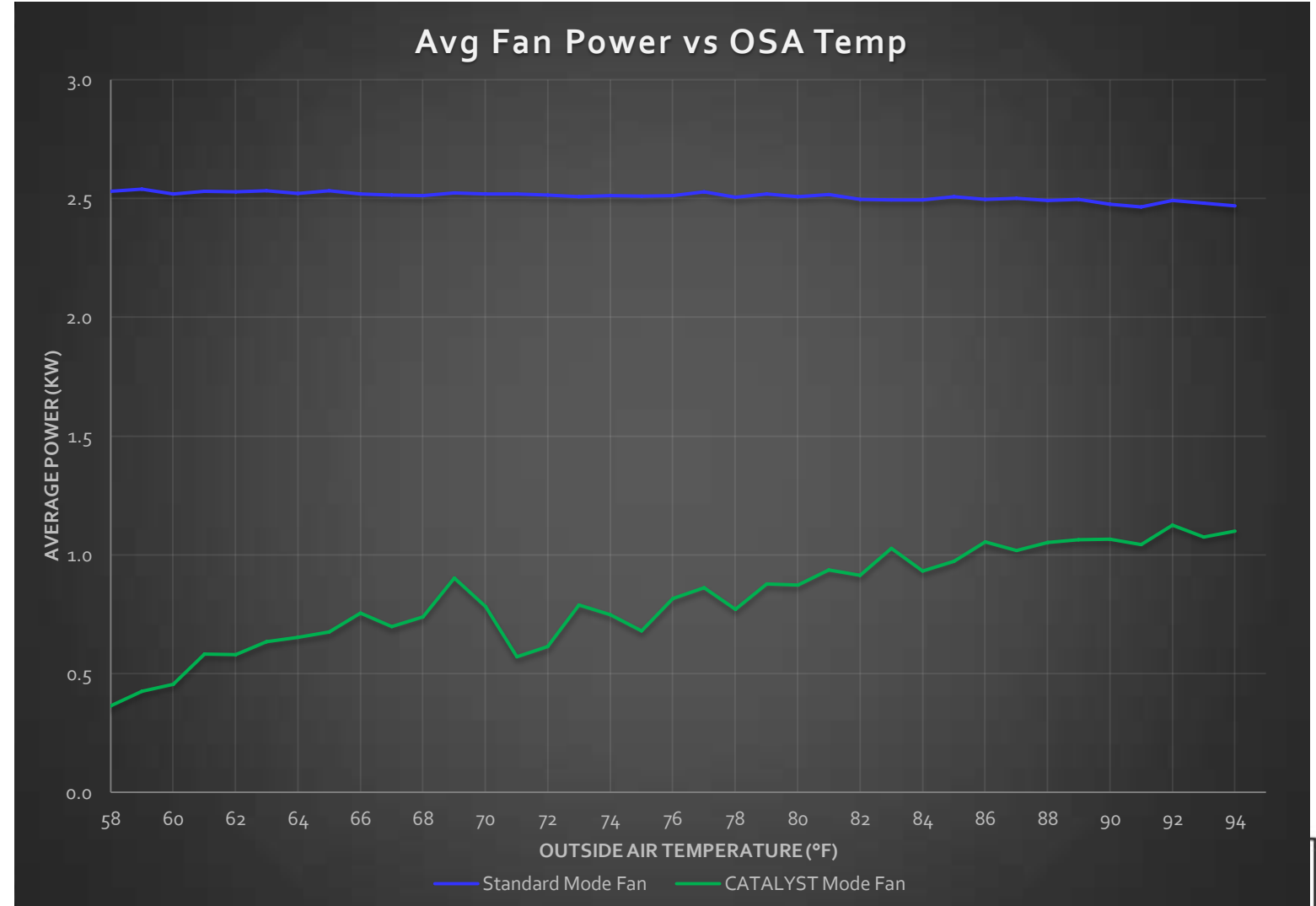
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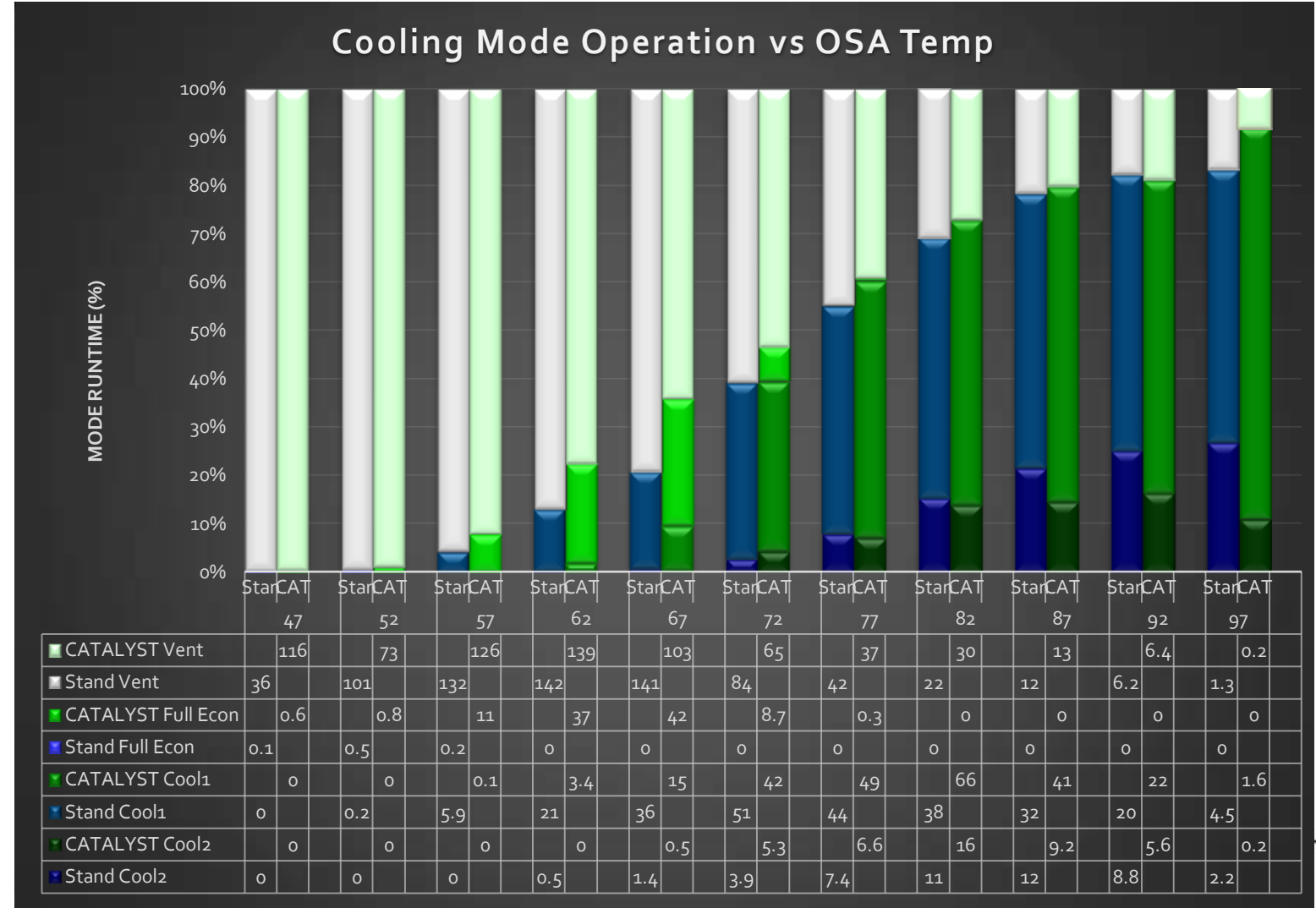
Fan Speed Bin Temperature Analysis



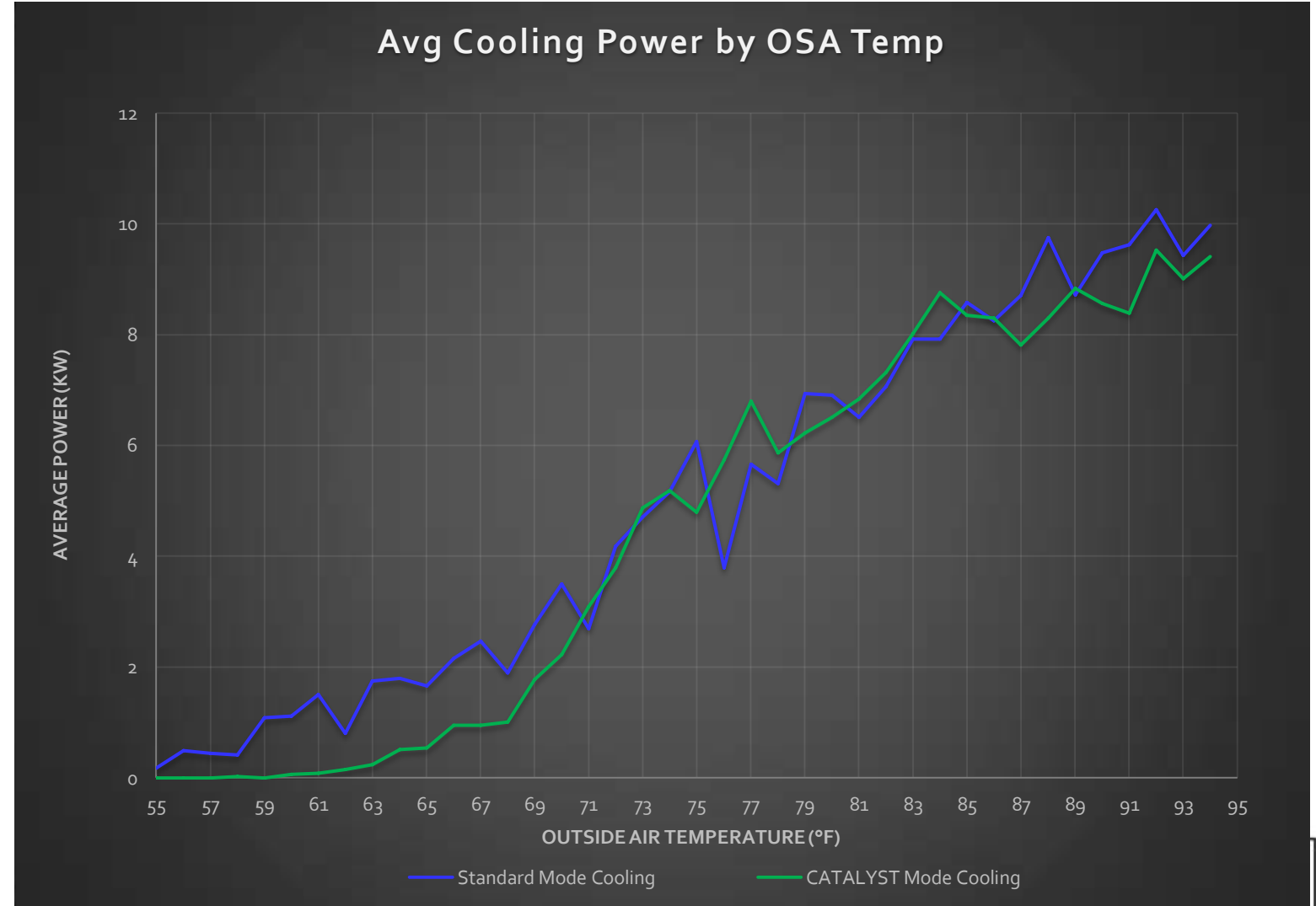
Fan Power Temperature Comparison



Cooling Mode Bin Temperature Analysis

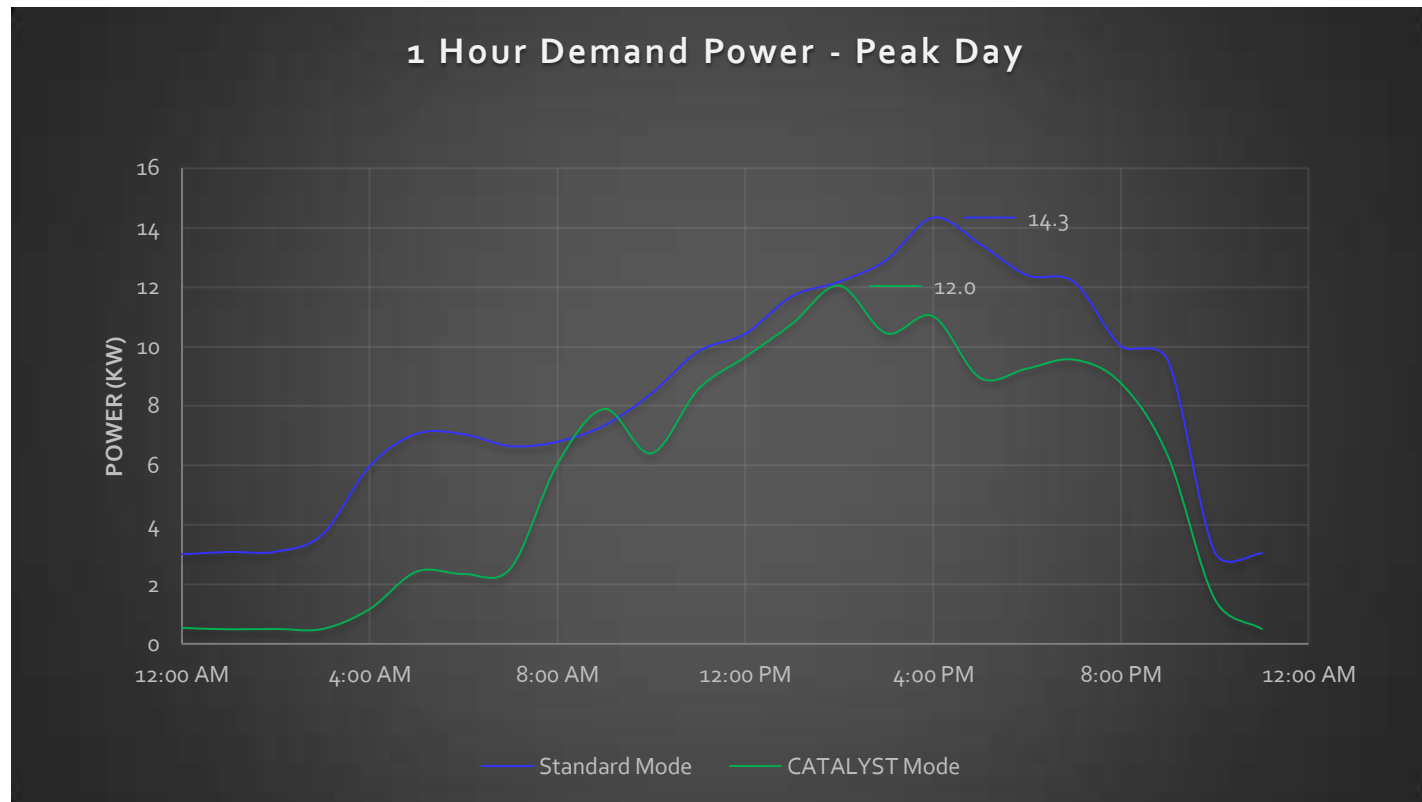


Cooling Power Temperature Comparison

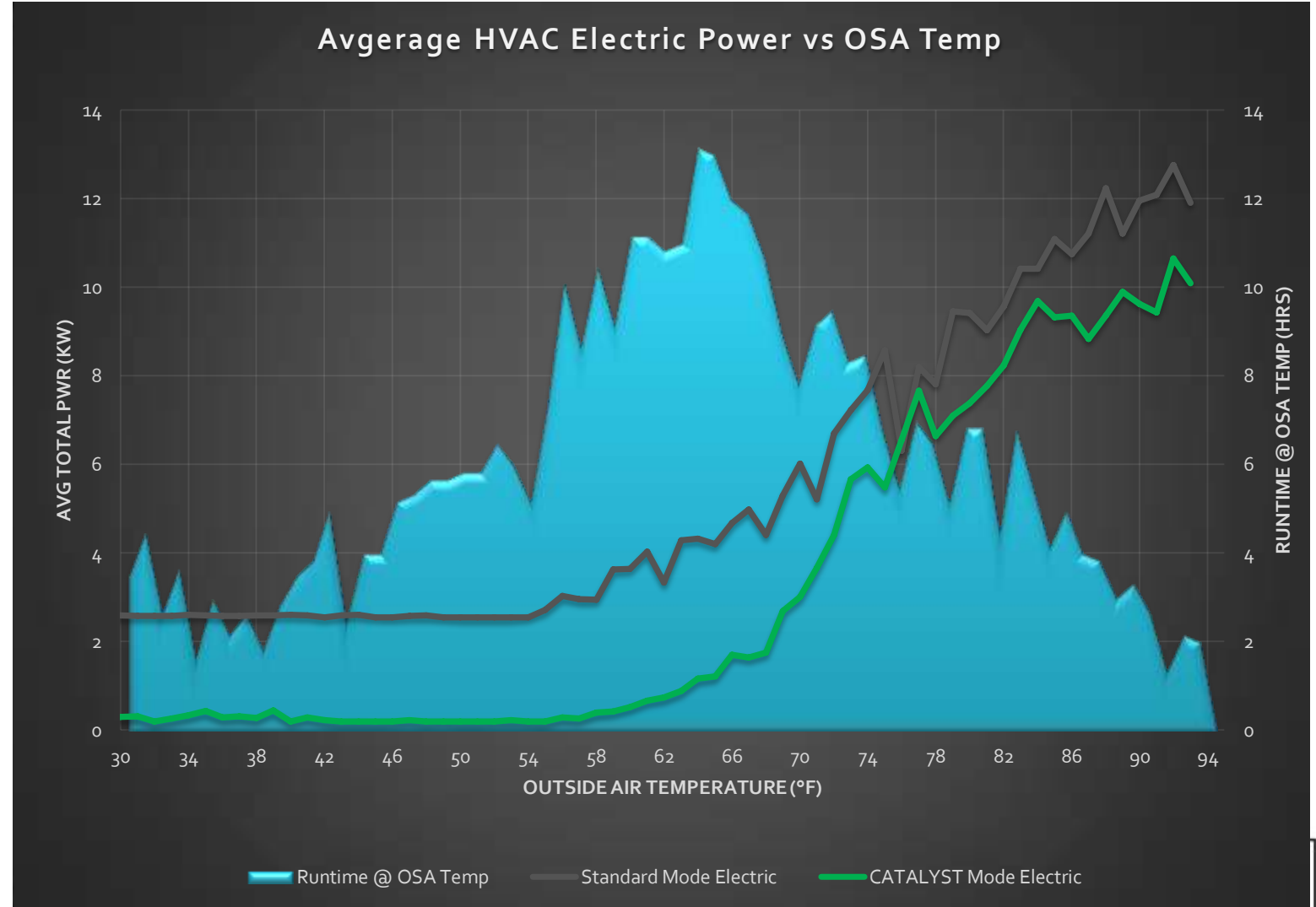


Final Results

Performance to Date							
Mode	Standard		CATALYST		Savings		
	Total Energy	Avg Power	Total Energy	Avg Power	Total Energy	Avg Power	
	(kWh)	(kW)	(kWh)	(kW)	(kWh)	(kW)	
Fan	3,153	2.5	721	0.6	2,432	2.0	77%
Cooling	3,212	2.6	2,882	2.3	330	0.3	10%
Electric	6,365	5.1	3,603	2.9	2,762	2.2	43%



Applying the data



What's Next?

PNNL Study

PNNL studied 66 installs on 8 different buildings in the Pacific Northwest

Average savings was 57%

Average simple payback period was 3 years

There were few reliability problems



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DRAFT
HVAC Rebates

Rebate Measure	Rebate	CCE- lifetime kWh savings
High Efficiency SS/RTU	Up to \$150 / Ton	\$0.069 (\$1,000/pk kW)
Early Retirement SS/RTU	\$100 / Ton	\$0.022
Advanced RTU controllers	\$2,000 / Unit	\$0.020
Premium Efficiency Package	\$500 / Unit	\$0.045
Evaporative Condensing	\$100 / Ton	\$0.041 (\$250/pk kW)
Advanced Evaporative Cooling	\$150 / Ton (or \$0.20/CFM)	\$0.023 (\$45/pk kW)
ECMs	TBD for HVAC systems	TBD savings



Thank you!