Commissioning to Net Zero

Cameron Scott, P.E., C.E.M

David W Griffin II, AIA|BEMP|GGA

Griffin EnerG Consulting

AIA Quality Assurance

The Building Commissioning Association is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES). Credit(s) earned on completion of this program will be reported to AIA/CES for AIA members. Certificates of the Completion for both AIA members and non-AIA members are available upon request.

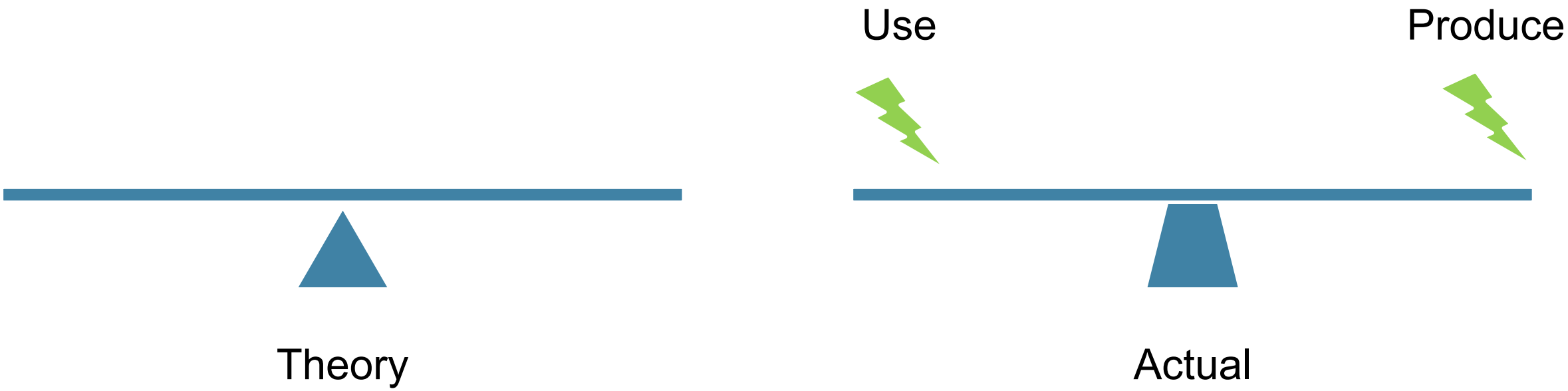
This program is registered with AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Learning Objectives

1. Develop a commissioning plan to tune a net zero building
2. Understand process to install analytics
3. Compare submeters with energy model
4. Tune HVAC and electrical equipment

Definition_ZNE



Definition_ZNE

A building whose total amount of energy used on an annual basis is roughly equal to the amount of renewable energy created on the site or off-site.

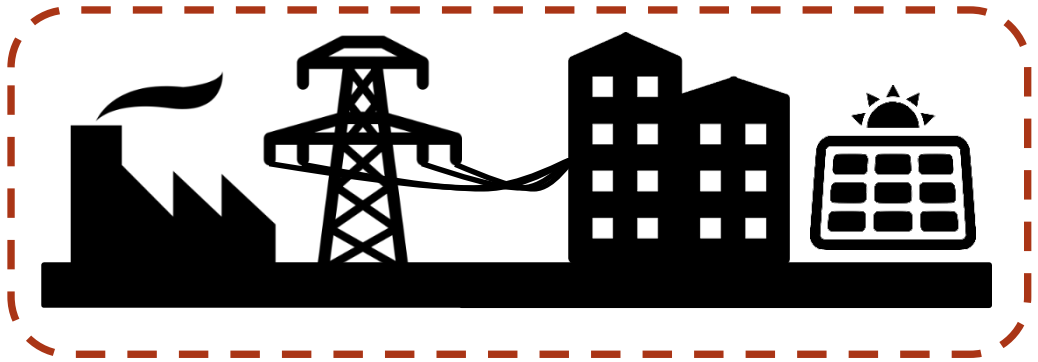
- Site Net Zero
- Source Net Zero
- Zero emission
- Zero Cost
- Off-the-Grid
- Zero electric

People are pretty much alike. It's only that our differences are more susceptible to definition than our similarities.

-Linda Ellerbee

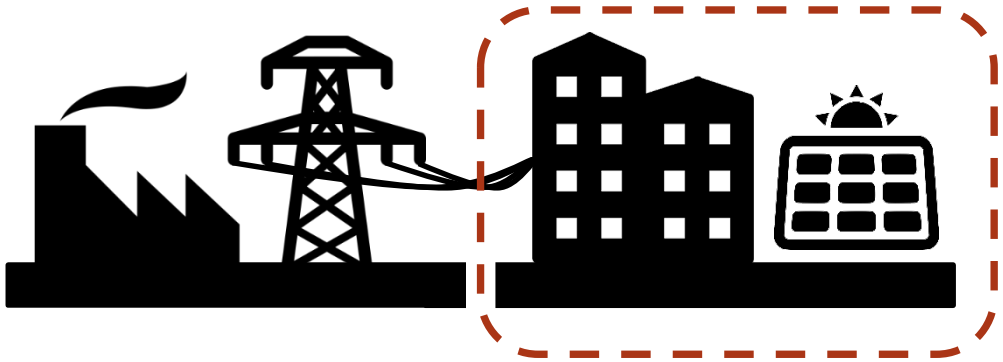
Site vs Source

Source



Production and transportation losses by energy type are factored into calculation.

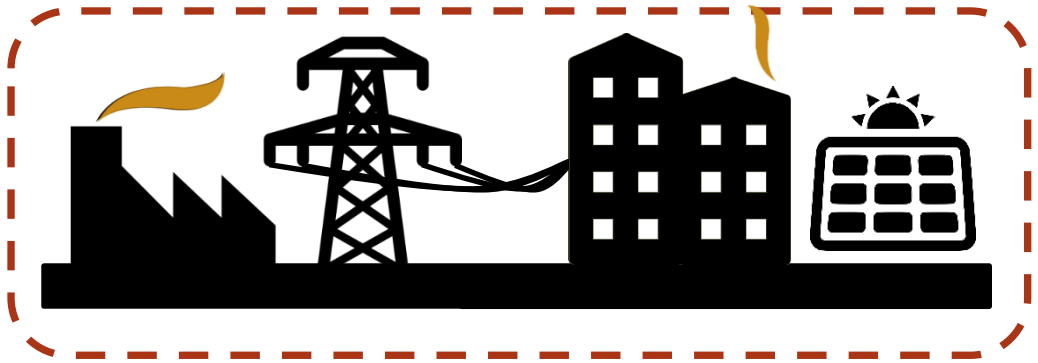
Site



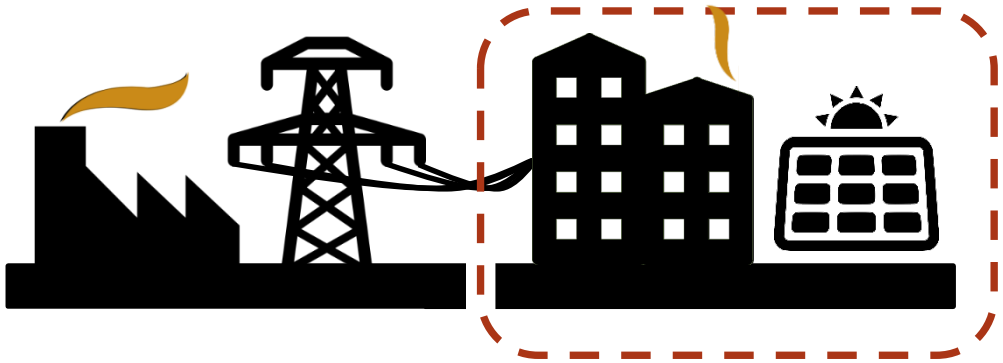
Production and transportation losses by energy type are not factored into calculation.

Emissions/Carbon

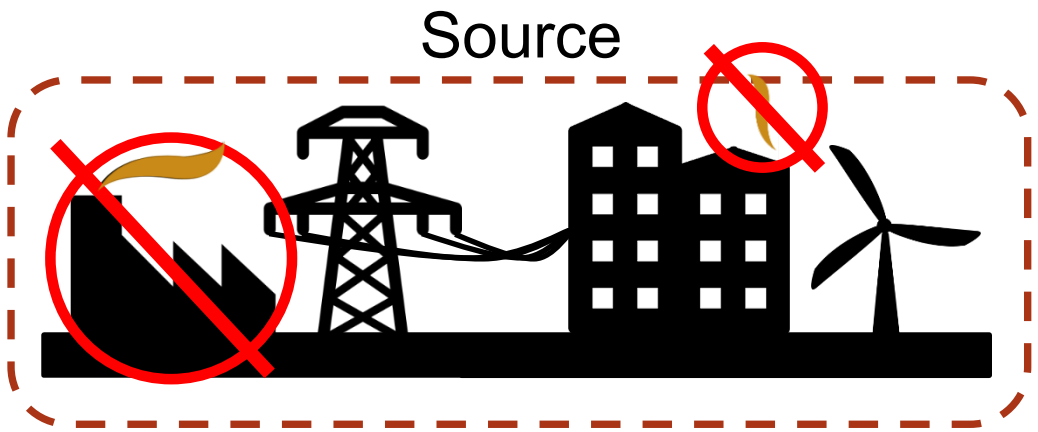
Source

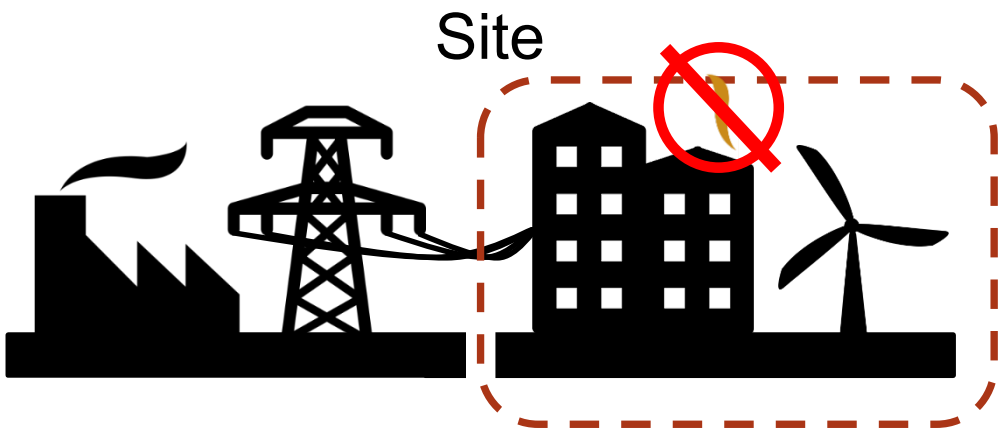


Site



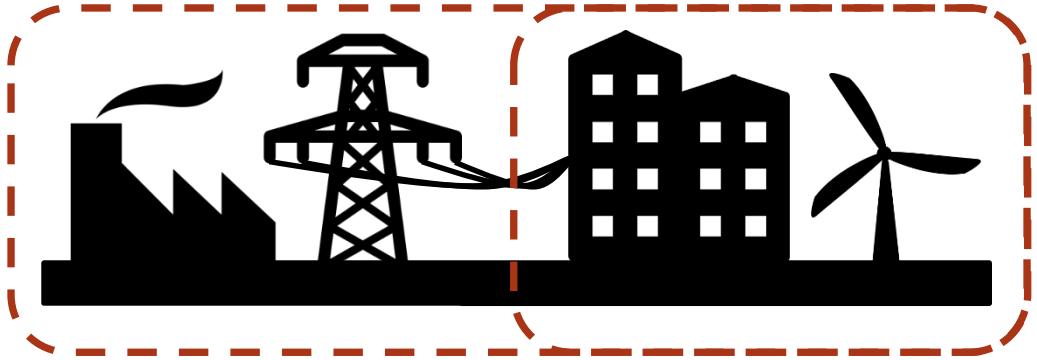
Electric



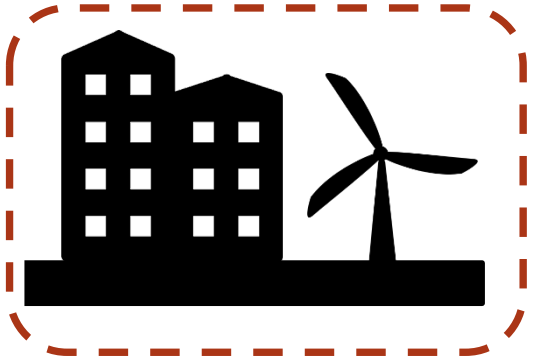


Misc.

Cost



Off-the-Grid



The Process_Priorities

1) Marketing

2) Money

3) Sustainability

Desires dictate our priorities, priorities shape our choices, and choices determine our actions.

-Dallin H. Oaks

The Process_Reduction First

Energy Conservation Measure (ECM)

- Reduces energy required for building to operate

- Energy Efficiency Measure (EEM)
  - Reduces energy consumed by building to operate

If you can't describe what you are doing as a process, you don't know what you're doing.

-W. Edwards Deming

Salt Lake City Net Zero Fire Stations

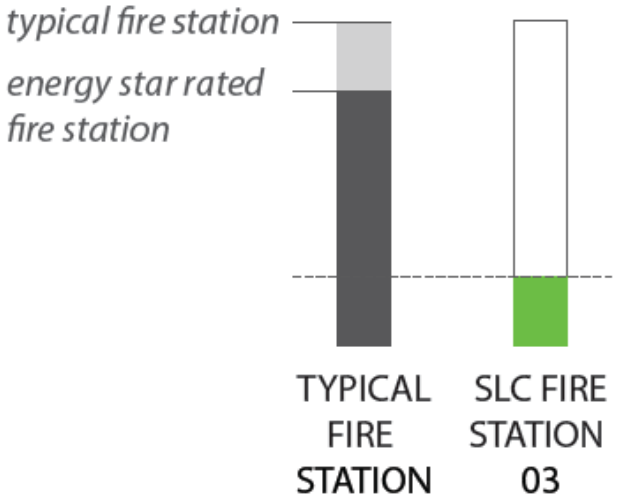
Net Zero Design: Renewable Energy Production

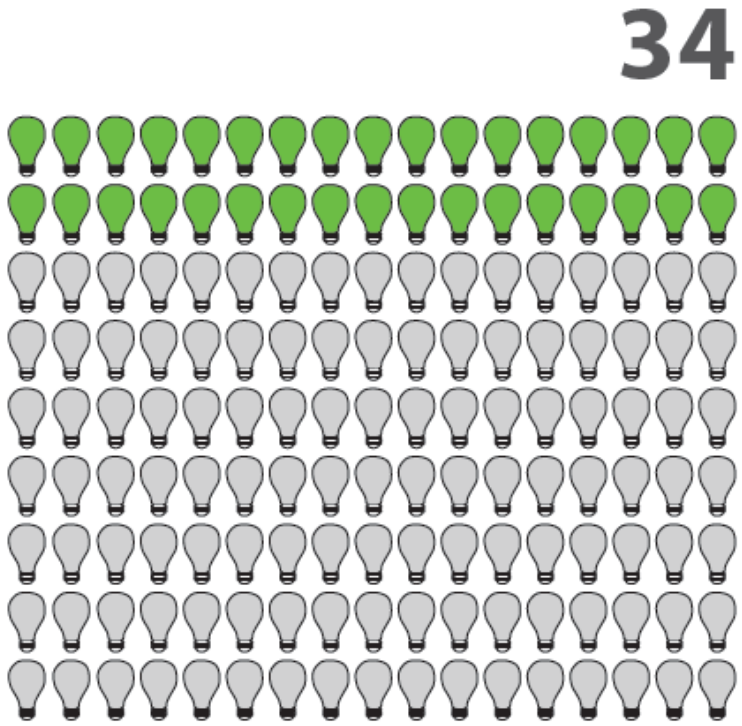
The power generated by the solar panel array is equivalent to the power needed to supply (27)SLC homes annually*

of Certified Net Zero Fire Stations

Start the presentation to see live content. Still no live content? Install the app or get help at **PollEv.com/app**

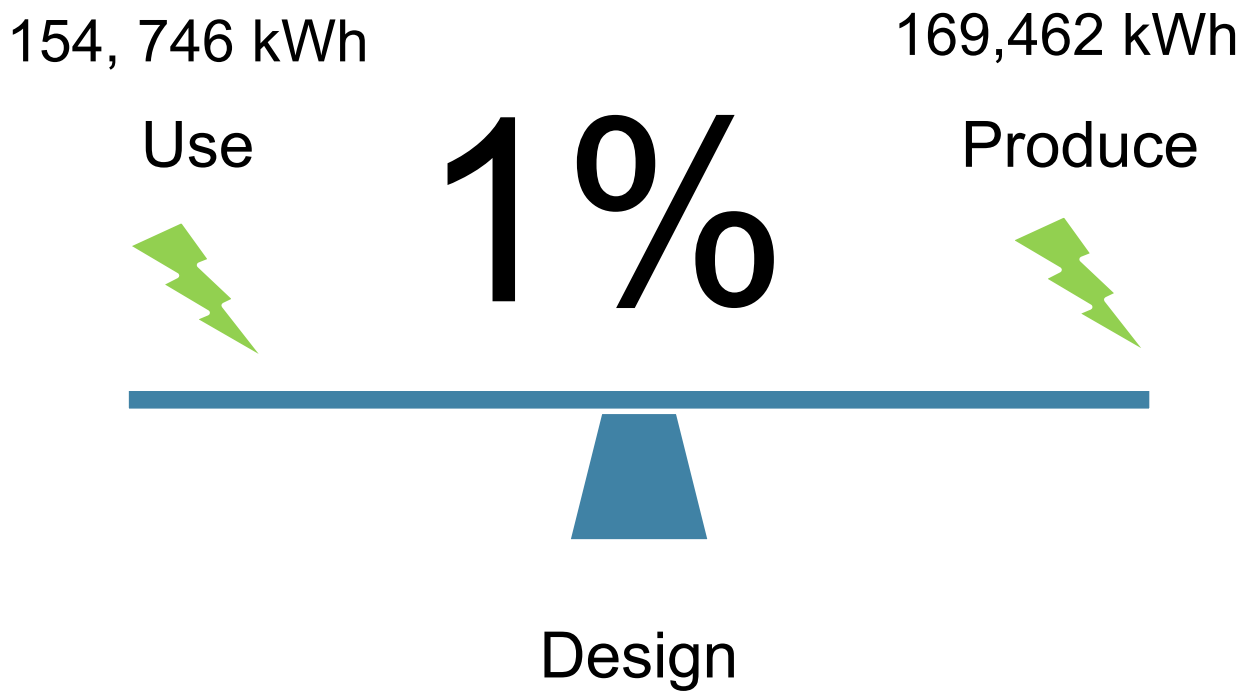
Net Zero Design: Energy Use Reduction





EUI is a building's annual energy use per unit area, typically measured in thousands of BTU per square foot per year (kBTU/ft2/yr)

Designed Net Zero Calculation



Modeled Solar Production

Solar Design By Engineer

Predicted Solar	
Panel [#]	300
Panel Rating [kW]	0.365
Efficiency [%]	0.8
Average Effective Time [hr]	5.3
Length of Time [Days/yr]	365
Total	169,462

PVWatts Calculator by NREL

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	3.03	7,921	817
February	3.71	8,717	899
March	5.11	13,014	1,342
April	6.02	14,411	1,486
May	6.96	16,803	1,732
June	7.55	17,253	1,779
July	7.51	17,219	1,775
August	7.00	16,144	1,664
September	6.12	14,008	1,444
October	4.88	11,967	1,234
November	3.43	8,438	870
December	2.57	6,782	699
Annual	5.32	152,677	$ 15,741

Annual Production 150,261 (kWh)

Energy Modeling Accuracy

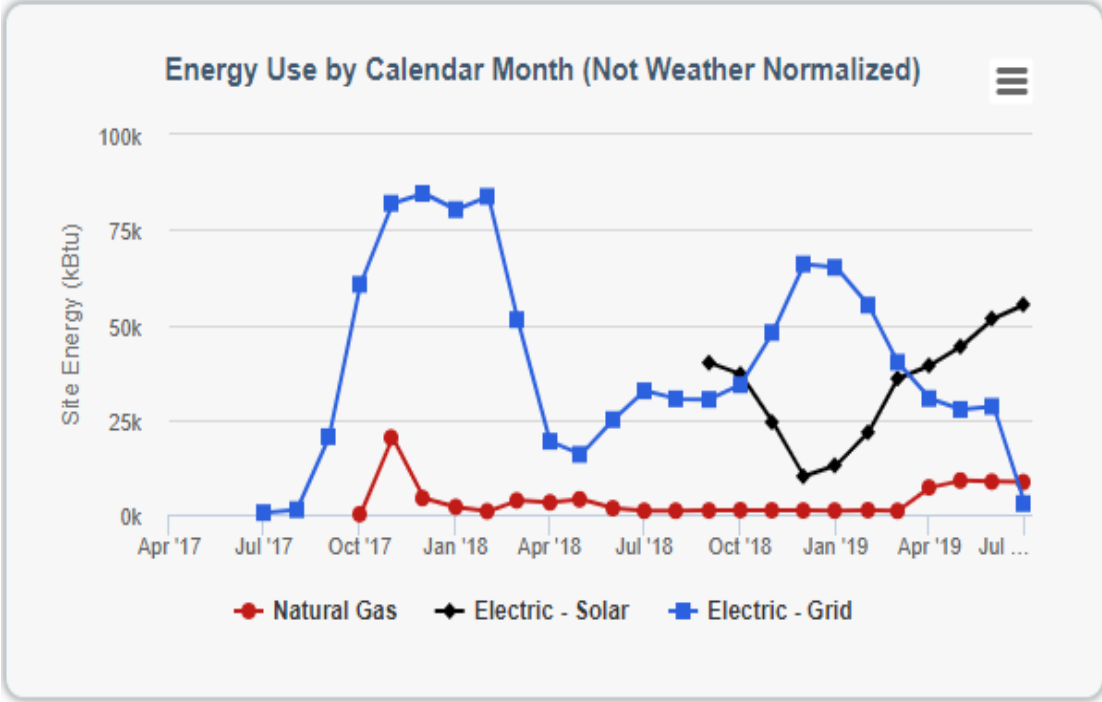
EPS Pilot Findings
Total Energy Use

	REM/Rate	SIMPLE	HES-Mid	HES-Full
Mean Actual Use	101	101	101	101
Mean Predicted Use	133	84	157	119
Mean Error	32	-17	48	18
Mean Absolute Error	37	27	75	28
Median Absolute Error	31	21	66	23
Mean Absolute Percent Error	43.7%	25.1%	96.6%	33.4%
Median Absolute Percent Error	31.1%	24.0%	73.8%	21.8%
Percent of Homes with Accurate Prediction (less than +/- 25%)	43.2%	51.6%	19.5%	53.7%
Percent of Homes w/ Large Error in Prediction (larger than +/- 50%)	31.6%	7.9%	60.5%	21.6%

Table 3.5 Total Energy (MBtu) for 190-Home Sample

https://www.greenbuildingadvisor.com/article/energy-modeling-isnt-very-accurate

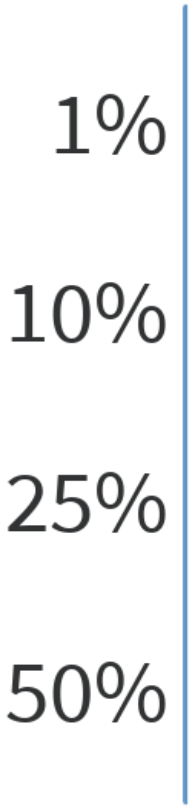
Usage Results after 1st Year



Metrics Summary

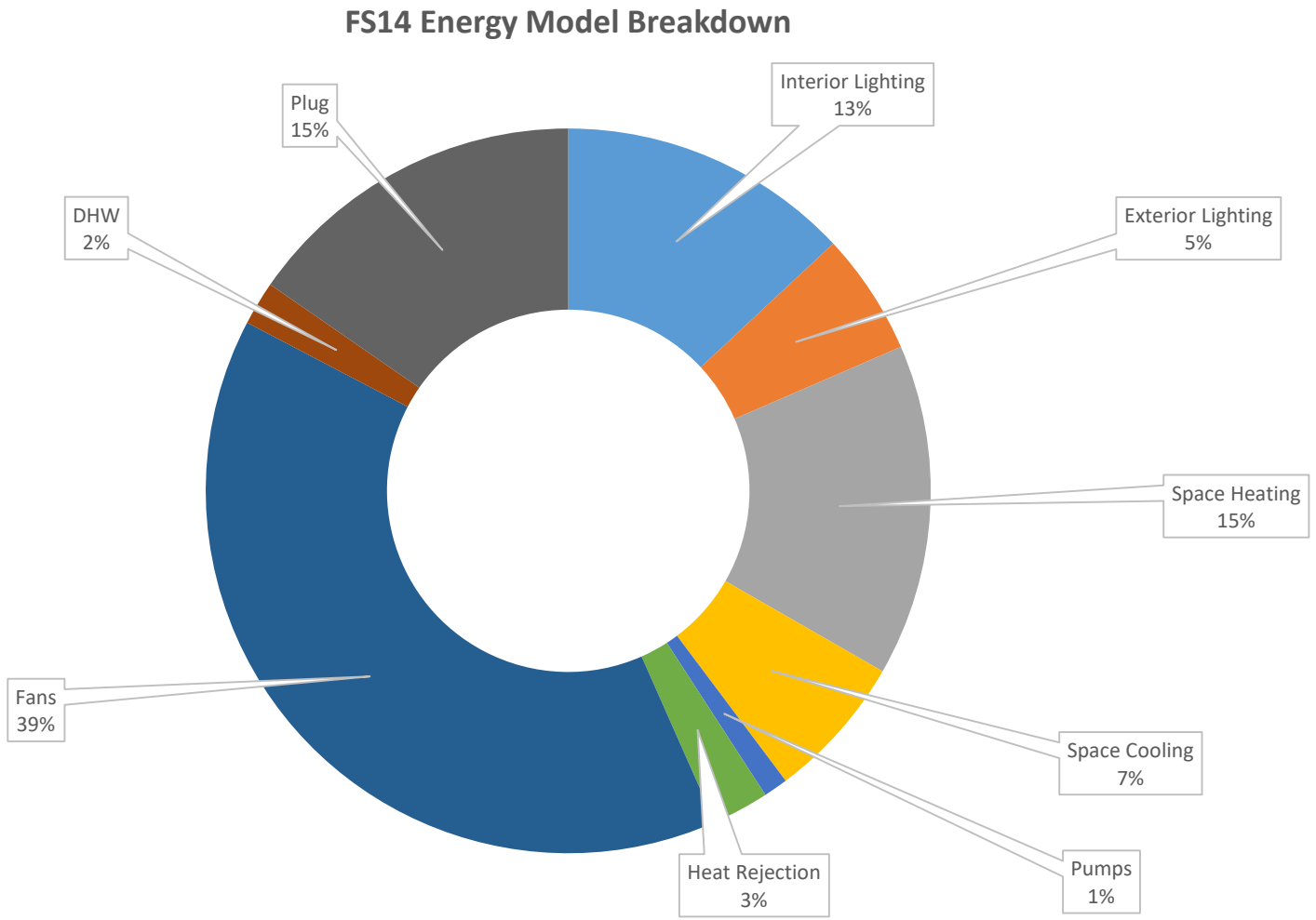
Metric	Dec 2018 (Other)	Jun 2019 (Energy Current)	Change
ENERGY STAR Score (1-100)	Not Available	Not Available	N/A
Source EUI (kBtu/ft²)	107.9	117.4	9.50 (8.80%)
Site EUI (kBtu/ft²)	44.3	57.3	13.00 (29.30%)
Energy Cost ($)	13,496.68	13,305.34	-191.34 (-1.40%)
Total GHG Emissions Intensity (kgCO2e/ft²)	3.2	3.0	-0.20 (-6.20%)
Water Use (All Water Sources) (kgal)	Not Available	Not Available	N/A
Total Waste (Disposed and Diverted) (Tons)	Not Available	Not Available	N/A

In the OPR, what error should be included in the energy model design



Start the presentation to see live content. Still no live content? Install the app or get help at PollEv.com/app

Energy Model Decision



Operation verse Efficiency

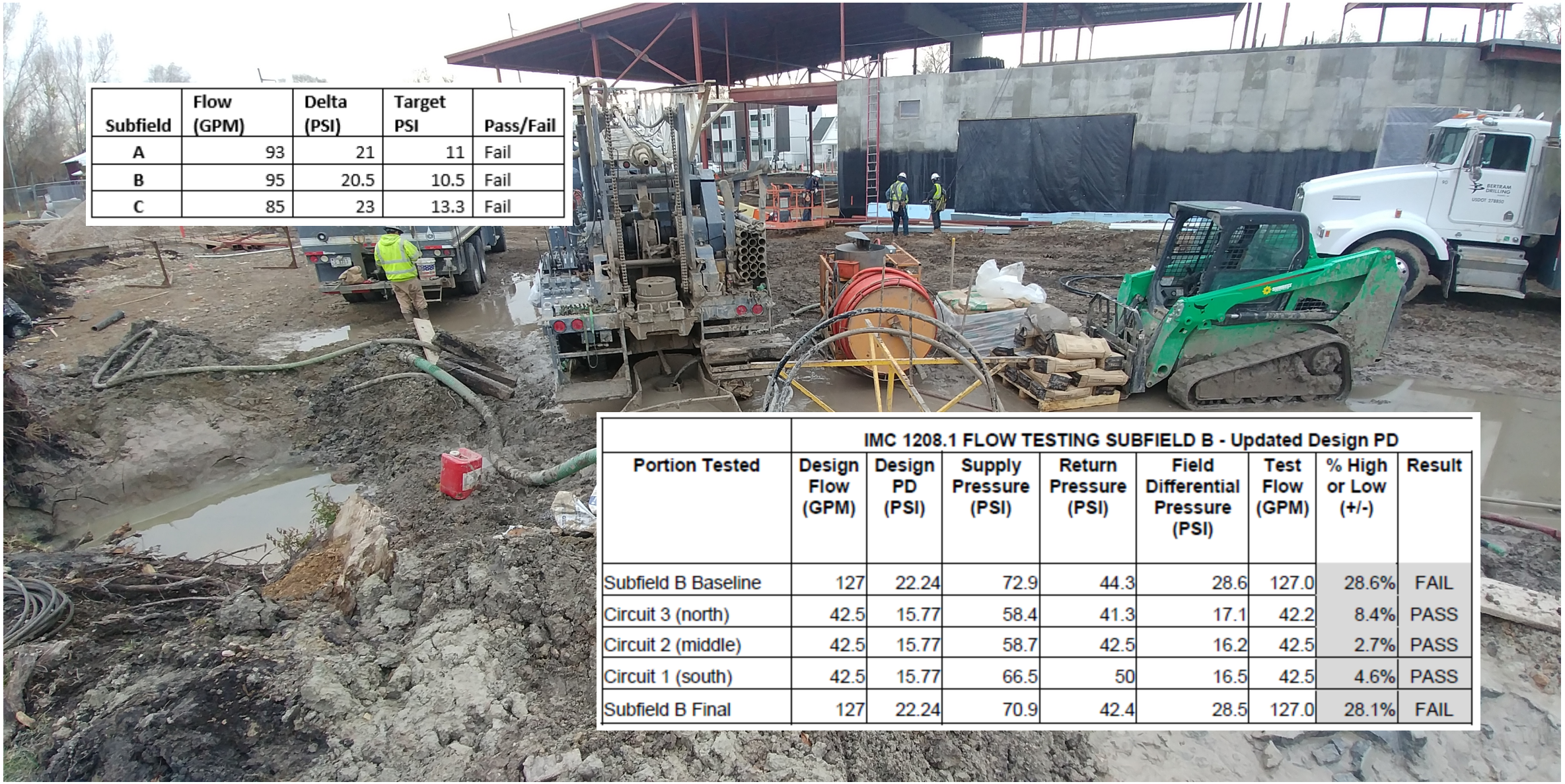
Designed Heating Setpoint = 55° F

Current Heating Setpoint = 65° F

Criteria for selecting operational behaviors worth changing?

Start the presentation to see live content. Still no live content? Install the app or get help at PollEv.com/app

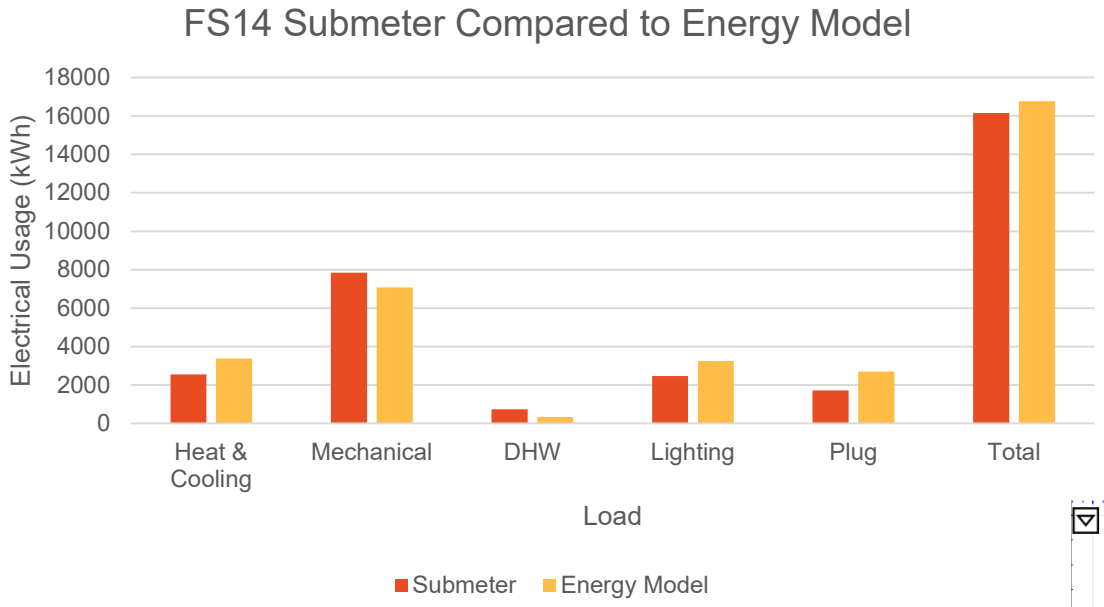
Go to the Mattresses



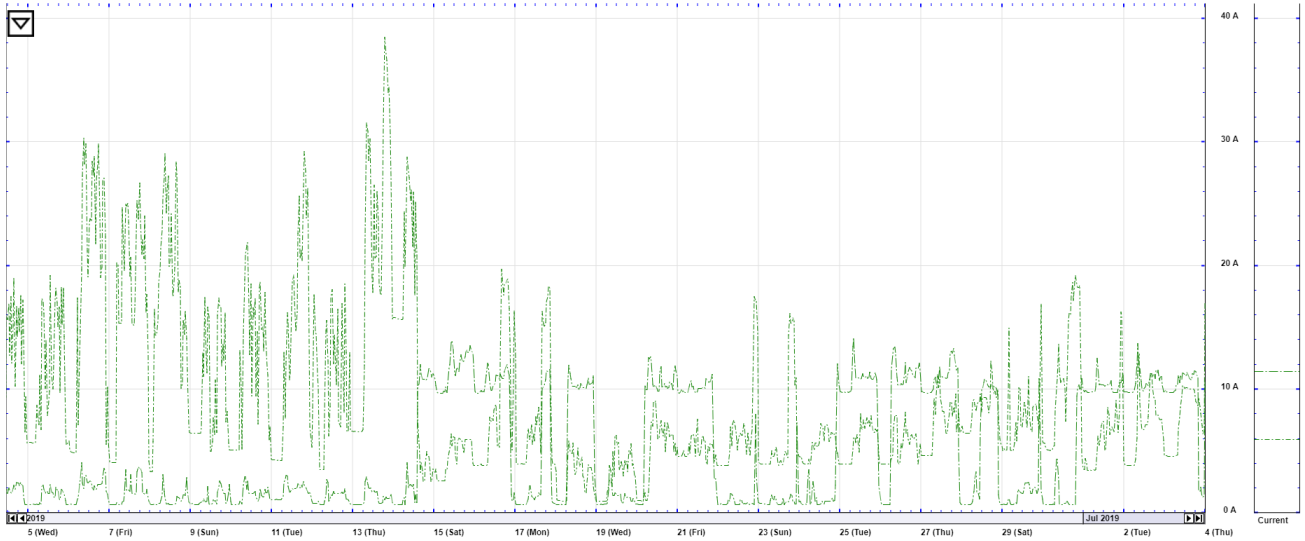
Subfield	Flow (GPM)	Delta (PSI)	Target PSI	Pass/Fail
A	93	21	11	Fail
B	95	20.5	10.5	Fail
C	85	23	13.3	Fail

	IMC 1208.1 FLOW TESTING SUBFIELD B - Updated Design PD							
Portion Tested	Design Flow (GPM)	Design PD (PSI)	Supply Pressure (PSI)	Return Pressure (PSI)	Field Differential Pressure (PSI)	Test Flow (GPM)	% High or Low (+/-)	Result
Subfield B Baseline	127	22.24	72.9	44.3	28.6	127.0	28.6%	FAIL
Circuit 3 (north)	42.5	15.77	58.4	41.3	17.1	42.2	8.4%	PASS
Circuit 2 (middle)	42.5	15.77	58.7	42.5	16.2	42.5	2.7%	PASS
Circuit 1 (south)	42.5	15.77	66.5	50	16.5	42.5	4.6%	PASS
Subfield B Final	127	22.24	70.9	42.4	28.5	127.0	28.1%	FAIL

Identify Issues with Electrical Submeters



Phase Balance



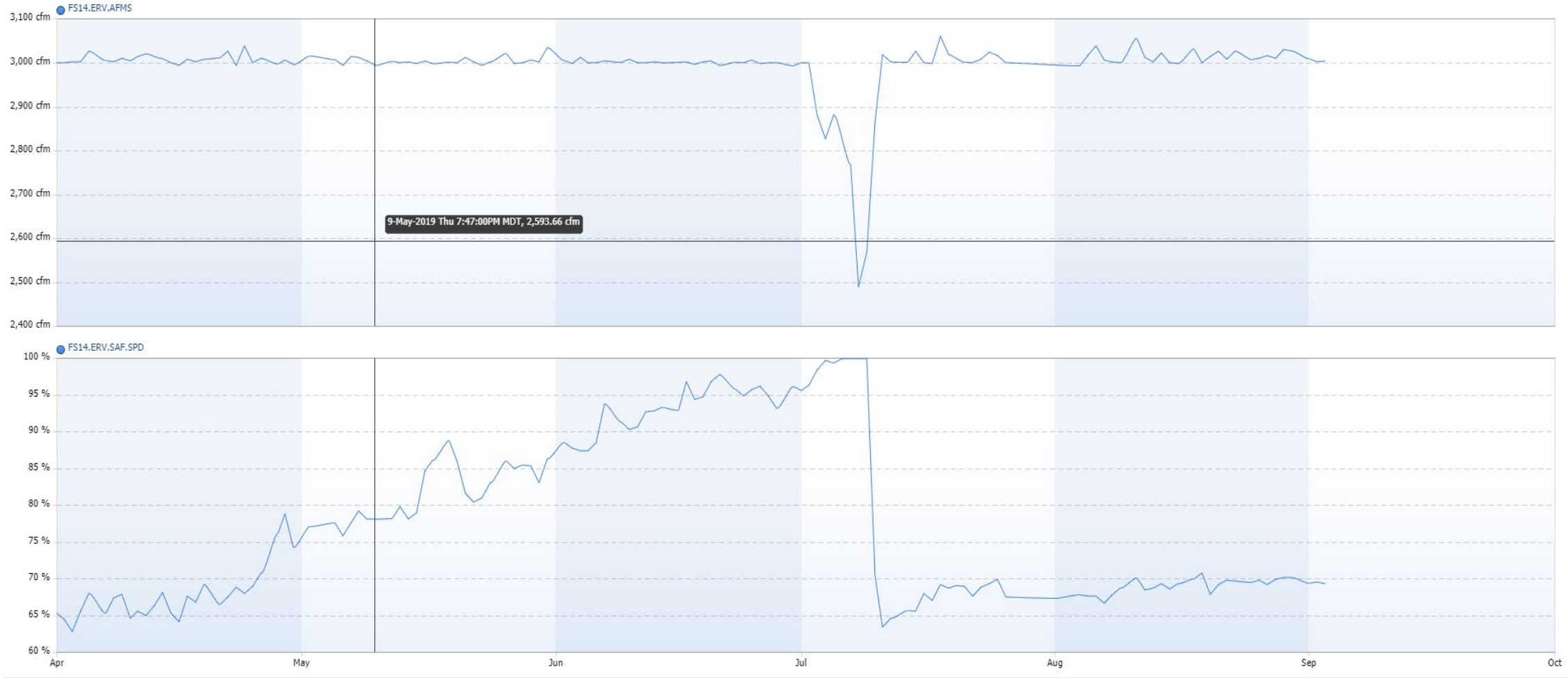
Building Analytic and Benchmarking

Building Analytics

ENERGY STAR® PortfolioManager®

BMS

Preventive Maintenance Plan



The Process_Review

1) Set priorities
2) Choose definition
3) Reduce energy use
4) Produce energy
5) Track and verify

Desires dictate our priorities, priorities shape our choices, and choices determine our actions.

-Dallin H. Oaks

David W Griffin II, AIA|BEMP|GGA
dgriffin@griffinec.com

Griffin EnerG Consulting

Cameron Scott, P.E., C.E.M
cameron.scott@slcgov.com