Building An Operational Structure for Persistence

Christopher Benson, PE, CEM, LEED AP
Program Manager, Sustainability & Energy
University of Utah, Dept. of Facilities Management

Jane Guyer, PE, CxA, LEED AP
Principal Engineer
ETC Group, LLC

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Overview

1. Setting the Table
2. Recognizing Major Contributors to Performance Risk
3. A New Model for Persistence
4. Other Benefits

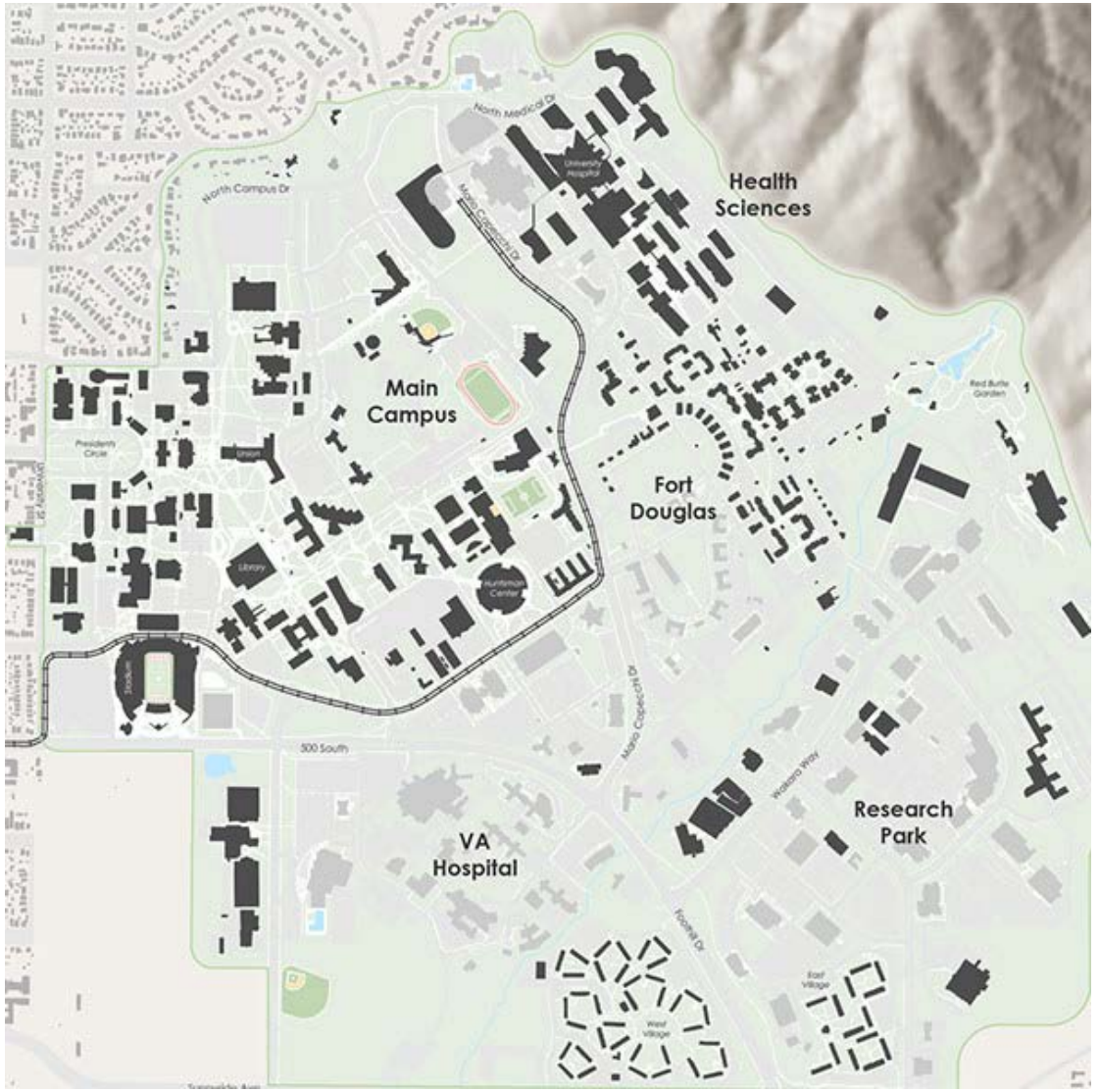
SETTING THE TABLE:
Primary Driver for Change

University committed to carbon neutrality by 2050

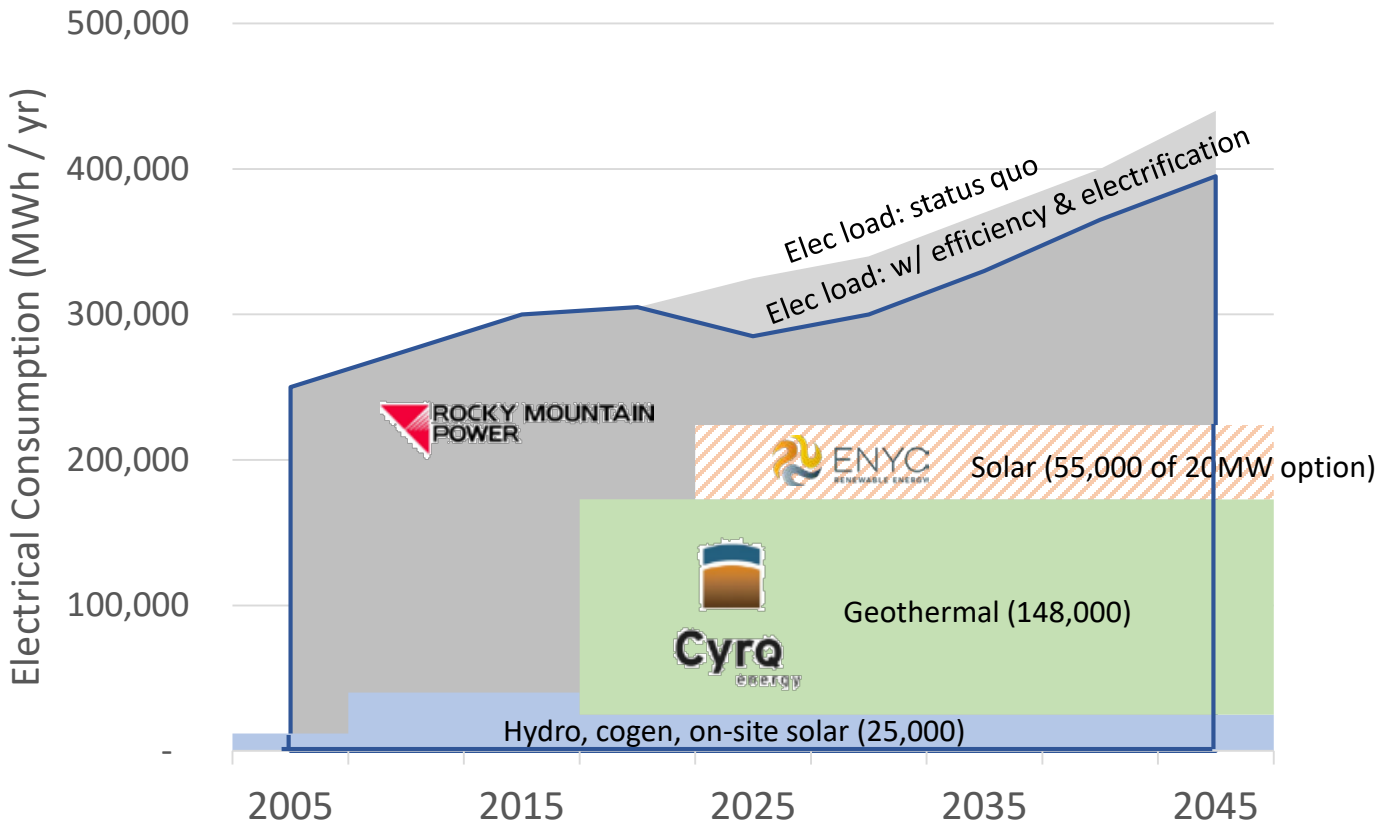
SETTING THE TABLE: University of Utah Scale

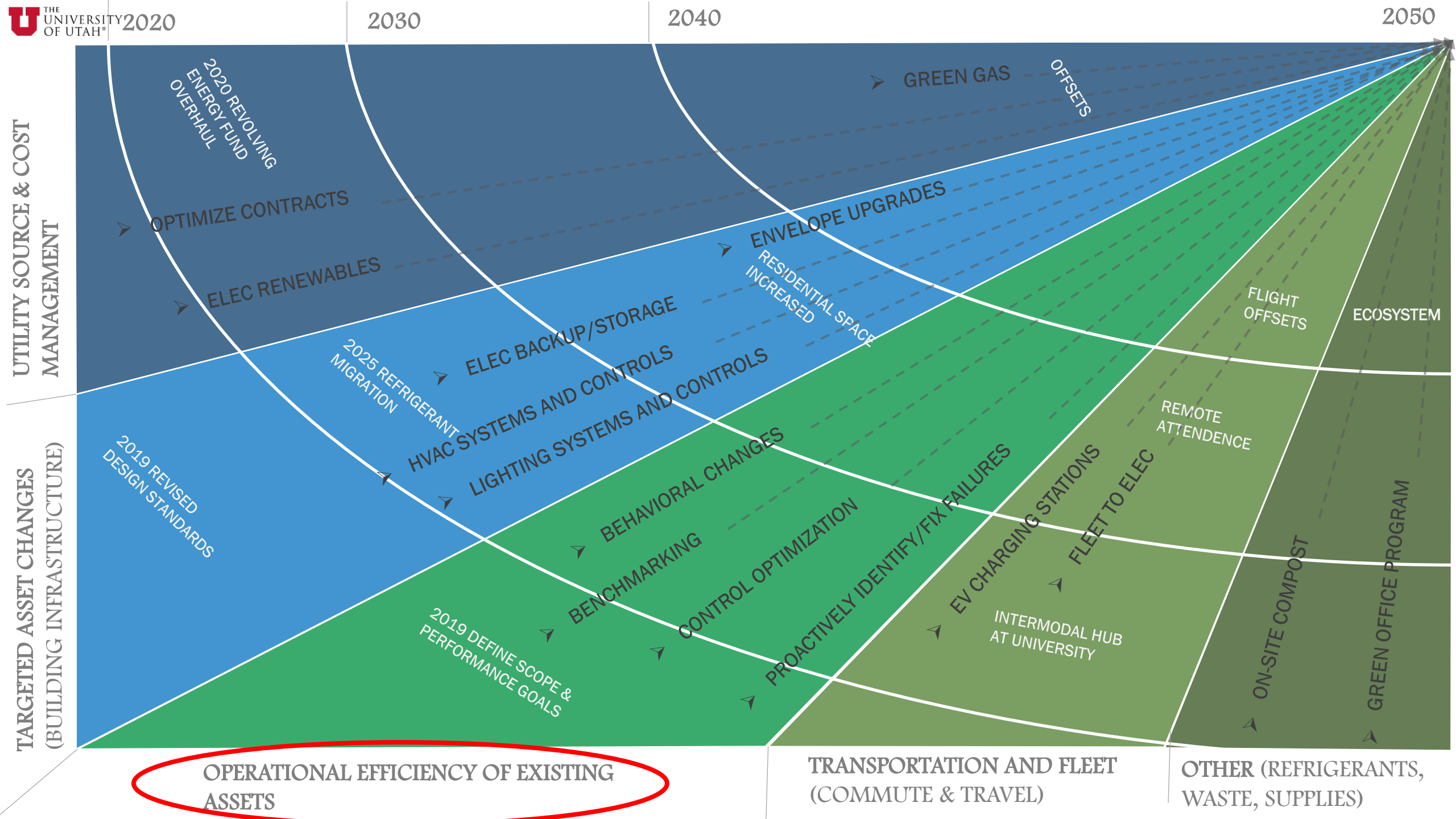
MAIN CAMPUS

- 278 buildings (17M sq ft floor area) for classroom, office, research, medical, housing, etc
- Equivalent to 10th largest city in Utah
- $30M/yr utility bills. 1% of all electricity and gas use in Utah



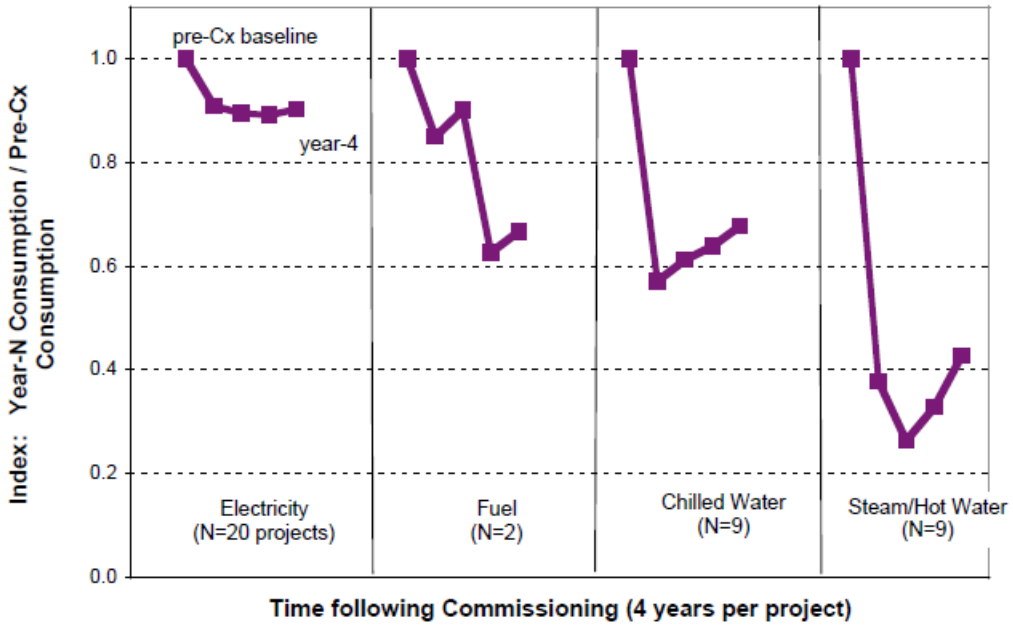
SETTING THE TABLE:
Renewables As Portion of Electrical Load




THE UNIVERSITY OF UTAH
2020
2030
2040
2050
UTILITY SOURCE & COST MANAGEMENT
TARGETED ASSET CHANGES (BUILDING INFRASTRUCTURE)
2020 REVOLVING ENERGY FUND OVERHAUL
OPTIMIZE CONTRACTS
ELEC RENEWABLES
GREEN GAS
OFFSETS
ENVELOPE UPGRADES
RESIDENTIAL SPACE INCREASED
2025 REFRIGERANT MIGRATION
ELEC BACKUP/STORAGE
HVAC SYSTEMS AND CONTROLS
LIGHTING SYSTEMS AND CONTROLS
2019 REVISED DESIGN STANDARDS
BEHAVIORAL CHANGES
BENCHMARKING
CONTROL OPTIMIZATION
PROACTIVELY IDENTIFY/FIX FAILURES
2019 DEFINE SCOPE & PERFORMANCE GOALS
EV CHARGING STATIONS
FLEET TO ELEC
INTERMODAL HUB AT UNIVERSITY
REMOTE ATTENDENCE
FLIGHT OFFSETS
ECOSYSTEM
ON-SITE COMPOST
GREEN OFFICE PROGRAM
OPERATIONAL EFFICIENCY OF EXISTING ASSETS
TRANSPORTATION AND FLEET (COMMUTE & TRAVEL)
OTHER (REFRIGERANTS, WASTE, SUPPLIES)

SETTING THE TABLE:
Performance Degradation After Commissioning

Fig 24. Emergence & Persistence of Energy Savings (weather-normalized)



LBNL/Portland Energy Conservation/Energy Systems Lab Texas A&M, The Cost Effectiveness of Commercial-Buildings Commissioning, 2004

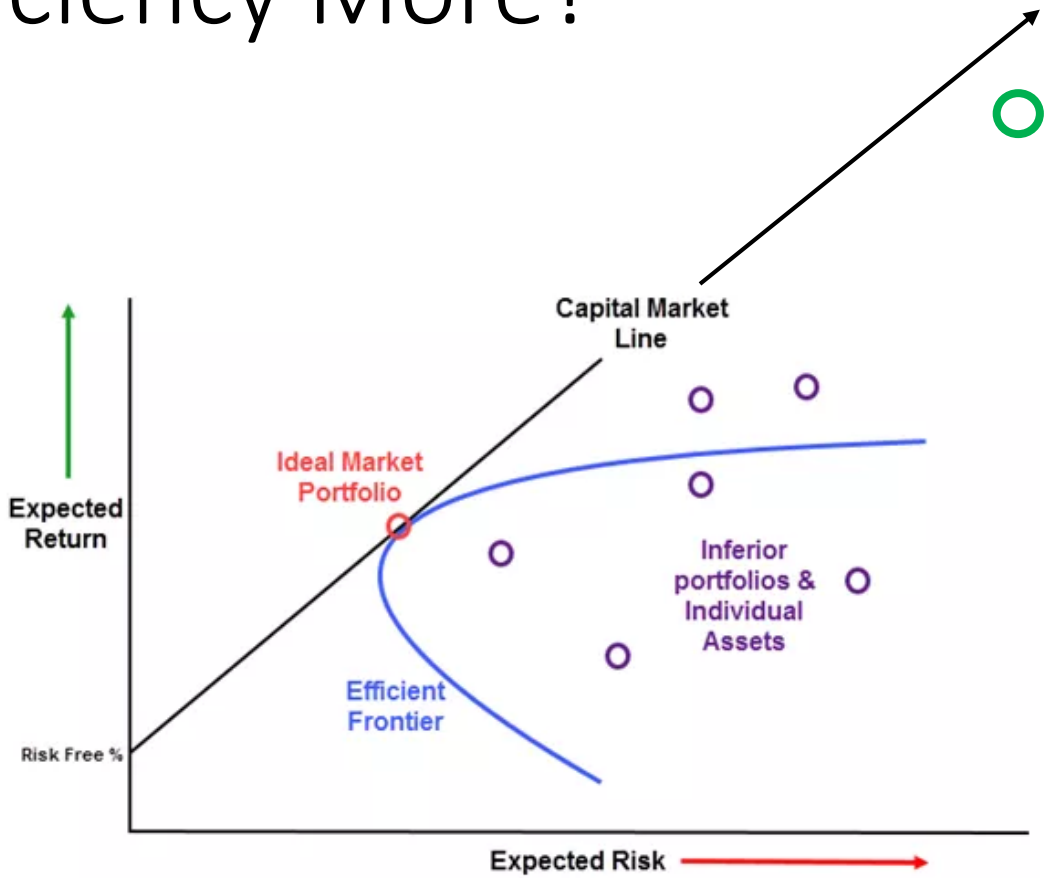
SETTING THE TABLE:
Top Operational Efficiency Opportunities Largely Unchanged

TOP 10 = TOP 10

2006 **2019**

SETTING THE TABLE:
Why Aren't Investors Targeting Operational Efficiency More?

EX: Occupancy Scheduling (200% Simple ROI)



Investopedia.com, CAPM, 2019

RECOGNIZING MAJOR CONTRIBUTORS TO PERFORMANCE RISK

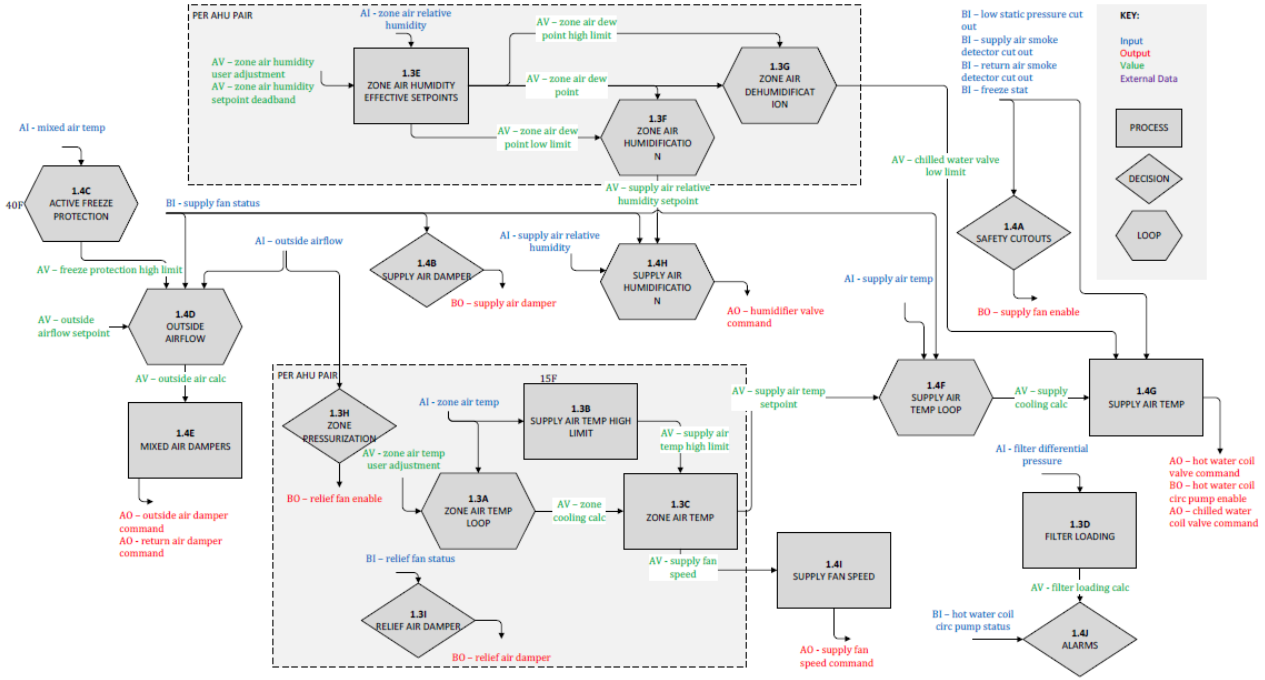


FIGURE – AHU Single Zone Sequence Flow Chart

Total Building Commissioning, University of Utah Marriott Library, Example AHU Sequence of Operation Flow Chart, 2015

1. **Solutions are too complicated and diverse to manage**
2. **Most projects don't address root cause *management* issues**
3. **No simple way to measure success over time**

A NEW MODEL FOR PERSISTENCE

FOCUS: prioritize top opportunities as a portfolio. Phase by stakeholder group and potential value

STANDARDIZE: establish standard solutions for common systems

COMMIT: formally revise/add job functions and protect staff time as management priority

MONITOR: utilize sensors and targeted analytics to monitor success of high-value initiatives over time

A NEW MODEL FOR PERSISTENCE: Prioritizing Top Opportunities as a Portfolio

UofU FM S&E Revolving Loan Prioritization

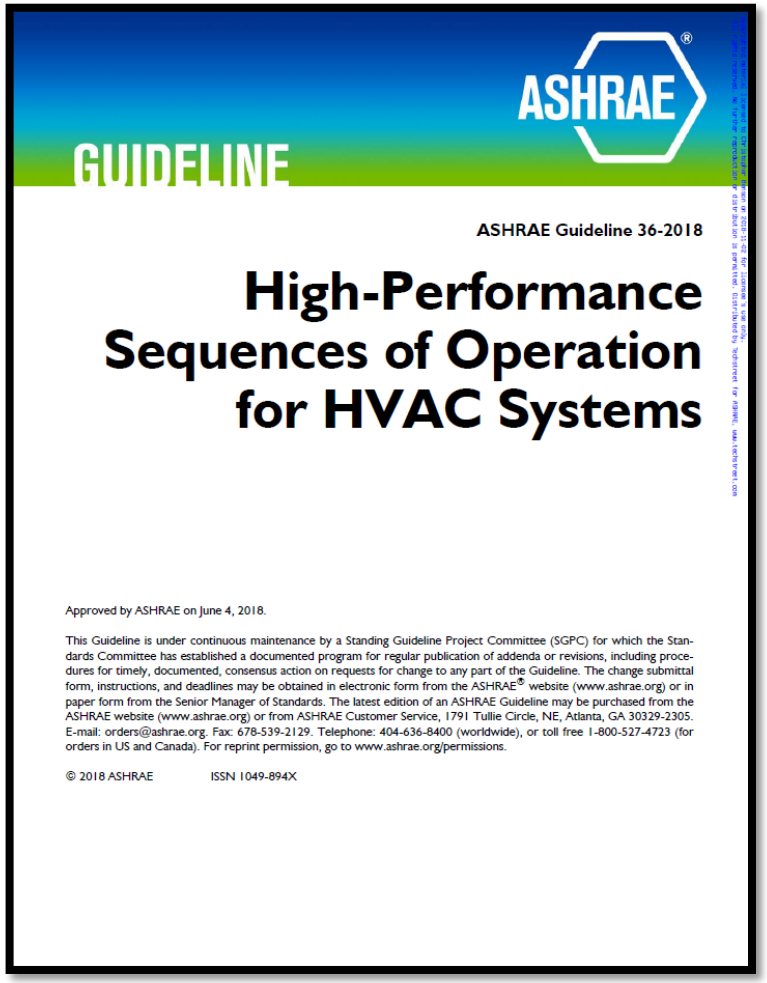
Benson, 2019-05-09

			Other Value Considerations										
Equip	Issue type	Measure Name	Health/safety, asset protection	Air Quality	O&M Labor Savings	Comfort	Measure Ease (1-simple fix, 2-some investigation/design, 3-major project)	Measure Life (yr)	Full-Scale Up-front Cost	Full-Scale Annual Labor for Full Persistence (FTE)	Full-Scale Annual Net Value	Savings to Investment Ratio (SIR)	Target Implementation Year
COGEN TURBI	scheduling/shutdowns	operate for elec demand peaking vs base heating	N	Y	Y	N	2	5.0	$ 3,000	0.0	$ 98,000	123.8	FY20
HEATING PLAN	optimization	Coordinate balancing valves (partially closed) and VFDs	N	N	Y	N	1	10.0	$ 3,000	-	$ 22,500	46.1	FY20
COOLING PLAN	optimization	Coordinate balancing valves (partially closed) and VFDs	N	N	Y	N	1	10.0	$ 1,000	-	$ 7,500	46.1	FY20
AHU	optimization	BAS override, reverse control, PID tuning	N	Y	Y	Y	2	5.0	$ 2,031	0.1	$ 14,214	26.5	FY20
ELEC SERVICE	supply type/cost	rate tariff changes (time of day or primary vs blended or	N	N	N	N	2	5.0	$ 3,375	0.0	$ 15,356	19.2	FY21
AHU	optimization	BAS override	N	Y	Y	N	1	2.0	$ 2,725	0.1	$ 17,715	11.3	FY20
AHU	optimization	BAS override	Y	N	Y	N	1	2.0	$ 2,725	0.1	$ 17,715	11.3	FY20
COOLING PLAN	scheduling/shutdowns	seasonal plant shutdowns	N	N	Y	N	3	1.0	$ 31,500	0.1	$ 302,400	8.7	FY20
AHU	old/undesired technolo	advanced rooftop controller vs standalone controls	N	Y	Y	Y	2	10.0	$ 179,550	-	$ 179,550	7.4	FY20
AHU	scheduling/shutdowns	occupancy scheduling and temp setbacks vs minimal (ma	N	Y	Y	N	3	5.0	$ 828,495	0.4	$ 1,587,949	7.3	FY20
STEAM TRAP	corrective maint issue	blow through, flooded, plugged	N	Y	Y	N	2	4.0	$ 62,720	0.1	$ 92,400	5.2	FY20
HEATING PLAN	scheduling/shutdowns	seasonal plant shutdowns	N	Y	Y	N	3	1.0	$ 94,500	0.2	$ 340,200	3.3	FY20
AHU	corrective maint issue	external leak (usually noticed and fixed without intervent	N	Y	N	N	2	4.0	$ 15,322	-	$ 11,491	2.7	FY21
AHU VALVES	corrective maint issue	clogged/damaged valve seat, open bypass, loose connec	N	Y	Y	N	2	4.0	$ 70,178	0.4	$ 49,710	2.5	FY21
COOLING PLAN	system issue	supply water temp setpoint reset w/ increased use of wa	N	N	Y	N	3	5.0	$ 15,000	0.0	$ 9,375	2.5	FY21
AHU	optimization	Supply air temp setpoint reset	N	Y	Y	Y	2	5.0	$ 697,680	0.7	$ 436,050	2.4	FY20
CHILLER	system issue	variable primary pumping w/ bypass flow control	N	N	Y	N	2	10.0	$ 147,000	0.0	$ 47,775	2.2	FY21
LIGHTING OUT	old/undesired technolo	LED vs metal halide	Y	N	Y	N	3	15.0	$ 350,000	-	$ 70,000	1.9	FY21
LIGHTING IND	old/undesired technolo	LED vs fluorescent tube	Y	N	Y	N	3	15.0	$ 7,728,300	-	$ 1,159,245	1.5	high capita
LIGHTING OUT	old/undesired technolo	LED vs metal halide	Y	N	Y	N	2	15.0	$ 75,000	-	$ 11,250	1.5	FY21

A NEW MODEL FOR PERSISTENCE: Prioritizing Top Opportunities as a Portfolio – FY20 Scope

- A-1. Cogen transition to electric peaking
- A-2. Plant pumping optimization
- B-1. AHU setpoint optimization
- B-2. AHU advanced rooftop controllers
- C-1. Seasonal heat/cool mode optimization
- C-2. Occupancy scheduling and setbacks
- D. Steam trap survey and corrections

A NEW MODEL FOR PERSISTENCE: Establish Standard Solutions for Common Systems



ASHRAE Guideline 36-2018, Cover and VAV reheat excerpt

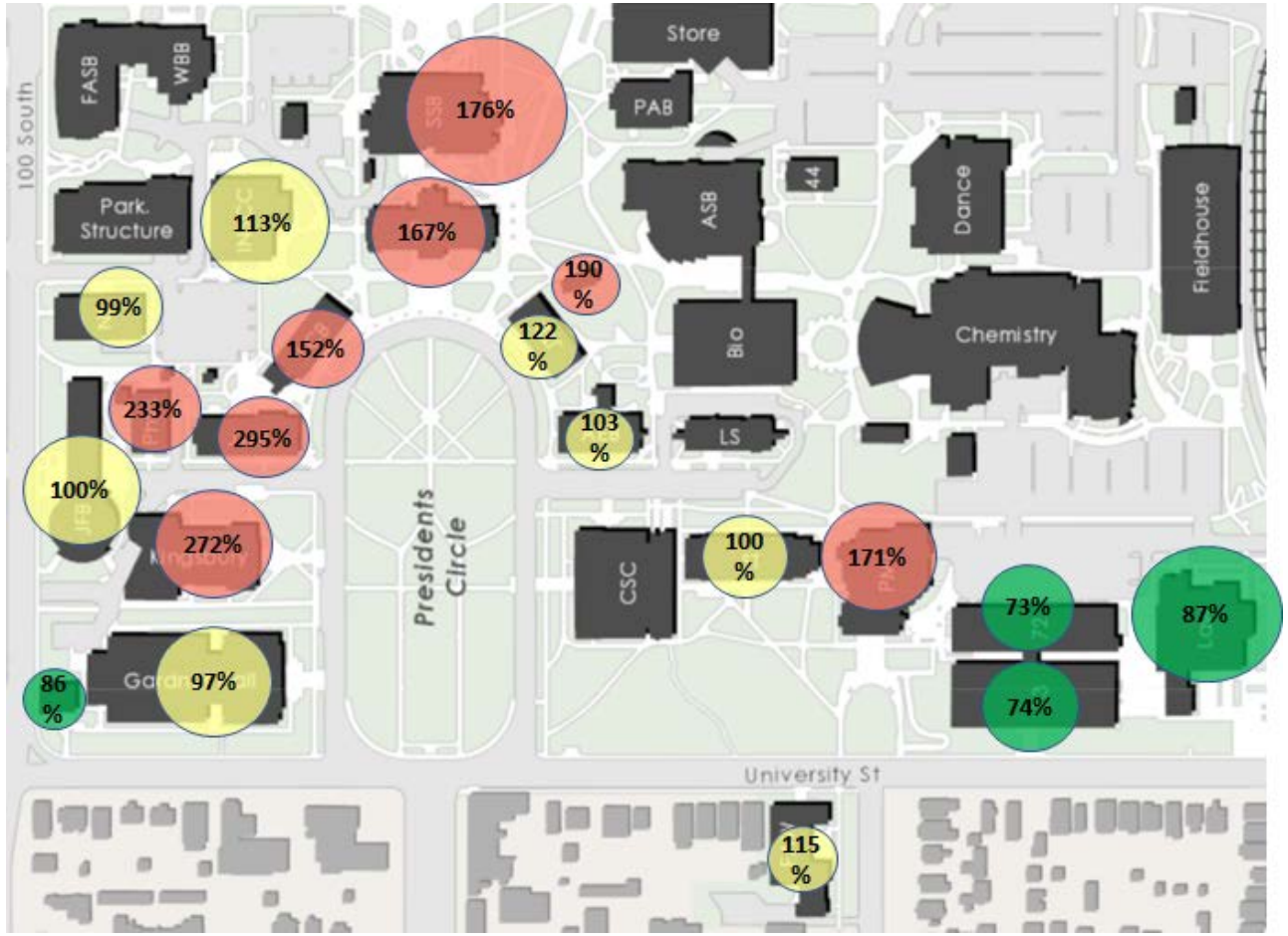
5.6.8.1 Cooling SAT Reset Requests

a. If the zone temperature exceeds the zone's cooling set point by 3°C (5°F) for 2 minutes and after suppression period due to set point change per Section 5.1.19, send 3 requests.
b. Else if the zone temperature exceeds the zone's cooling set point by 2°C (3°F) for 2 minutes and after suppression period due to set point change per Section 5.1.19, send 2 requests.
c. Else if the cooling loop is greater than 95%, send 1 request until the cooling loop is less than 85%.
d. Else if the cooling loop is less than 95%, send 0 requests.

5.6.8.2 Static Pressure Reset Requests

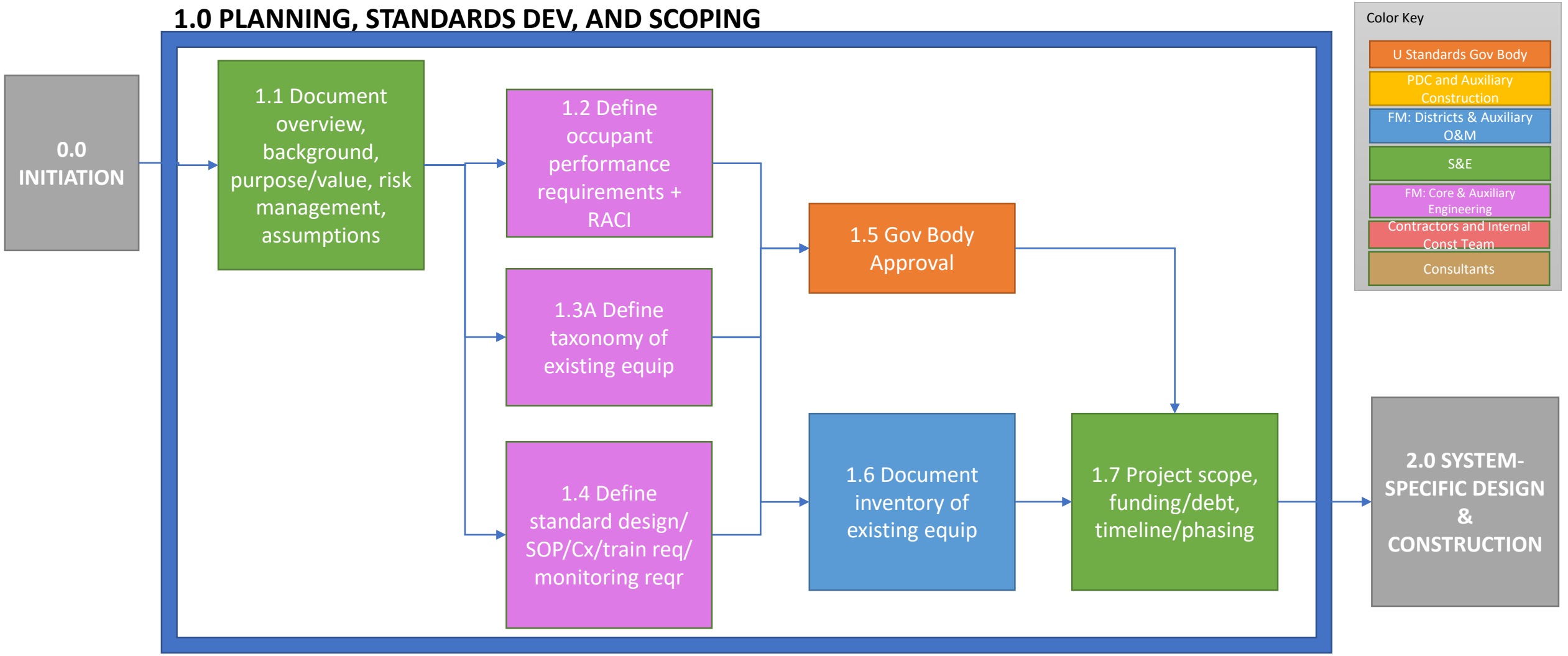
a. If the measured airflow is less than 50% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.
b. Else if the measured airflow is less than 70% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.
c. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.
d. Else if the damper position is less than 95%, send 0 requests.

A NEW MODEL FOR PERSISTENCE:
Phase by Stakeholder Group and Potential Value



University of Utah District 1 Benchmark Report, 2018

A NEW MODEL FOR PERSISTENCE:
Formally Revise Job Functions and Protect Staff Time



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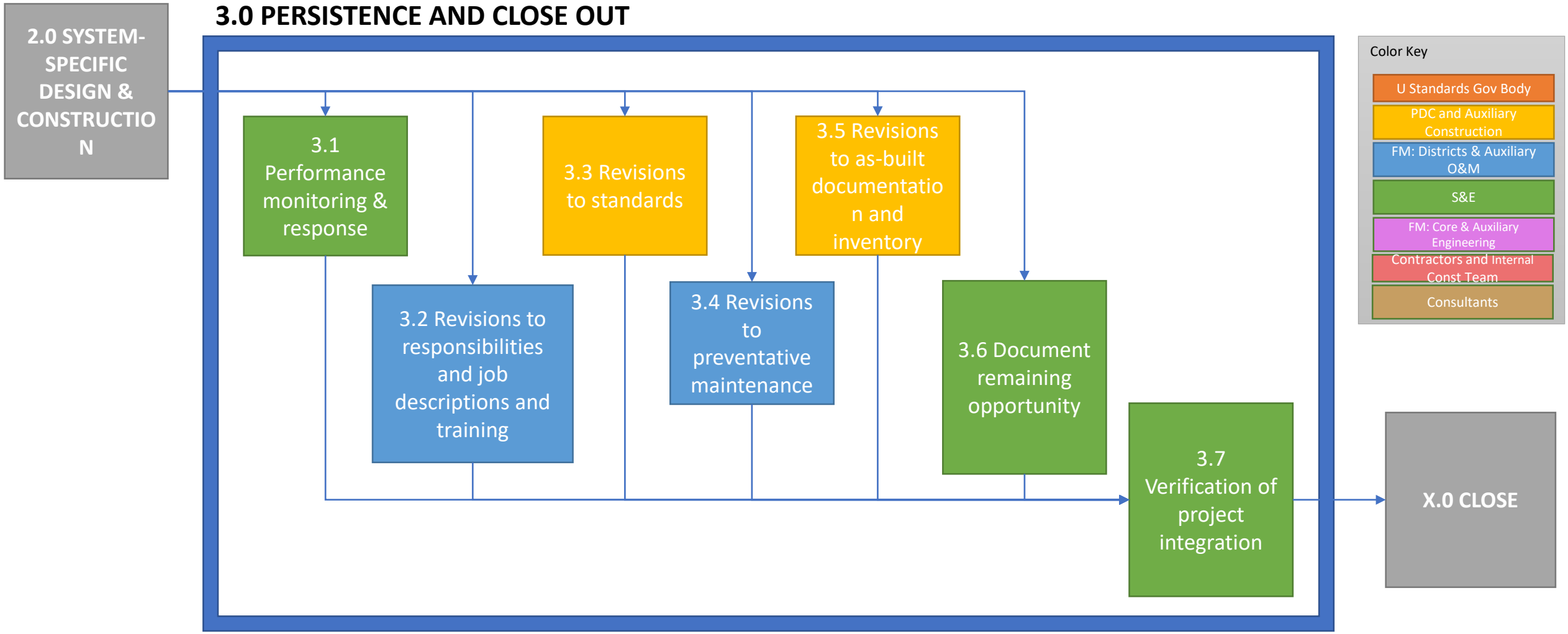

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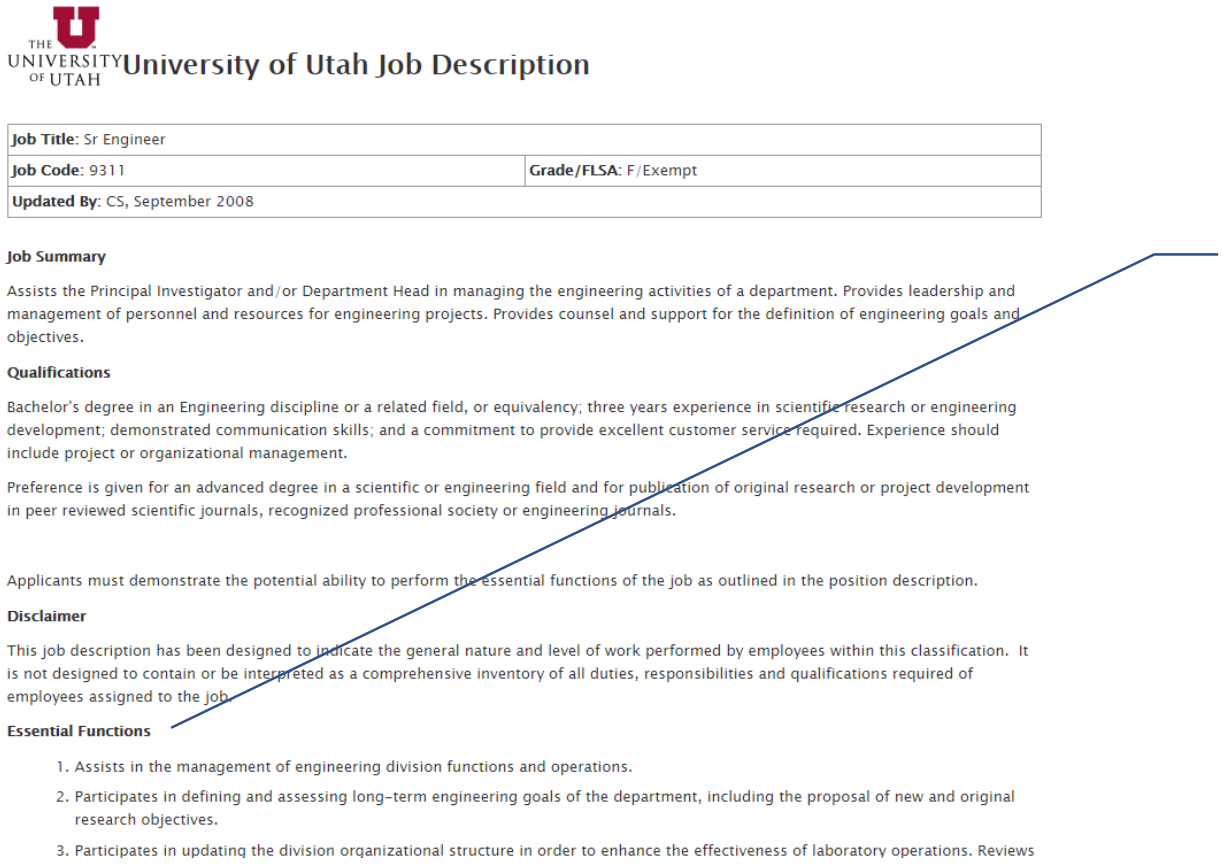


THE UNIVERSITY OF UTAH University of Utah Job Description

Job Title: Sr Engineer	
Job Code: 9311	**Grade/FLSA**: F/Exempt
Updated By: CS, September 2008	

Job Summary

Assists the Principal Investigator and/or Department Head in managing the engineering activities of a department. Provides leadership and management of personnel and resources for engineering projects. Provides counsel and support for the definition of engineering goals and objectives.

Qualifications

Bachelor's degree in an Engineering discipline or a related field, or equivalency; three years experience in scientific research or engineering development; demonstrated communication skills; and a commitment to provide excellent customer service required. Experience should include project or organizational management.

Preference is given for an advanced degree in a scientific or engineering field and for publication of original research or project development in peer reviewed scientific journals, recognized professional society or engineering journals.

Applicants must demonstrate the potential ability to perform the essential functions of the job as outlined in the position description.

Disclaimer

This job description has been designed to indicate the general nature and level of work performed by employees within this classification. It is not designed to contain or be interpreted as a comprehensive inventory of all duties, responsibilities and qualifications required of employees assigned to the job.

Essential Functions

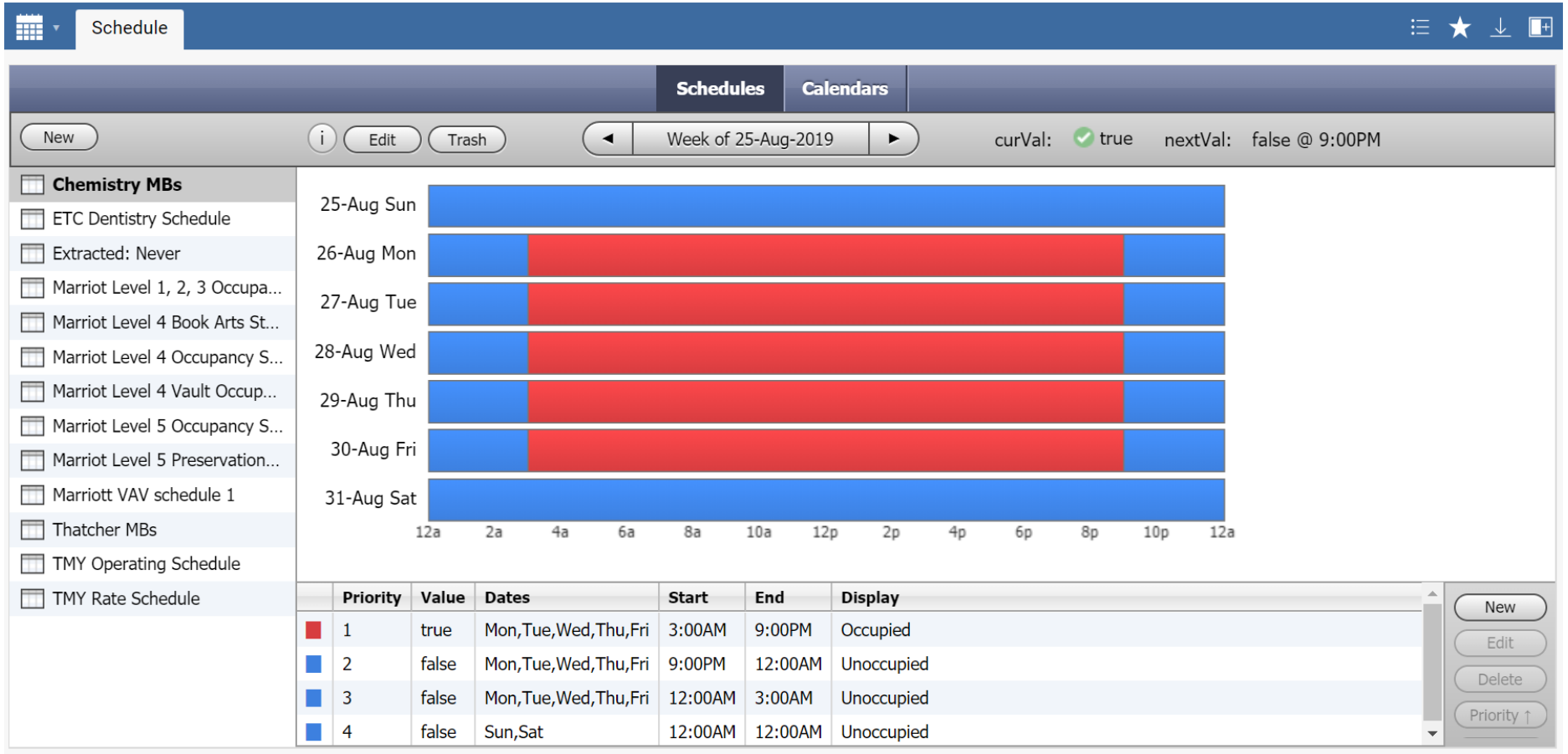
1. Assists in the management of engineering division functions and operations.
2. Participates in defining and assessing long-term engineering goals of the department, including the proposal of new and original research objectives.
3. Participates in updating the division organizational structure in order to enhance the effectiveness of laboratory operations. Reviews

University of Utah, Job Description for Sr Engineer, 2019-09

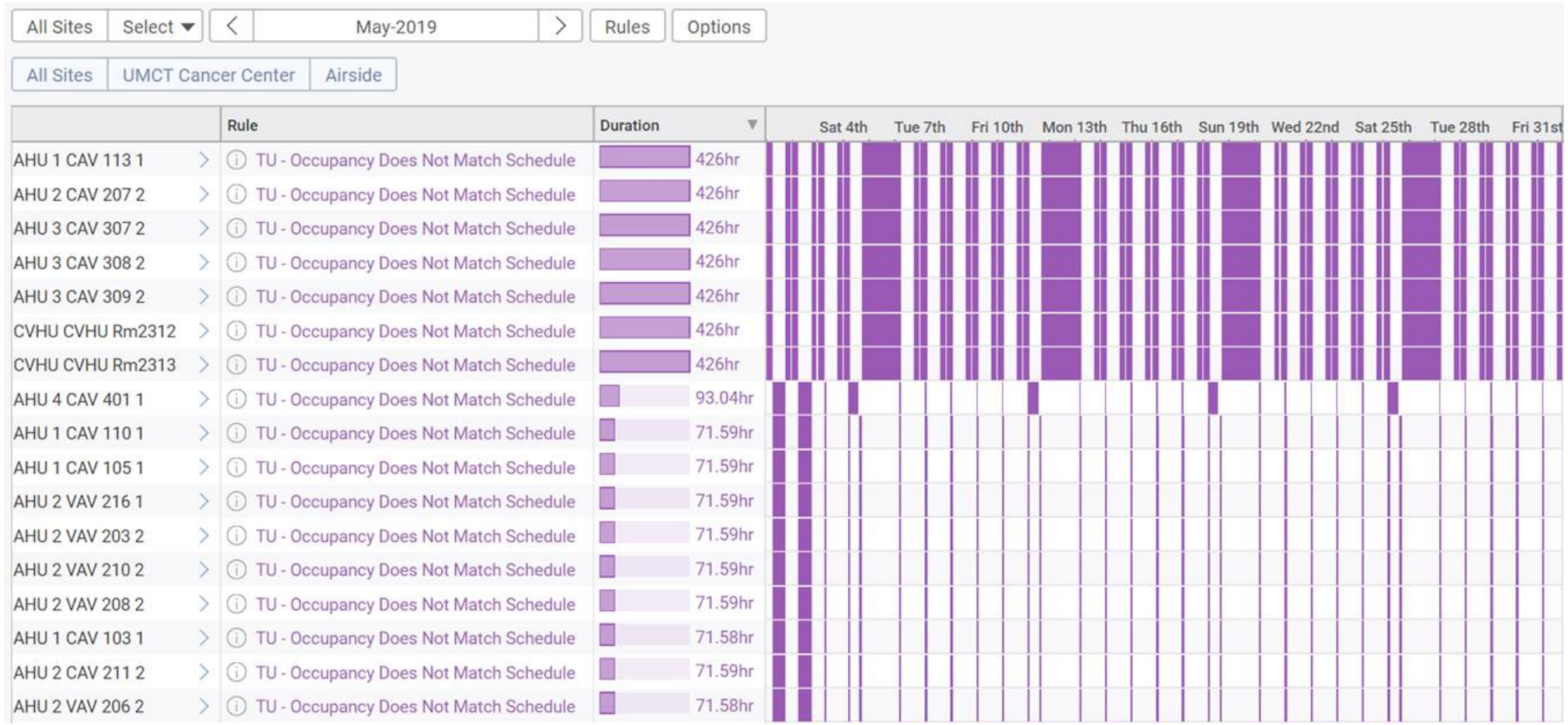
Example Function Change:

4 (NEW). Monthly review performance of top-priority operational efficiency measures. Where degradation has occurred, coordinate…

A NEW MODEL FOR PERSISTENCE:
Analytic Example #1: Establishing Building Schedules

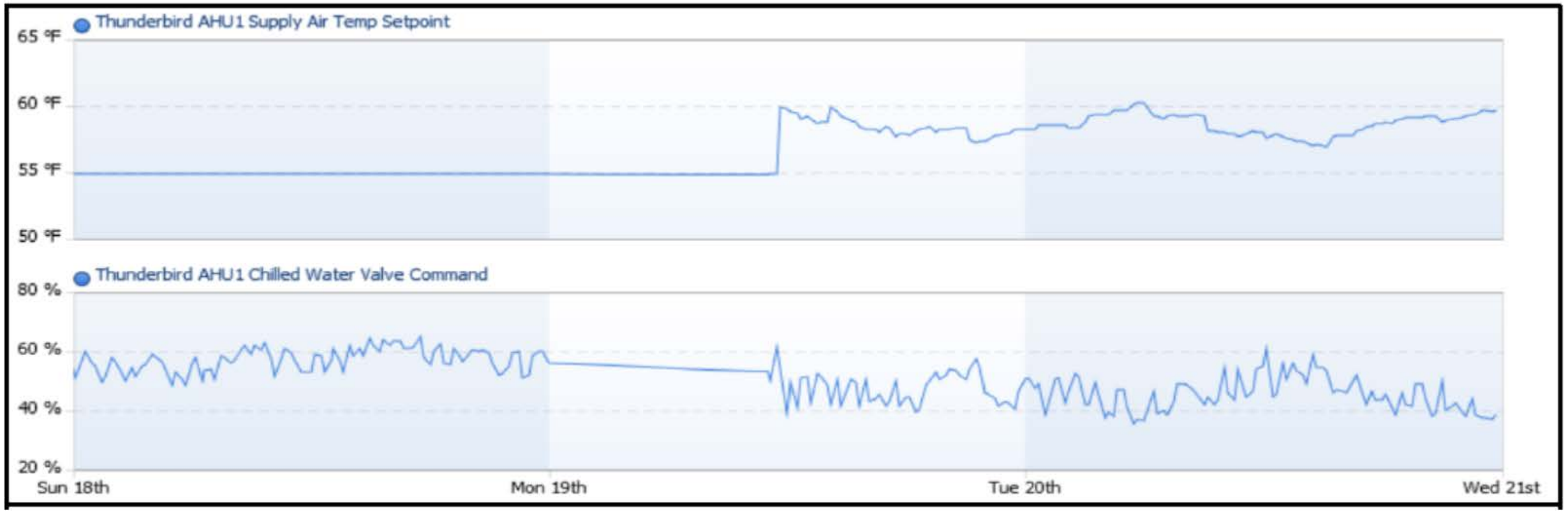


A NEW MODEL FOR PERSISTENCE:
Analytic Example #1: Persistent Building Schedules

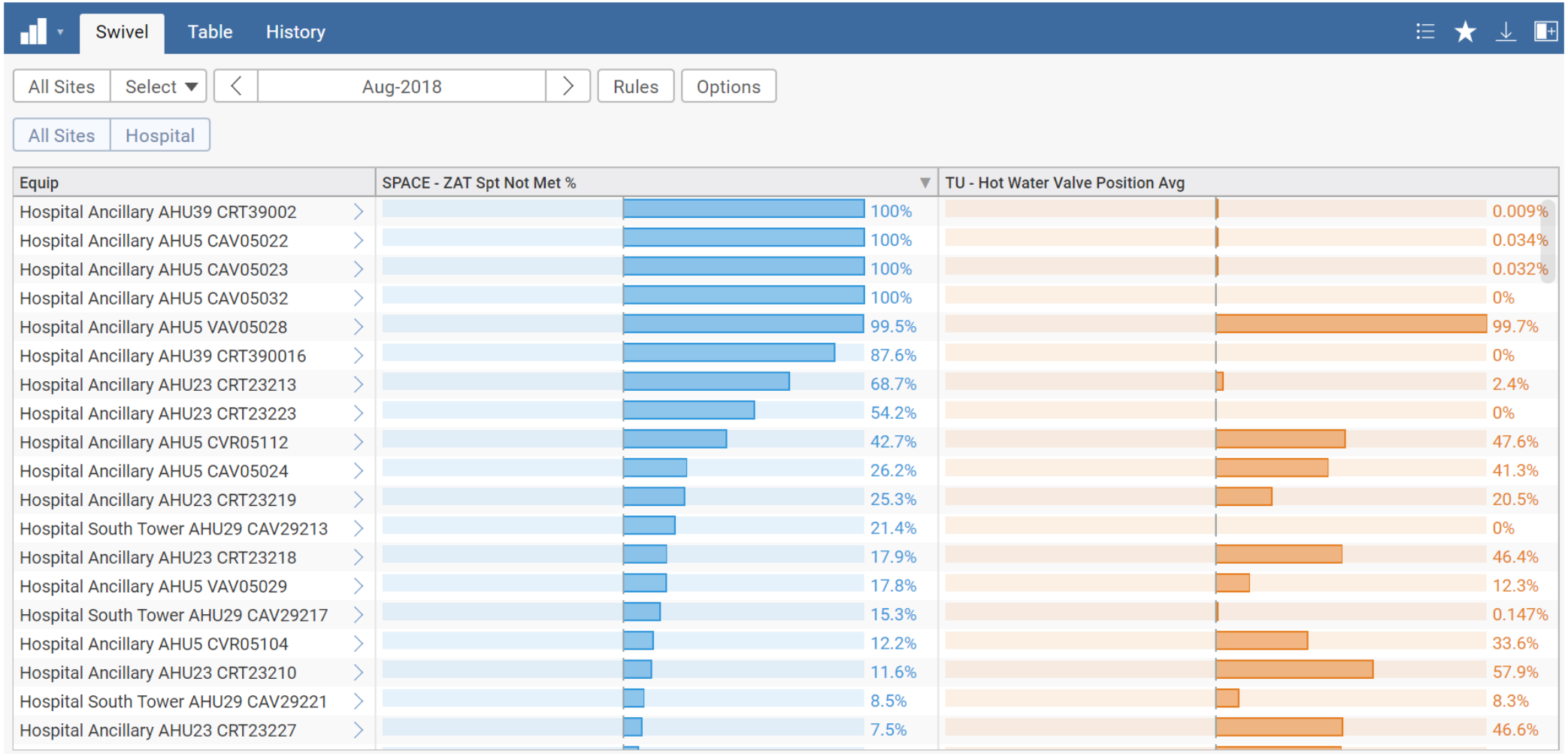


A NEW MODEL FOR PERSISTENCE:
Analytic Example #2: Supply Air Temperature Reset

- It saves energy
- Does it impact comfort?

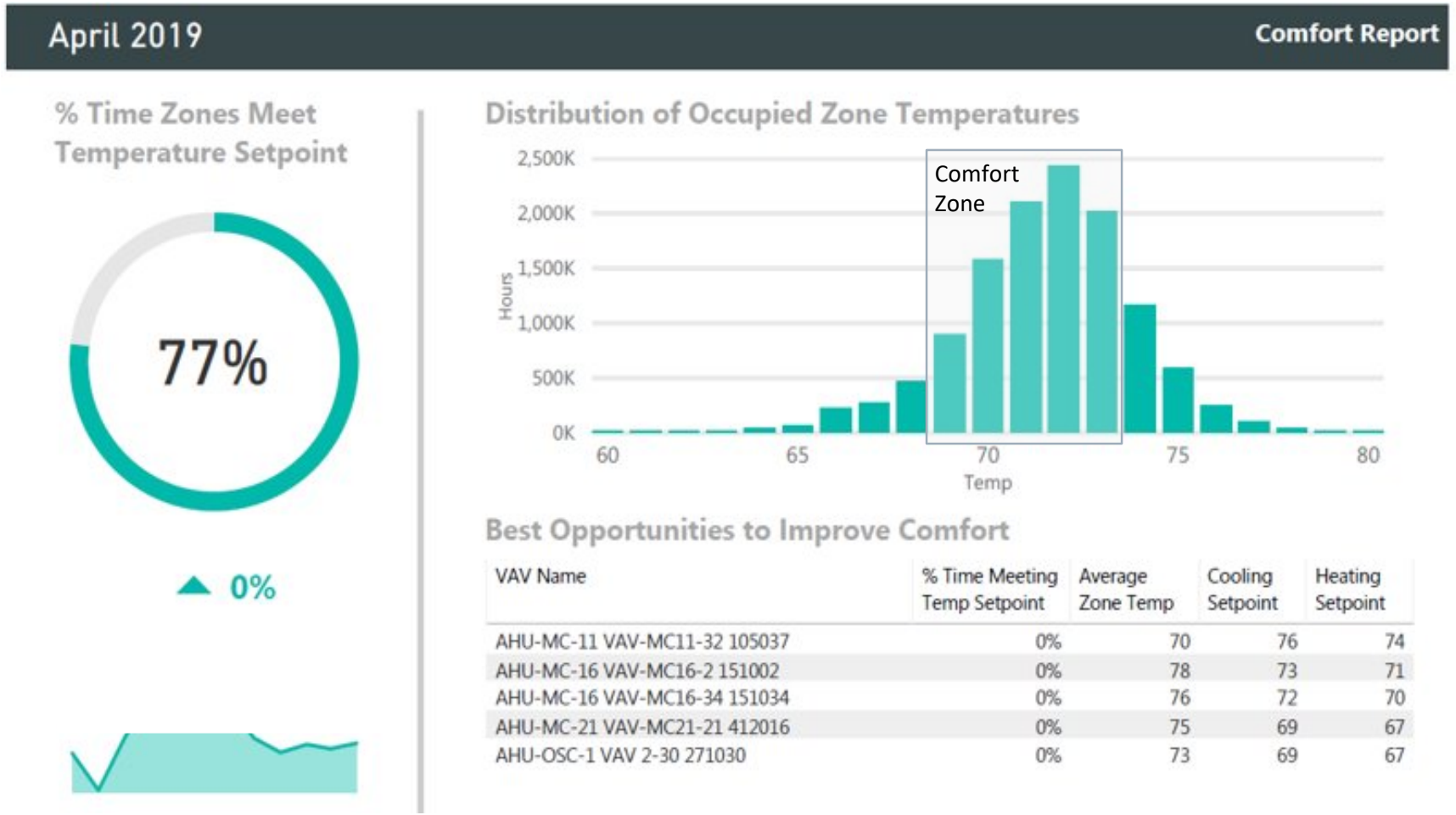


A NEW MODEL FOR PERSISTENCE:
Analytic Example #2: Persistent Savings & Maintain Comfort

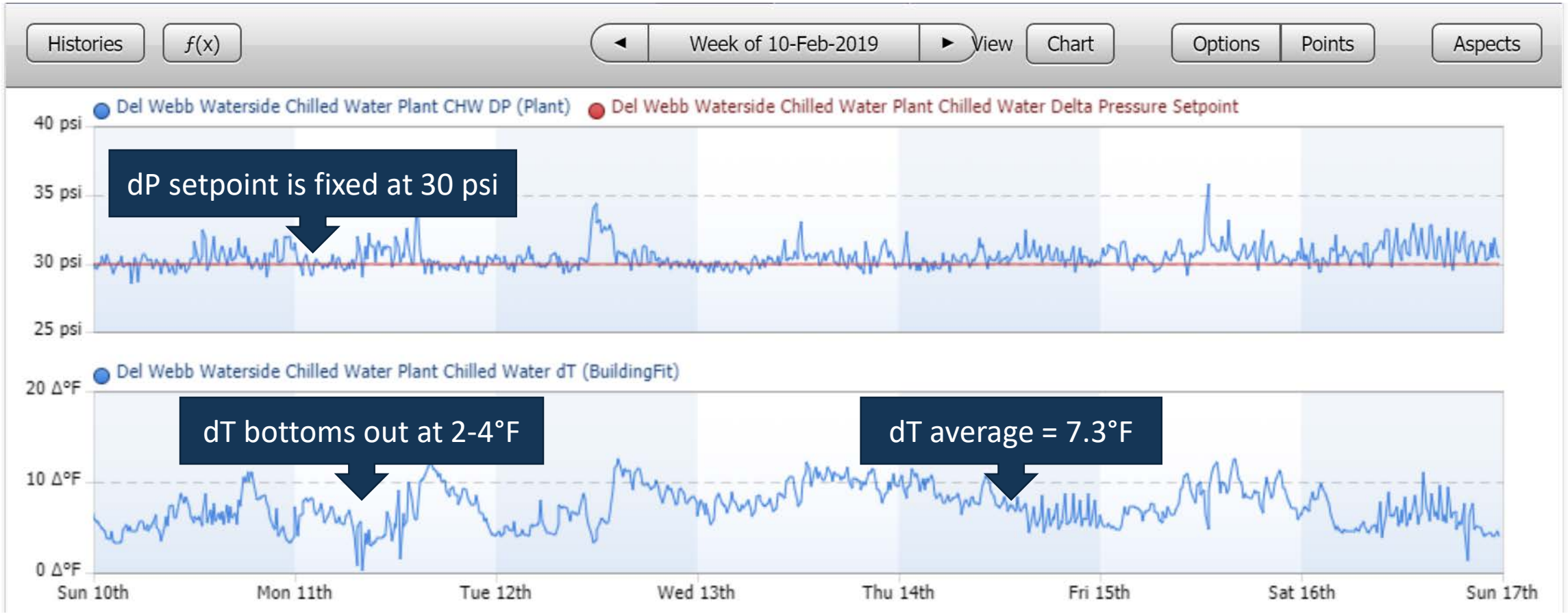


Equip	SPACE - ZAT Spt Not Met %	TU - Hot Water Valve Position Avg
Hospital Ancillary AHU39 CRT39002	100%	0.009%
Hospital Ancillary AHU5 CAV05022	100%	0.034%
Hospital Ancillary AHU5 CAV05023	100%	0.032%
Hospital Ancillary AHU5 CAV05032	100%	0%
Hospital Ancillary AHU5 VAV05028	99.5%	99.7%
Hospital Ancillary AHU39 CRT390016	87.6%	0%
Hospital Ancillary AHU23 CRT23213	68.7%	2.4%
Hospital Ancillary AHU23 CRT23223	54.2%	0%
Hospital Ancillary AHU5 CVR05112	42.7%	47.6%
Hospital Ancillary AHU5 CAV05024	26.2%	41.3%
Hospital Ancillary AHU23 CRT23219	25.3%	20.5%
Hospital South Tower AHU29 CAV29213	21.4%	0%
Hospital Ancillary AHU23 CRT23218	17.9%	46.4%
Hospital Ancillary AHU5 VAV05029	17.8%	12.3%
Hospital South Tower AHU29 CAV29217	15.3%	0.147%
Hospital Ancillary AHU5 CVR05104	12.2%	33.6%
Hospital Ancillary AHU23 CRT23210	11.6%	57.9%
Hospital South Tower AHU29 CAV29221	8.5%	8.3%
Hospital Ancillary AHU23 CRT23227	7.5%	46.6%

A NEW MODEL FOR PERSISTENCE:
Analytic Example #2: Persistent Savings & Maintain Comfort



A NEW MODEL FOR PERSISTENCE:
Analytic Example #3: Monitoring Control of CHW Plant ΔT



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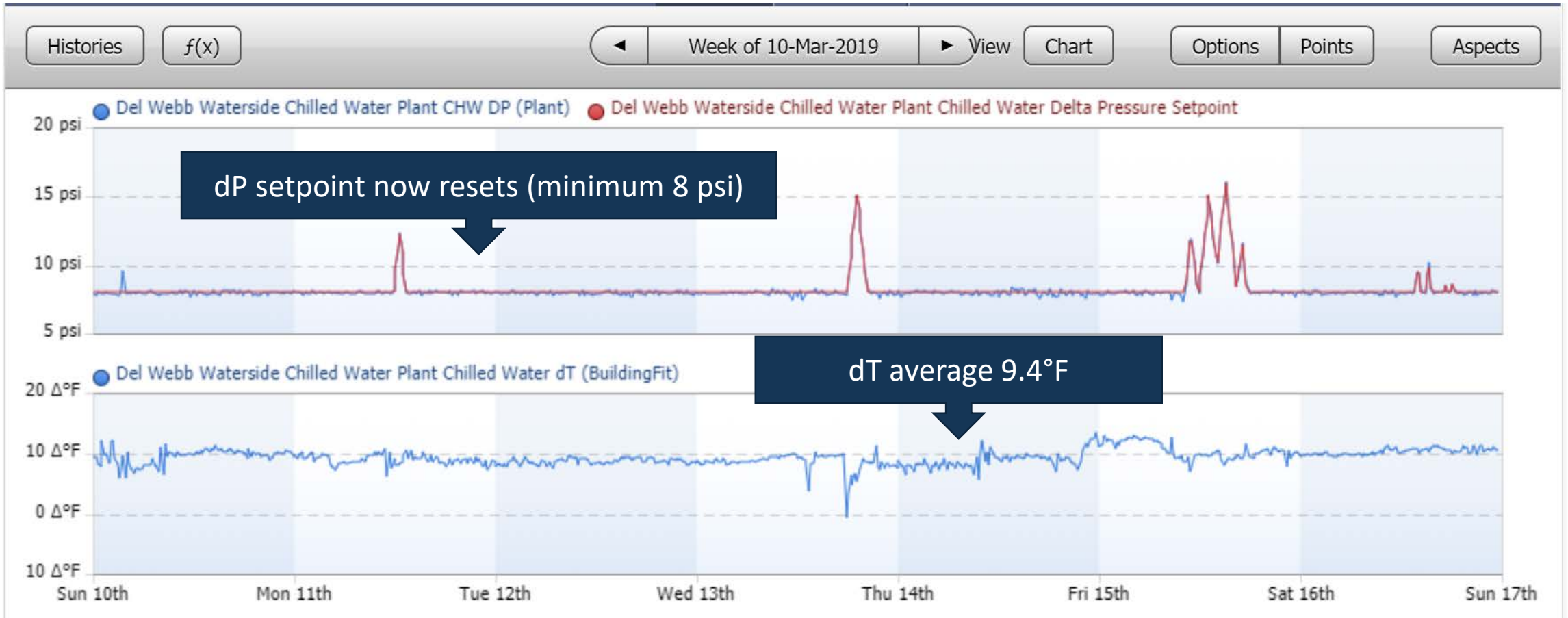

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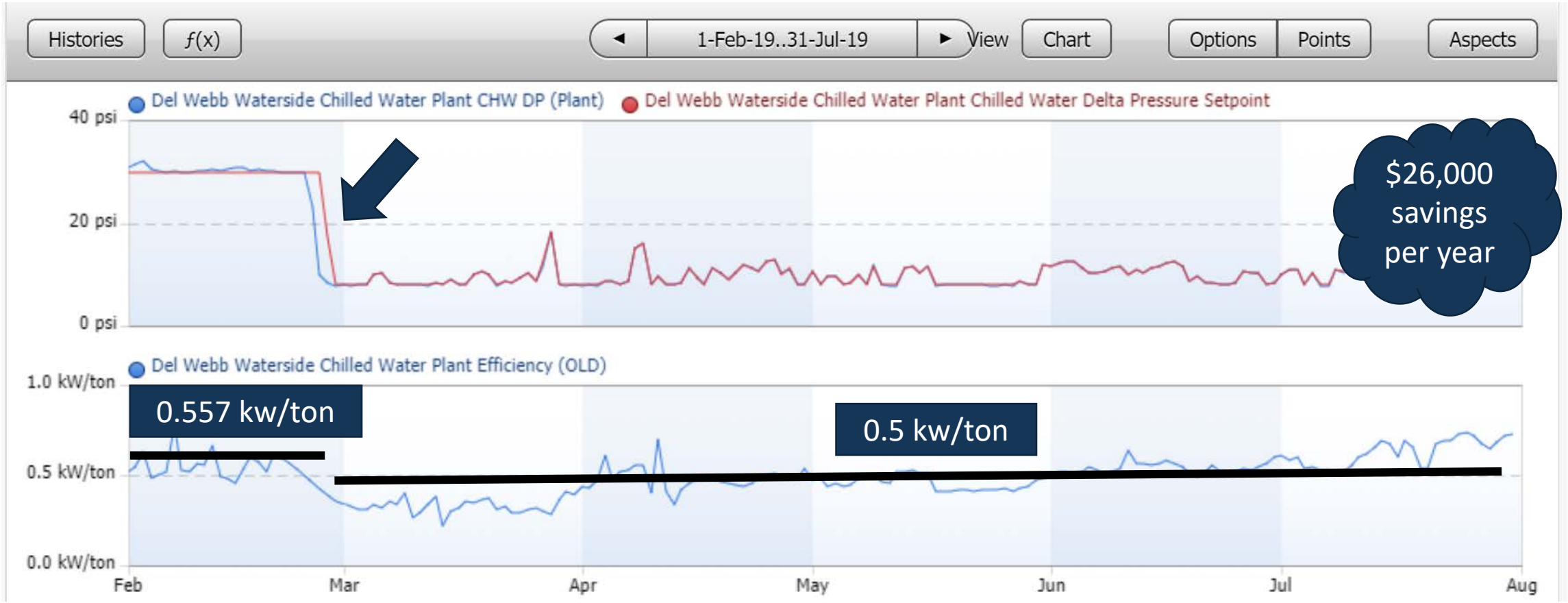
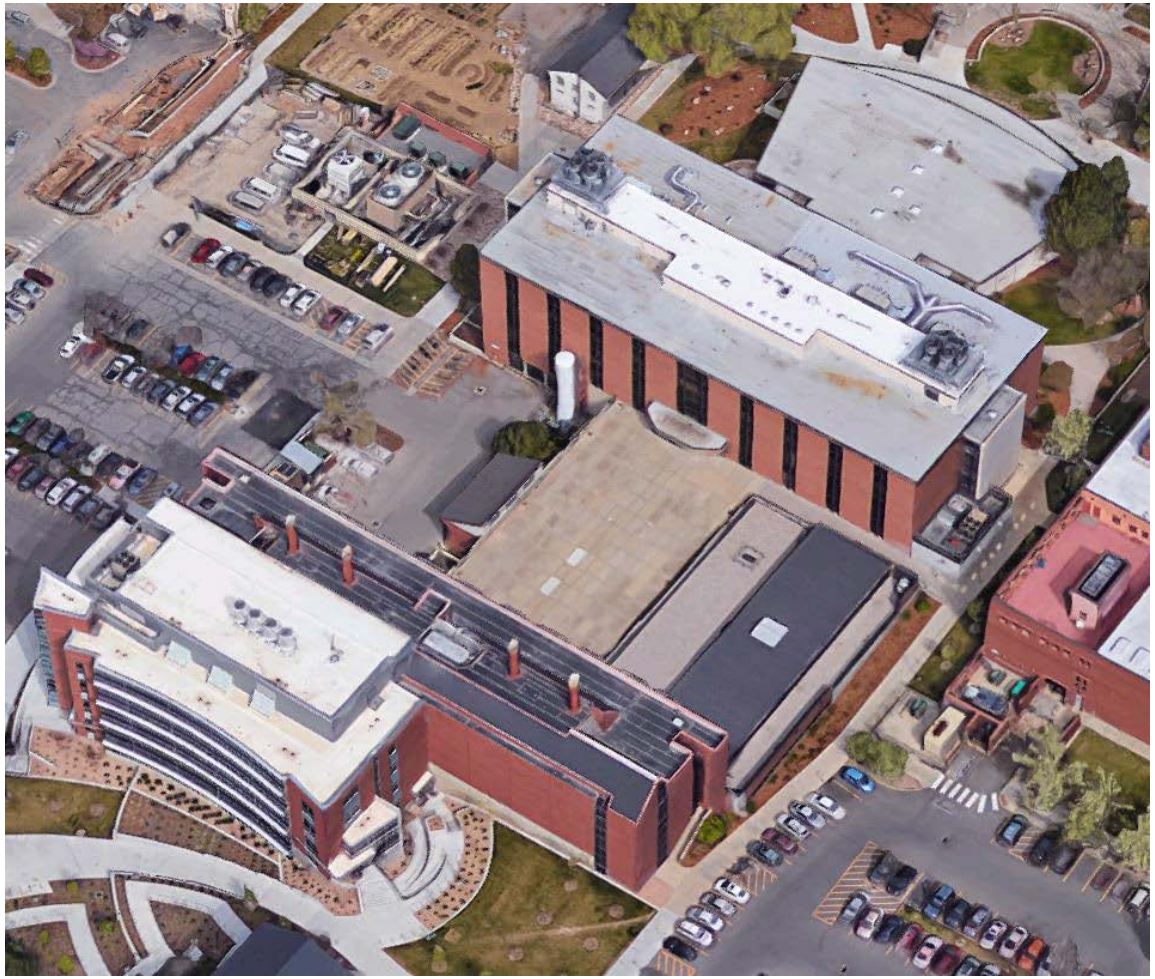
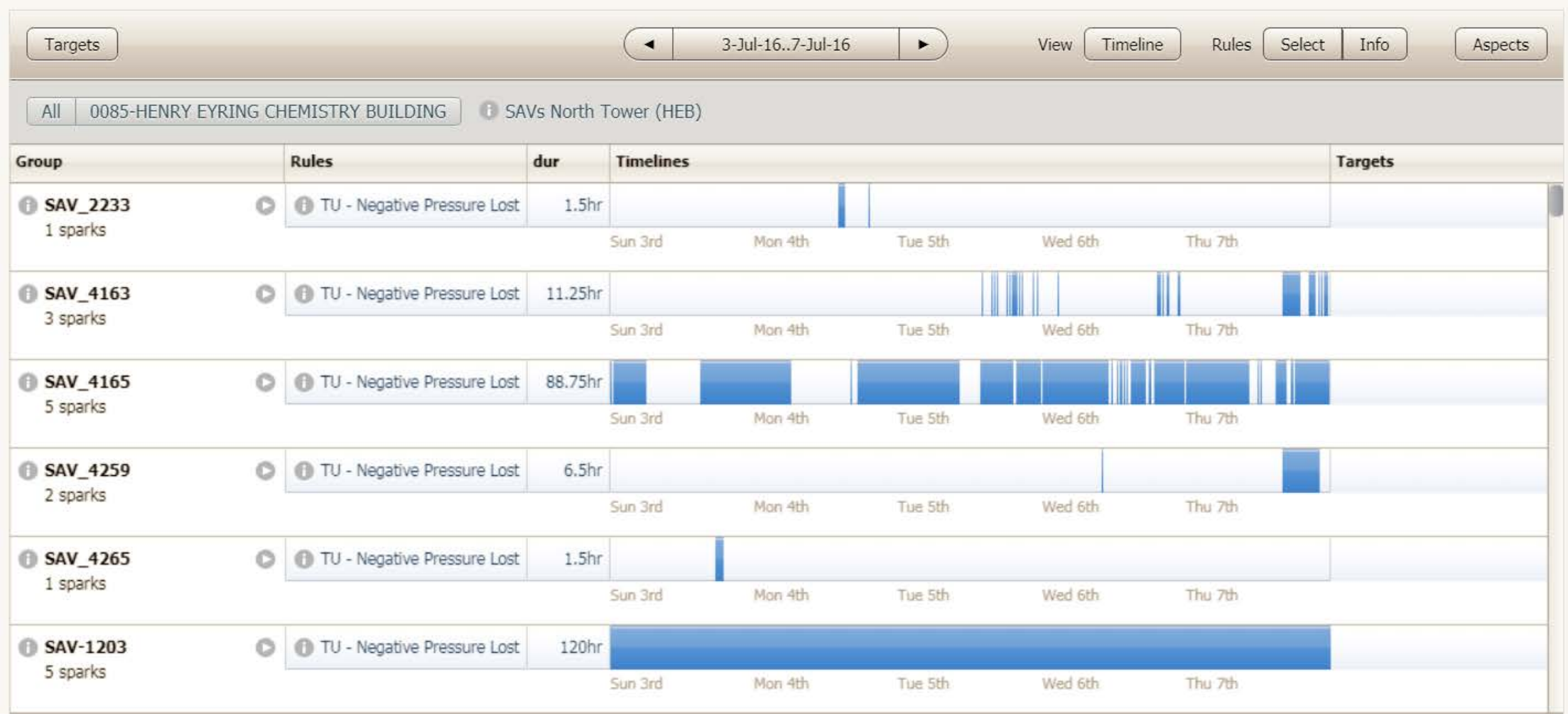


OTHER BENEFITS: Health and Safety
Negative Lab Pressure

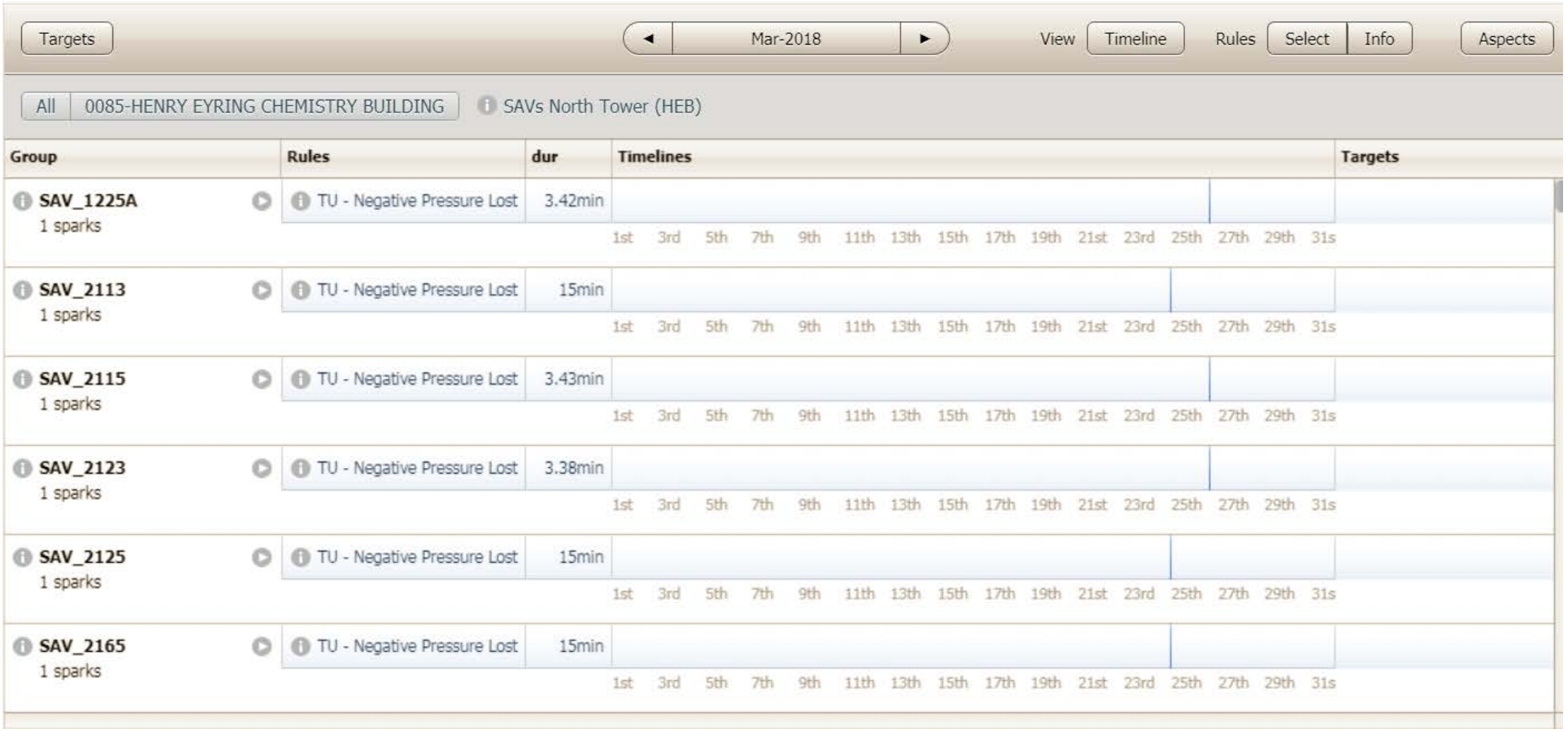


OTHER BENEFITS: Health and Safety
Negative Lab Pressure

OTHER BENEFITS:
Analytic Example #4: Negative Lab Pressure



OTHER BENEFITS:
Analytic Example #4: Negative Lab Pressure

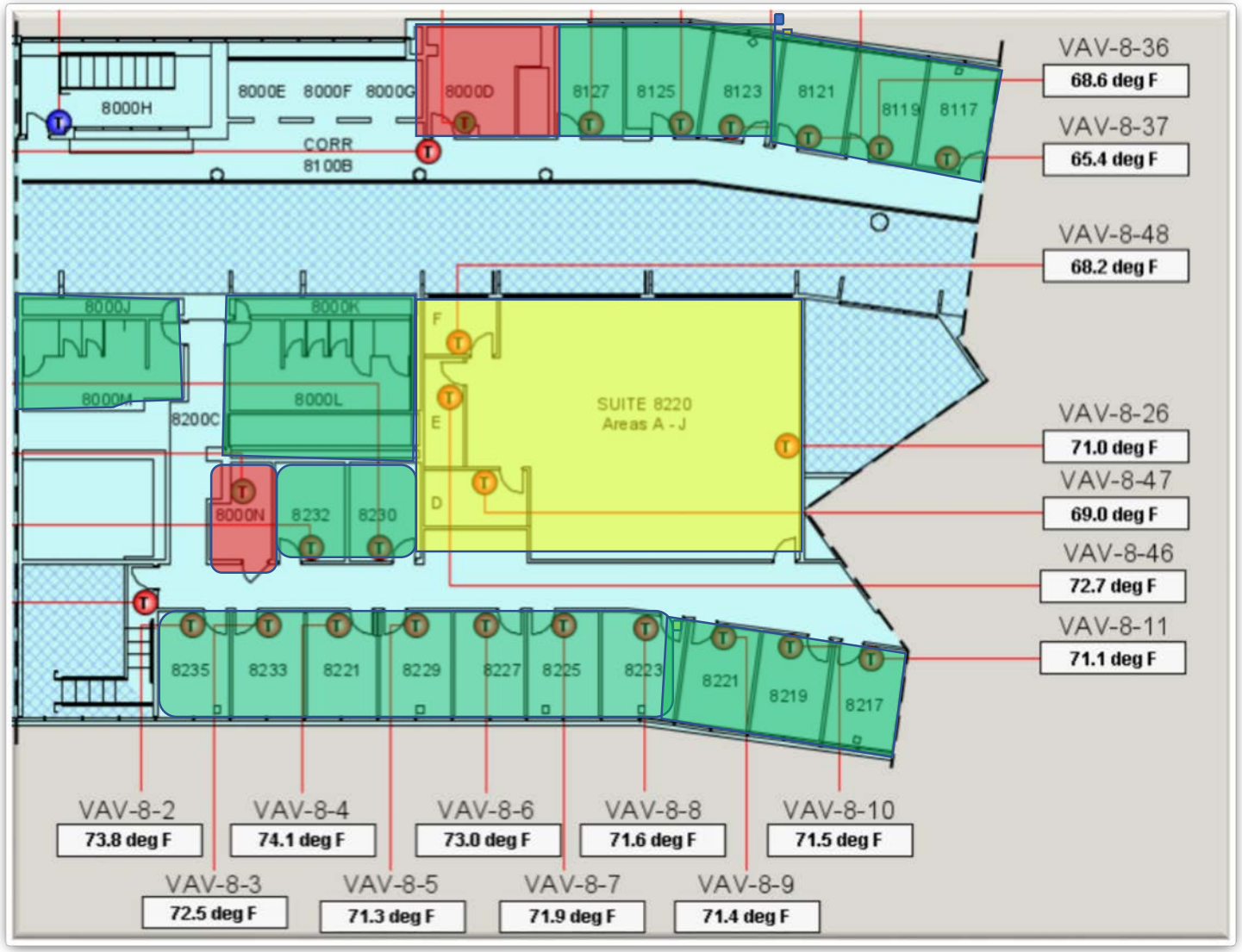


OTHER BENEFITS: Value Adds of New Model

1. Reduced cost of design

2. Save time and improved quality of O&M with new references for troubleshooting and training

3. Process for identifying /prioritizing additional opportunities



Thank you!

Questions?

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Program Manager, Sustainability & Energy
University of Utah, Dept. of Facilities Management

Jane Guyer, PE, CxA, LEED AP
Principal Engineer
ETC Group, LLC
jguyer@etcgrp.com
801-232-0883

BONUS SLIDES

OTHER BENEFITS: Occupancy Control of HVAC

OTHER BENEFITS: Savings Measurement