CleanMed
SALT LAKE CITY

Building Consensus for Emissions Reducing Energy Projects

Michael Bigelow

PE, CEM, CCP, LEED AP BD+C

Seattle Children's Hospital

Speaker

Michael Bigelow (he/him)

PE, CEM, CCP, LEED AP BD+C
Program Manager

Systems Engineering, Energy and Water Programs

Seattle Children’s Hospital

CleanMed
SALT LAKE CITY

Moderator

Shanda Demorest, DNP, RN, PHN (she/her)

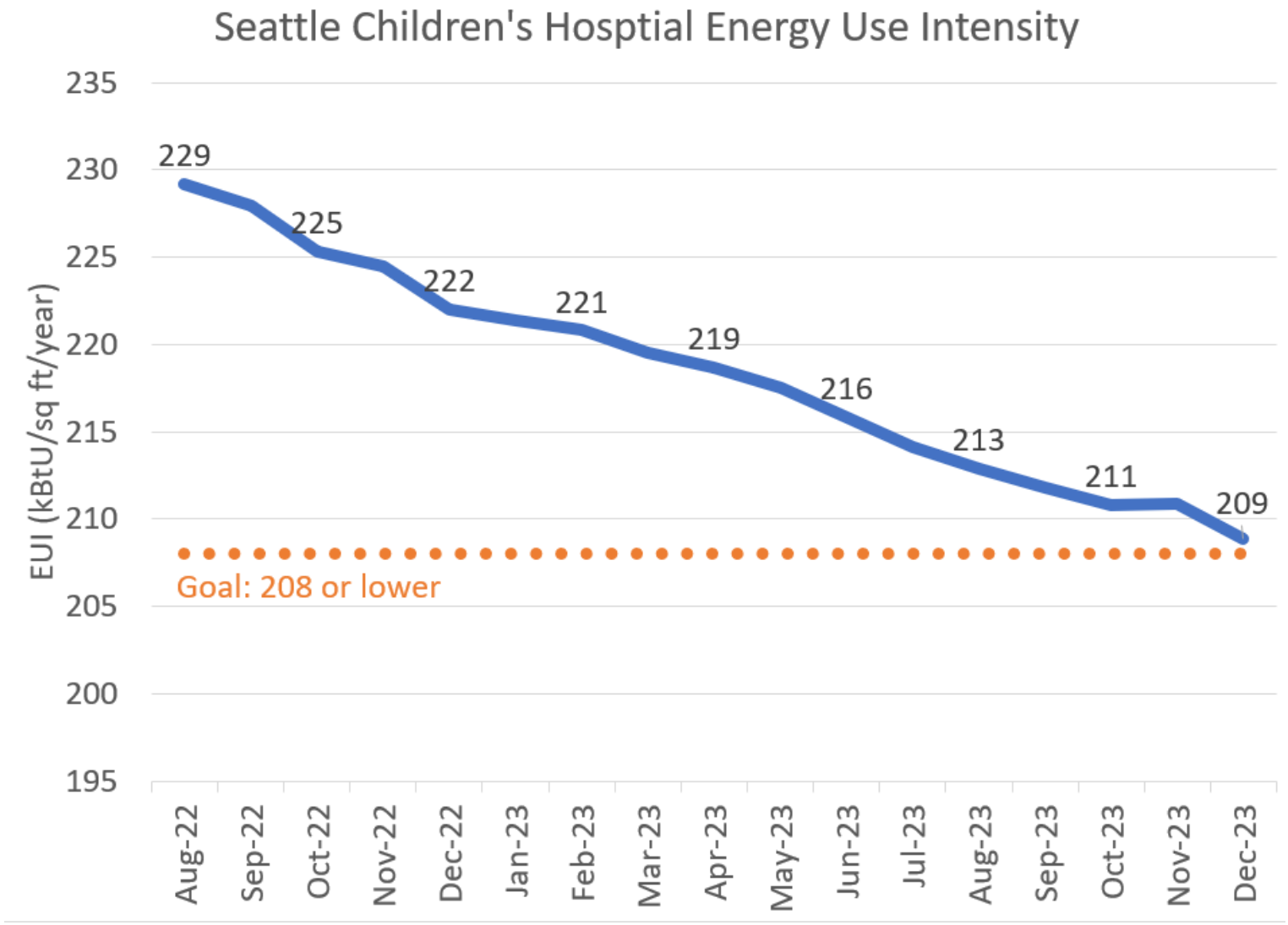
- Director, Sustainability Solutions
- Practice Greenhealth & Health Care Without Harm
- Affiliate Faculty, University of Minnesota School of Nursing
- U.S. Green Building Council LEED Green Associate

CleanMed
SALT LAKE CITY

Seattle Children's Story: How it Started

- Cut energy by 20% in 5 years or pay $1.6M/year
- Added 355,000 sq ft of space & 8 Operating Rooms
- Limited Capital Budget

How it's going:



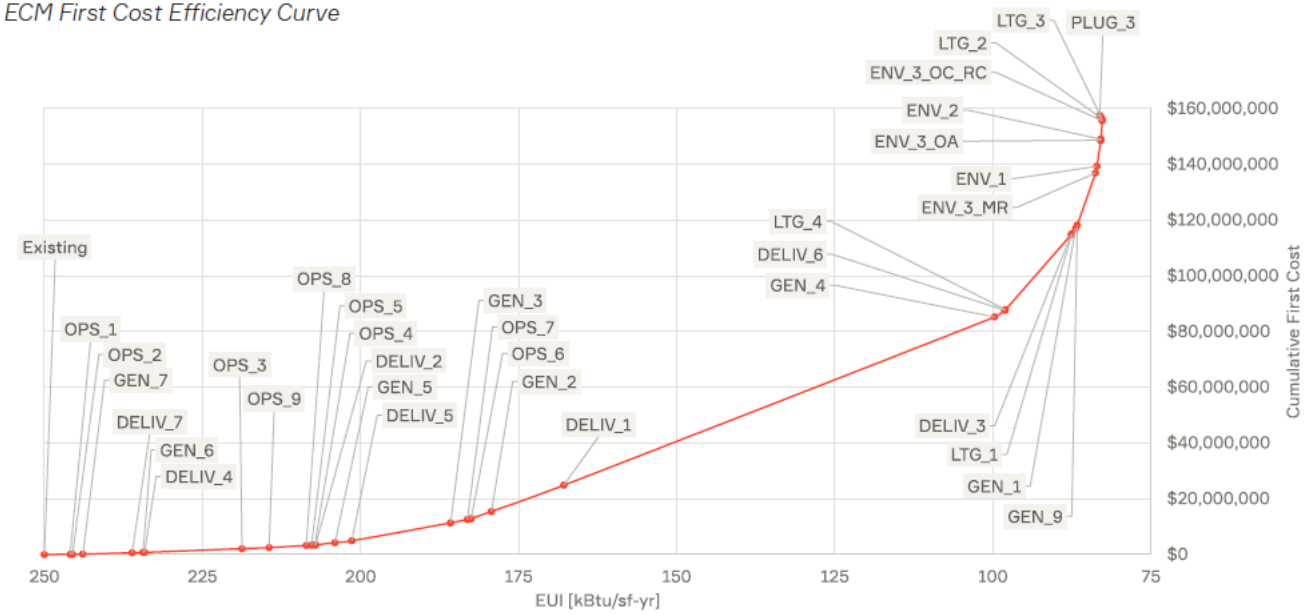
Audience Polls

- Backgrounds
- Interest in Buildings
- Exciting Challenges

How’d we get here?

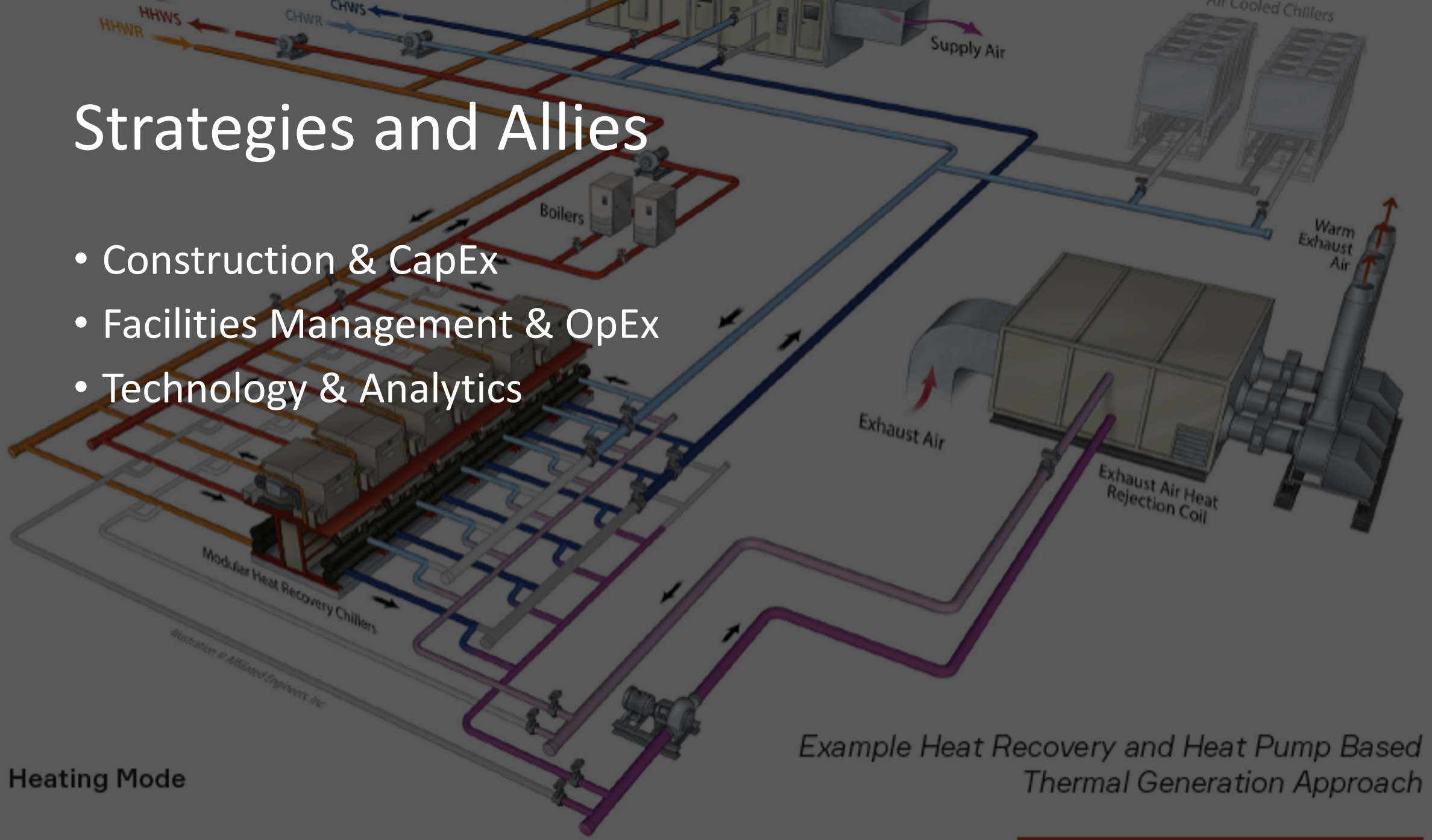
- Strategy
- Case Study
- Current State & what’s next

ECM First Cost Efficiency Curve



Strategies and Allies

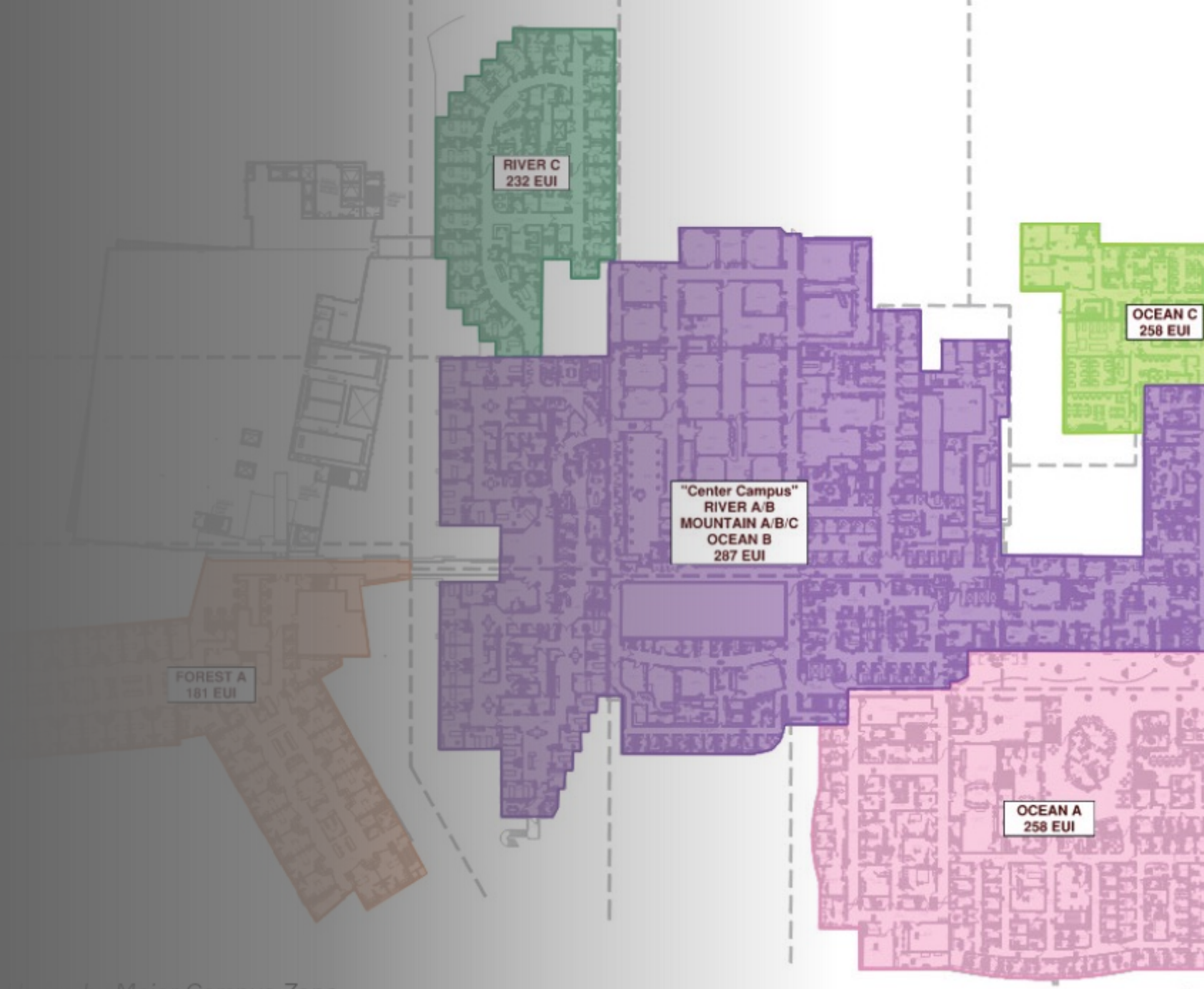
- Construction & CapEx
- Facilities Management & OpEx
- Technology & Analytics



Example Heat Recovery and Heat Pump Based Thermal Generation Approach

Construction & CapEx

- NPV Driven
- 10-Year Plan Governed
- Impact minded



Usage by Major Campus Zone

Table

M Tag	EUI Savings	First Cost	Annual Utility Cost Savings	NPV
NV_1	0.22	$2,469,600	$2,229	-$2,233,711
NV_2	0.03	$437,760	($10)	-$401,746
_3_MR	2.88	$18,691,763	$20,823	-$16,854,639
_OC_RC	0.20	$6,581,250	$1,134	-$6,021,812
_3_OA	0.62	$9,281,250	$6,517	-$8,421,23
PS_1	4.08	$112,966	$56,711	$759,034
PS_2	0.36	$10,417	$4,697	$64,09
PS_3	15.40	$1,310,910	$179,822	$1,568,032
PS_4	0.49	$82,970	$6,353	$18,872
PS_5	0.84	$117,129	$8,053	$12,855
PS_6	0.62	$301,595	$7,514	-$161,255
PS_7	2.64	$1,159,686	$31,347	-$576,012
PS_8	5.88	$788,782	$89,440	$603,30
PS_9	4.29	$386,625	$54,058	$438,37
TG_1	0.12	$321,723	$1,155	-$270,65
TG_2	-0.05	$735,368	$4,497	-$598,1
TG_3	-0.13	$531,303	$9,617	-$322
TG_4	0.12	$202,226	$3,815	-$1
GT_5	0.21	$30,422,700	$102,214	-$26
UG_3	-0.23	$680,088	$15,504	-$
LIV_1	11.45	$9,403,319	$66,086	-$7,6
LIV_2	0.12	$23,715	$7,471	$
LIV_3	10.39	$26,900,000	$170,950	-$22,0
LIV_4	0.24	$19,368	$8,646	$
LIV_5	2.66	$679,042	$43,329	$
LIV_6	1.60	$2,400,000	$26,712	-$1,801,
LIV_7	7.81	$458,053	$120,033	$1,
EN_1	0.57	$1,860,000	$28,943	-$1,
EN_2	3.21	$2,635,000	$24,230	-$2,0
EN_3	15.62	$6,460,000	$3,586	-$5,8
EN_4	68.14	$60,363,444	$260,135	-$51,
EN_5	3.07	$733,759	$121,602	$1,2
EN_6	1.73	$136,462	$68,401	$9
EN_7	1.63	$50,000	$12,274	$1
EN_9	0.25	$1,248,275	$10,037	-$98

Finding the Funds

- Execute ASHRAE Level 2 Audit
- Rank opportunities by NPV
- Filter by 10-year plan compatible projects

Audit Results

Energy Conservation Measure (ECM) Summary Table

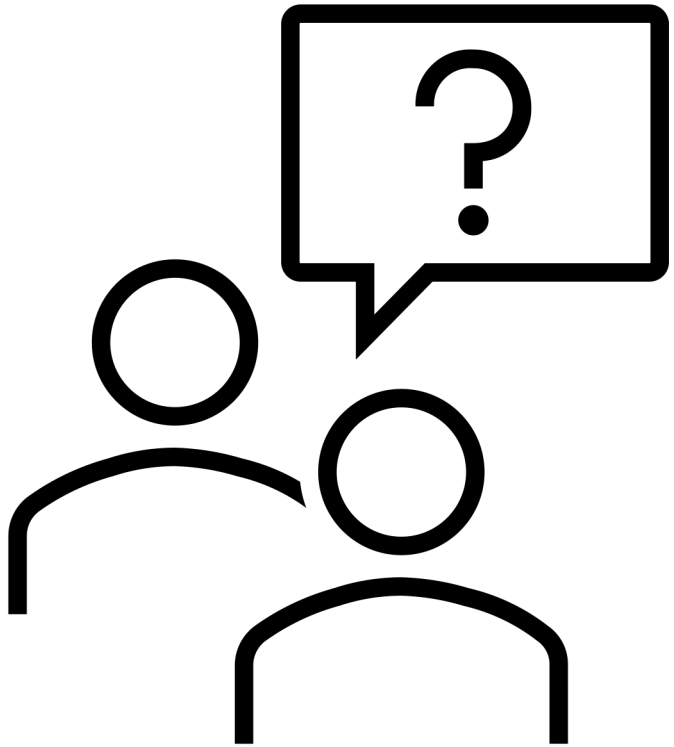
ECM Description	ECM Tag	EUI Savings	First Cost	Annual Utility Cost Savings	NPV
Ocean B glazing and air barrier	ENV_1	0.22	$2,469,600	$2,229	-$2,233,711
Ocean B/C cafeteria glazing and air barrier	ENV_2	0.03	$437,760	($10)	-$401,746
Mountain/River roof insulation	ENV_3_MR	2.88	$18,691,763	$20,823	-$16,854,639
Ocean/River C roof insulation	ENV_3_OC_RC	0.20	$6,581,250	$1,134	-$6,021,812
Ocean A roof insulation	ENV_3_OA	0.62	$9,281,250	$6,517	-$8,421,233
Patient rooms 12 ACH to 6 ACH	OPS_1	4.08	$112,966	$56,711	$759,034
Cath Lab temp&vent setbacks	OPS_2	0.36	$10,417	$4,697	$64,099
Oupatient clinic/admin temp&vent setbacks	OPS_3	15.40	$1,310,910	$179,822	$1,568,032
Mech room temp setbacks	OPS_4	0.49	$82,970	$6,353	$18,872
Forest A level 2 admin temp&vent setbacks	OPS_5	0.84	$117,129	$8,053	$12,855
Mountain/Ocean imaging temp&vent setbacks	OPS_6	0.62	$301,595	$7,514	-$161,255
OR/prep/recovery temp&vent setbacks	OPS_7	2.64	$1,159,686	$31,347	-$576,012
AHU SOO RetroCx (Mountain/River/Ocean)	OPS_8	5.88	$788,782	$89,440	$603,301
AHU SOO RetroCx (Forest A)	OPS_9	4.29	$386,625	$54,058	$438,375
Site lighting controls	LTG_1	0.12	$321,723	$1,155	-$270,650
Occ. sensor lighting controls	LTG_2	-0.05	$735,368	$4,497	-$598,132
Replace and reprogram lighting control panels	LTG_3	-0.13	$531,303	$9,617	-$322,980
Stair lighting 50% setback	LTG_4	0.12	$202,226	$3,815	-$123,806
LED Lighting Everywhere	LGT_5	0.21	$30,422,700	$102,214	-$26,212,722
Monitor/screen shutoff program	PLUG_3	-0.23	$680,088	$15,504	-$356,542
Return air or run- around on 100% OA systems	DELIV_1	11.45	$9,403,319	$66,086	-$7,695,691
Decommission unused equipment	DELIV_2	0.12	$23,715	$7,471	$99,562
100% OA systems to decoupled DOAS	DELIV_3	10.39	$26,900,000	$170,950	-$22,017,339
Remove double HEPA filters	DELIV_4	0.24	$19,368	$8,646	$121,412
Minimize Ocean C duct leakage	DELIV_5	2.66	$679,042	$43,329	$54,080
Pharmacy cooling solution	DELIV_6	1.60	$2,400,000	$26,712	-$1,801,005.07
Rebalance admin zones from 6 ACH	DELIV_7	7.81	$458,053	$120,033	$1,424,867
CT-1 replacement	GEN_1	0.57	$1,860,000	$28,943	-$1,261,615
RetroCx steam boiler flue economizer	GEN_2	3.21	$2,635,000	$24,230	-$2,075,397
HRC heat recovery for River/Mountain	GEN_3	15.62	$6,460,000	$3,586	-$5,875,985
Full transition to HP heat recovery CUP	GEN_4	68.14	$60,363,444	$260,135	-$51,787,660
CHW assessment bundle 1	GEN_5	3.07	$733,759	$121,602	$1,237,466
CHW assessment bundle 2	GEN_6	1.73	$136,462	$68,401	$949,541
Continued steam trap maintenance	GEN_7	1.63	$50,000	$12,274	$127,396
CT-7 replacement and chiller improvements	GEN_9	0.25	$1,248,275	$10,037	-$987,496

CleanMed
SALT LAKE CITY

Construction & Capital

Project	EUI Savings	First Cost	NPV
Upgrade Admin zones air distribution	8	$ 430,000	$ 1,300,000
Clinic & Admin controls upgrade	15	$ 1,400,000	$ 1,350,000
Central Plant assessment bundle 1	3	$ 750,000	$ 1,150,000
Chilled Water assessment bundle 2	2	$ 136,000	$ 838,000
Energy Management System	7	$ 650,000	$ 254,000
Total	35	$3,366,000	$4,892,000

Polls and Q&A



CleanMed
SALT LAKE CITY

Facilities Management & OpEx

WORK ORDER DRIVEN

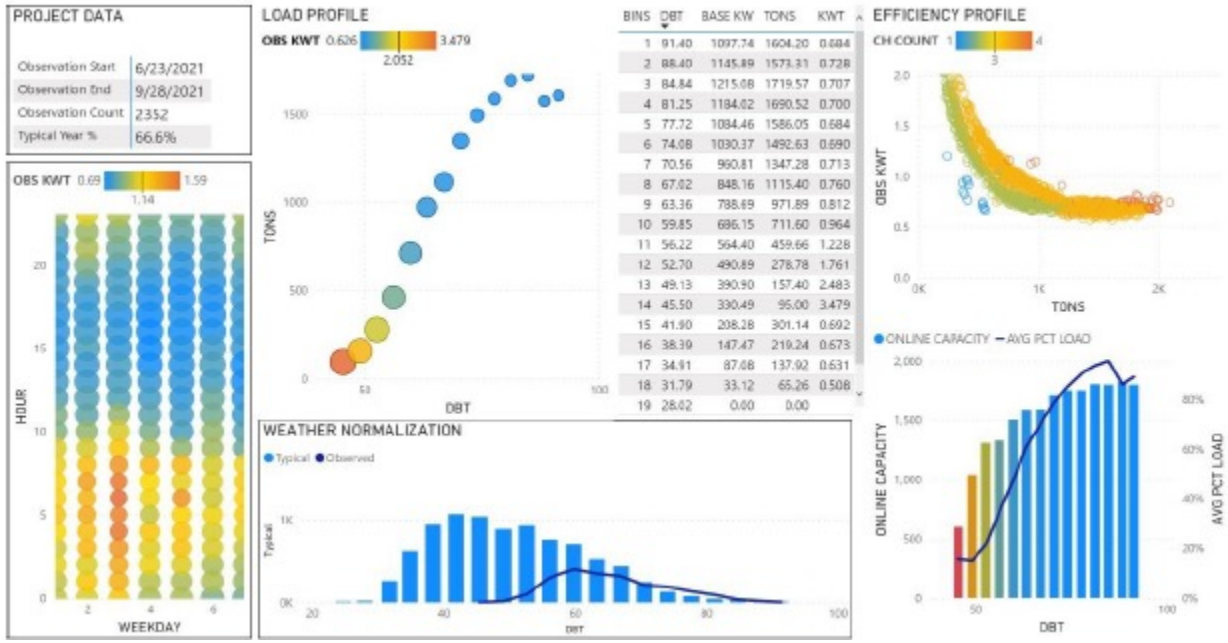
PERFORMANCE FOCUSED

ENVIRONMENTALLY MOTIVATED

One Program, Three Impacts

Ongoing Commissioning

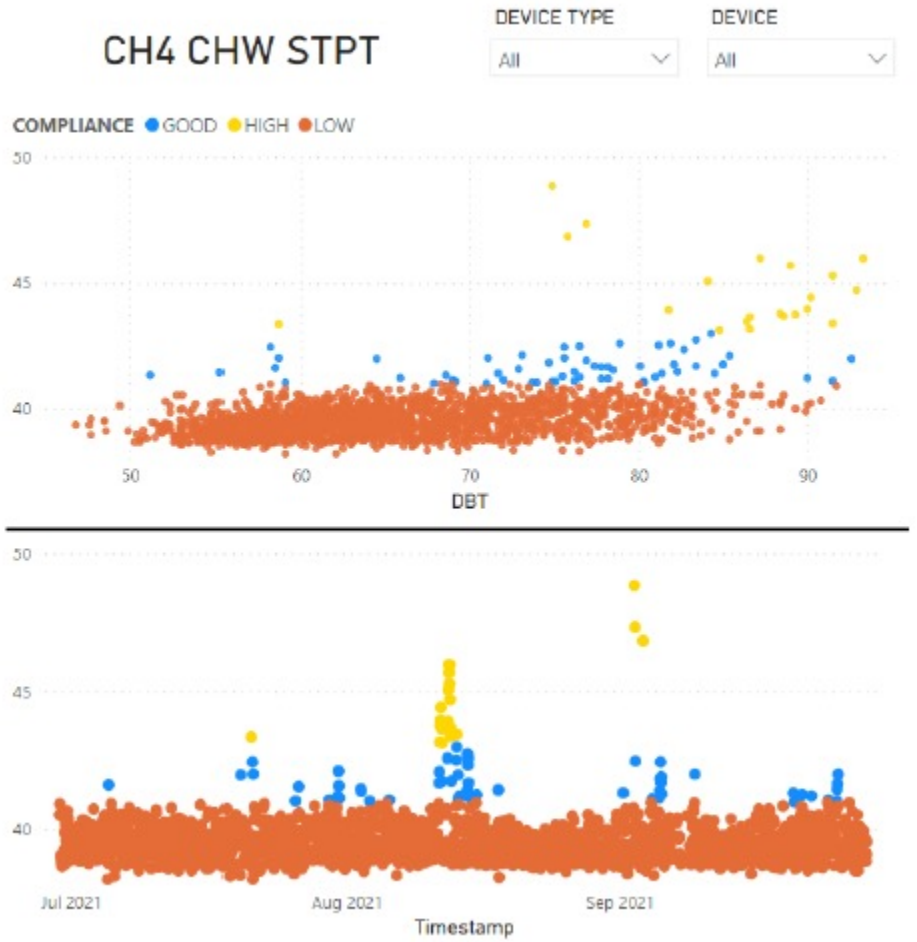
- Work order ready
- Optimizes performance
- Reduces energy waste



CleanMed SALT LAKE CITY

Ongoing Commissioning

- Facility requirements focused
- Data driven recommendations
- Set points, Schedules, Sequences

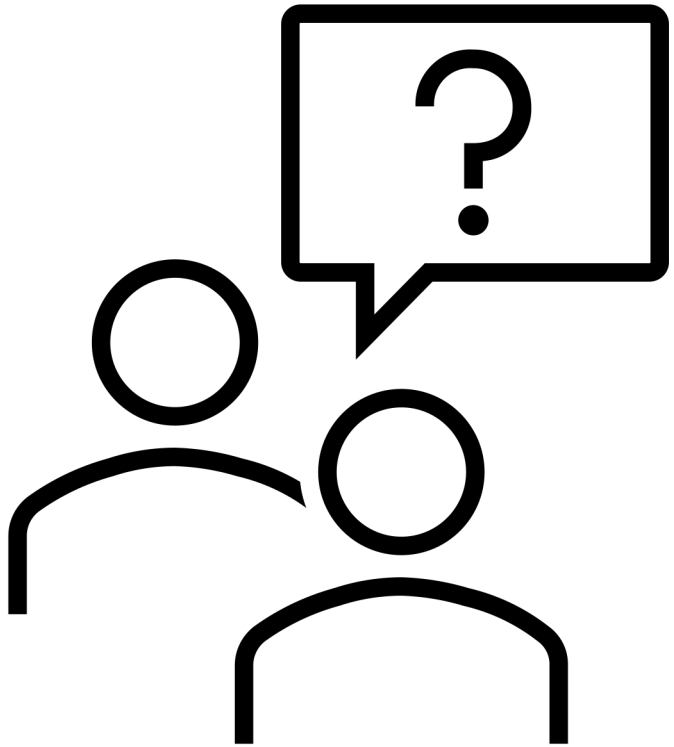


CleanMed
SALT LAKE CITY

Operational Efforts

Project	EUI Savings	First Cost	NPV
AHU Retro commissioning	5	$ 667,000	$ 410,000
AHU Resequencing	4	$ 326,000	$ 324,000
Refurbish steam traps	2	$ 50,000	$ 116,000
Total	11	$ 1,043,000	$ 850,000

Polls and Q&A



CleanMed
SALT LAKE CITY

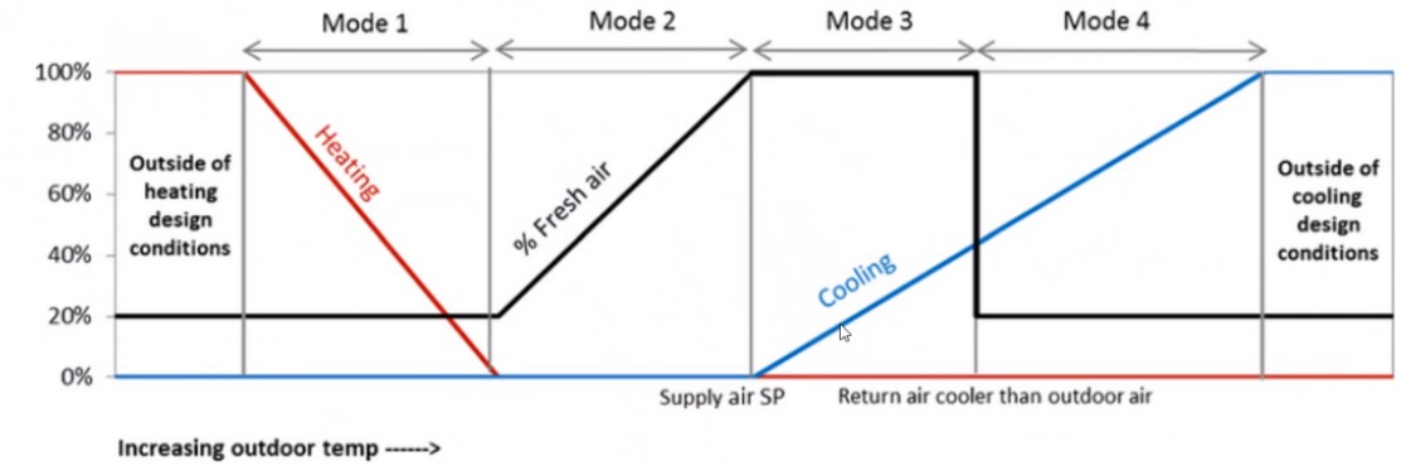
Technology and Analytics

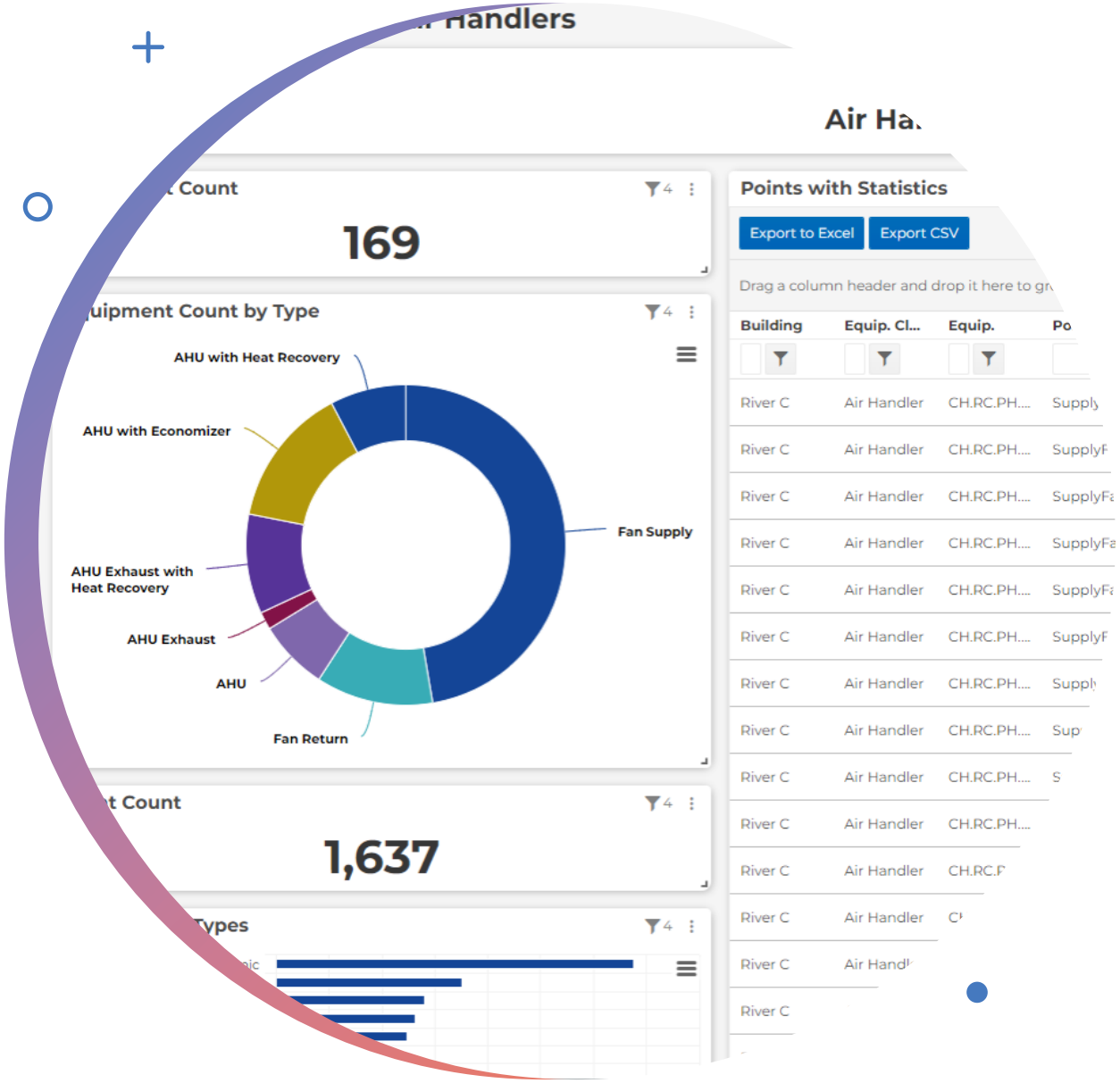
- Intersection of Construction & Operations
- Technology adoption drives process change
- Go from report on shelf to dashboard in your pocket
- Borrowed IT process
- CIO Roadmap connection

CleanMed
SALT LAKE CITY

Analytics Pilot

- Analytics revealed $17,000 of energy waste
- Issued Facilities Management work orders
- Programming corrections





Energy Management System

- Gathers building environmental data
- Leverages analytics to reveal opportunities
- Supports high performance operations

Fault Detection & Diagnostics

- Work order ready
- CMMS integration
- Governance team
- Supports Ongoing Commissioning

Maintenance Priority (0-10): 6

Notes: **PROBLEM: SIMULTANEOUS HEATING AND COOLING**

•The (pre)heating coil and cooling coil are either providing excess heating or cooling or operating simultaneously.

•This may have wasted around $23613 ($12176 in heating and $11437 in cooling) and 2105380 kBTU total over 30 day(s).

Possible Causes:

•Pre-heating coil valve leaking or stuck open.

•Cooling coil valve leaking or stuck open.

•Uncalibrated or malfunctioning temperature sensor.

•Controls or programming error.

PROBLEM: RETURN AIR RELATIVE HUMIDITY HIGHER THAN SETPOINT

•The return air relative humidity is higher than its setpoint.

Possible Causes:

•High outdoor air humidity.

•Excess moisture from in-zone sources such as showers, cooking, or moist air infiltration.

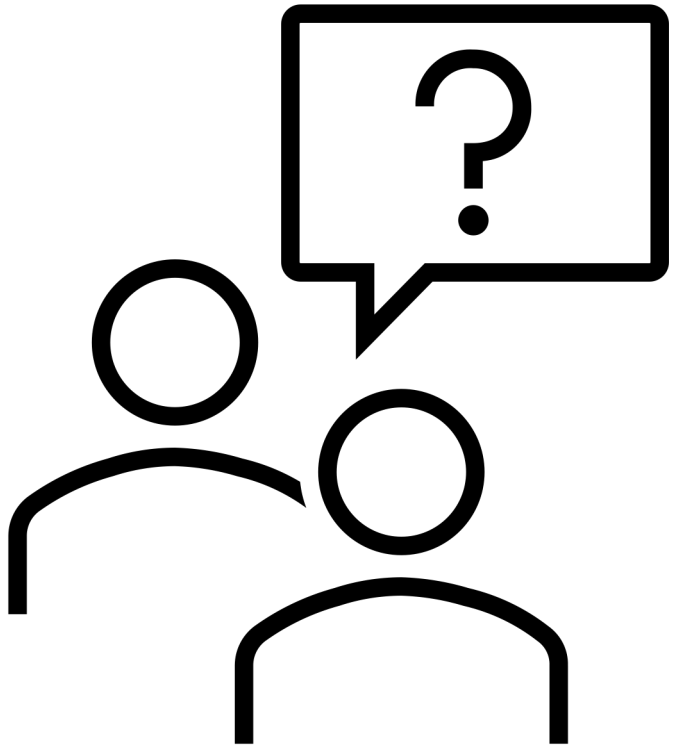
•Undersized cooling coil.

•Malfunctioning cooling coil.

•Malfunctioning or clogged humidifier valve.

•Uncalibrated or malfunctioning humidity sensor.

Polls and Q&A



CleanMed
SALT LAKE CITY

Lessons Learned

Coalitions of supporters make broad change possible

The right frameworks free up resources

Technology helps, but people drive change

Discussion

Contact

Michael Bigelow (he, him, his)

PE, CEM, CCP, LEED AP BD+C

Program Manager, Systems Engineering, Energy and Water

Seattle Children's

OFFICE 206.884.1402

Michael.Bigelow@Seattlechildrens.org

CleanMed SALT LAKE CITY