Better Buildings
U.S. DEPARTMENT OF ENERGY

EMIS Crash Course: An Overview of Energy Management and Information Systems

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Welcome!

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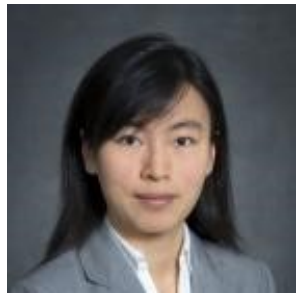


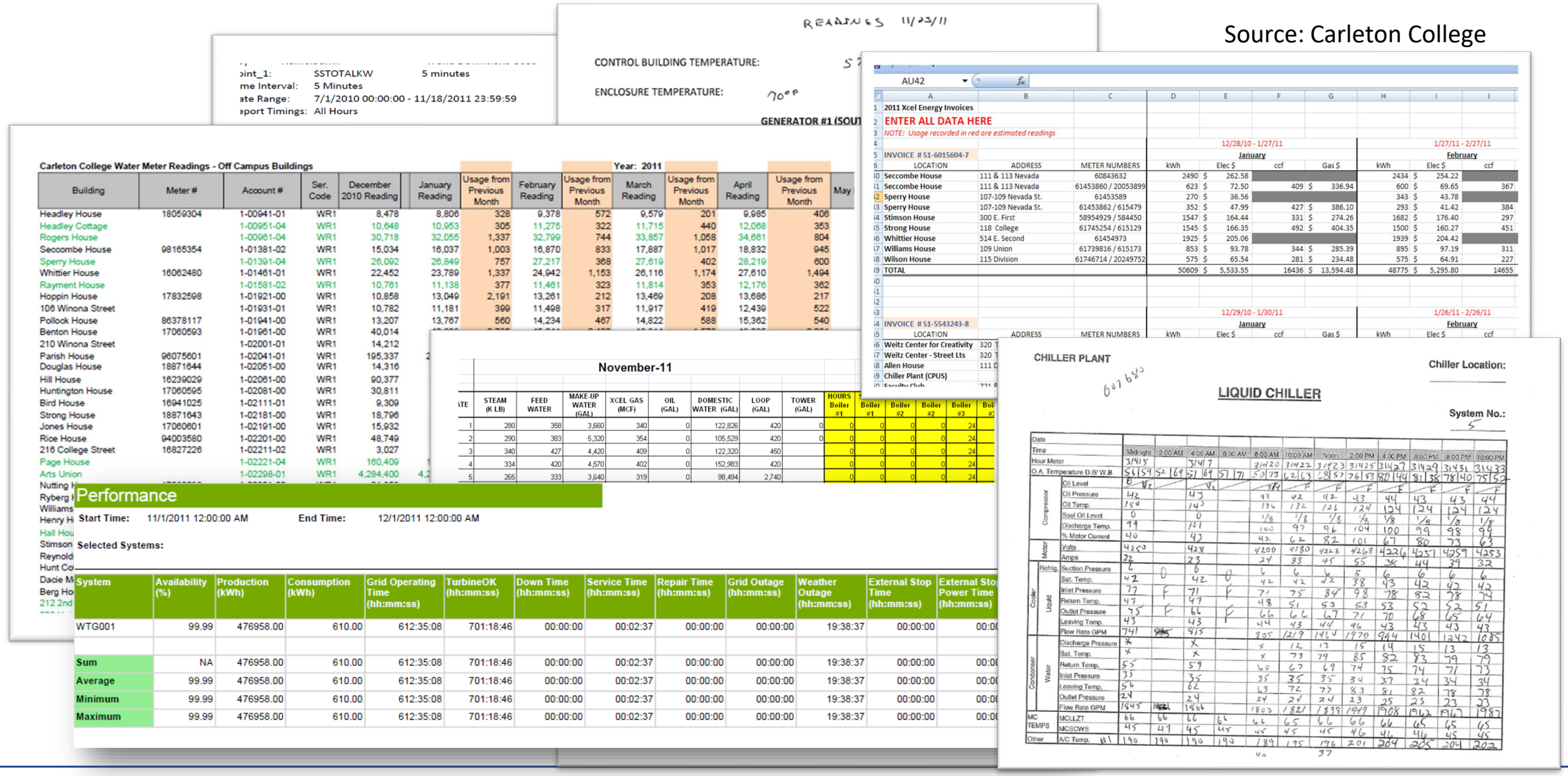
Guanjing Lin
Principal Scientific Engineering Associate

What we'll cover today…

- EMIS Capabilities
- Research Results on Costs and Savings
- Best Practices
- Resources

Data Before: A big mess!

Source: Carleton College



Carleton College Water Meter Readings - Off Campus Buildings — Year: 2011

Building	Meter #	Account #	Ser. Code	December 2010 Reading	January Reading	Usage from Previous Month	February Reading	Usage from Previous Month	March Reading	Usage from Previous Month	April Reading	Usage from Previous Month	May
Headley House	18059304	1-00941-01	WR1	8,478	8,806	328	9,378	572	9,579	201	9,985	406	
Headley Cottage		1-00951-04	WR1	10,648	10,953	305	11,275	322	11,715	440	12,068	353	
Rogers House		1-00961-04	WR1	30,718	32,055	1,337	32,799	744	33,857	1,058	34,661	804	
Seccombe House	98165354	1-01381-02	WR1	15,034	16,037	1,003	16,870	833	17,887	1,017	18,832	945	
Sperry House		1-01391-04	WR1	26,092	26,849	757	27,217	368	27,619	402	28,219	600	
Whittier House	16062480	1-01461-01	WR1	22,452	23,789	1,337	24,942	1,153	26,116	1,174	27,610	1,494	
Rayment House		1-01581-02	WR1	10,761	11,138	377	11,461	323	11,814	353	12,176	362	
Hoppin House	17832598	1-01921-00	WR1	10,858	13,049	2,191	13,261	212	13,469	208	13,686	217	
106 Winona Street		1-01931-01	WR1	10,782	11,181	399	11,498	317	11,917	419	12,439	522	
Pollock House	86378117	1-01941-00	WR1	13,207	13,767	560	14,234	467	14,822	588	15,362	540	
Benton House	17060593	1-01961-00	WR1	40,014									
210 Winona Street		1-02001-01	WR1	14,212									
Parish House	96075601	1-02041-01	WR1	195,337									
Douglas House	18871644	1-02051-00	WR1	14,316									
Hill House	16239029	1-02061-00	WR1	90,377									
Huntington House	17060595	1-02081-00	WR1	30,811									
Bird House	16941025	1-02111-01	WR1	9,309									
Strong House	18871643	1-02181-00	WR1	18,796									
Jones House	17060601	1-02191-00	WR1	15,932									
Rice House	94003580	1-02201-00	WR1	48,749									
216 College Street	16827226	1-02211-02	WR1	3,027									
Page House		1-02221-04	WR1	160,409									
Arts Union		1-02298-01	WR1	4,284,400									

November-11

	STEAM (K LB)	FEED WATER	MAKE-UP WATER (GAL)	XCEL GAS (MCF)	OIL (GAL)	DOMESTIC WATER (GAL)	LOOP (GAL)	TOWER (GAL)	HOURS Boiler #1	Boiler #1	Boiler #2	Boiler #2	Boiler #3	Boiler
1	280	358	3,660	340	0	122,826	420	0	0	0	0	0	24	
2	290	383	5,320	354	0	105,529	420	0	0	0	0	0	24	
3	340	427	4,420	409	0	122,320	450		0	0	0	0	24	
4	334	420	4,570	402	0	152,983	420		0	0	0	0	24	
5	265	333	3,640	319	0	98,494	2,740		0	0	0	0	24	

Performance

Start Time: 11/1/2011 12:00:00 AM End Time: 12/1/2011 12:00:00 AM

Selected Systems:

System	Availability (%)	Production (kWh)	Consumption (kWh)	Grid Operating Time (hh:mm:ss)	TurbineOK (hh:mm:ss)	Down Time (hh:mm:ss)	Service Time (hh:mm:ss)	Repair Time (hh:mm:ss)	Grid Outage (hh:mm:ss)	Weather Outage (hh:mm:ss)	External Stop Time (hh:mm:ss)	External Stop Power Time (hh:mm:ss)
WTG001	99.99	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:0
Sum	NA	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:0
Average	99.99	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:0
Minimum	99.99	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:0
Maximum	99.99	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:0

2011 Xcel Energy Invoices

ENTER ALL DATA HERE

NOTE: Usage recorded in red are estimated readings

INVOICE # 51-6015604-7			12/28/10 - 1/27/11 January				1/27/11 - 2/27/11 February		
LOCATION	ADDRESS	METER NUMBERS	kWh	Elec $	ccf	Gas $	kWh	Elec $	ccf
Seccombe House	111 & 113 Nevada	60843632	2490	$ 262.58			2434	$ 254.22	
Seccombe House	111 & 113 Nevada	61453860 / 20053899	623	$ 72.50	409	$ 336.94	600	$ 69.65	367
Sperry House	107-109 Nevada St.	61453589	270	$ 36.56			343	$ 43.78	
Sperry House	107-109 Nevada St.	61453862 / 615479	352	$ 47.99	427	$ 386.10	293	$ 41.42	384
Stimson House	300 E. First	58954929 / 584450	1547	$ 164.44	331	$ 274.26	1682	$ 176.40	297
Strong House	118 College	61745254 / 615129	1545	$ 166.35	492	$ 404.35	1500	$ 160.27	451
Whittier House	514 E. Second	61454973	1925	$ 205.06			1939	$ 204.42	
Williams House	109 Union	61739816 / 615173	853	$ 93.78	344	$ 285.39	895	$ 97.19	311
Wilson House	115 Division	61746714 / 20249752	575	$ 65.54	281	$ 234.48	575	$ 64.91	227
TOTAL			50609	$ 5,533.55	16436	$ 13,594.48	48775	$ 5,295.80	14655

INVOICE # 51-5543243-8			12/29/10 - 1/30/11 January				1/26/11 - 2/26/11 February		
LOCATION	ADDRESS	METER NUMBERS	kWh	Elec $	ccf	Gas $	kWh	Elec $	ccf
Weitz Center for Creativity	320								
Weitz Center - Street Lts	320								
Allen House	111								
Chiller Plant (CPUS)									

CHILLER PLANT

LIQUID CHILLER

Chiller Location:

System No.: 5

		Midnight	2:00 AM	4:00 AM	6:00 AM	8:00 AM	10:00 AM	Noon	2:00 PM	4:00 PM	6:00 PM	8:00 PM	10:00 PM
Date													
Time													
Hour Meter		31415		31417		31420	31422	31423	31425	31427	31429	31431	31433
O.A. Temperature D.B/ W.B		56/54	52/49	52/51	51/49	50/48	62/53	68/57	76/63	80/64	81/68	78/64	75/62
Compressor	Oil Level												
	Oil Pressure	42		43		43	42	42	43	44	43	43	44
	Oil Temp.	134		143		136	132	126	124	124	124	124	124
	Seal Oil Level	0		0		1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
	Discharge Temp.	99		101		100	97	96	104	100	99	98	99
	% Motor Current	40		43		42	62	82	101	67	80	73	63
Motor	Volts	4253		4247		4200	4180	4228	4263	4226	4251	4259	4253
	Amps	27		23		24	33	45	55	36	44	39	32
Cooler Liquid	Refrig. Suction Pressure	6	0	6	0	6	6	4	5	6	6	6	6
	Sat. Temp.	42		42		42	42	42	38	43	42	42	42
	Inlet Pressure	77	F	71	F	71	75	84	98	78	82	78	74
	Return Temp.	47		47		48	51	53	63	53	52	52	51
	Outlet Pressure	75	F	66	F	66	66	67	71	70	68	65	64
	Leaving Temp.	43		43		44	43	44	46	43	43	43	43
	Flow Rate GPM	741	Spec	415		805	1219	1414	1970	944	1401	1242	1285
Condenser Water	Discharge Pressure	X		X		X	12	13	15	14	15	13	13
	Sat. Temp.	X		X		X	73	79	85	82	83	79	79
	Return Temp.	55		54		60	67	69	74	75	74	71	73
	Inlet Pressure	33		35		35	35	35	34	37	34	34	34
	Leaving Temp.	56		62		63	72	77	83	81	82	78	78
	Outlet Pressure	24		24		24	24	24	23	25	23	23	23
	Flow Rate GPM	1445	Heat	1866		1803	1821	1839	1949	1908	1942	1967	1987
MC TEMPS	MCLLZT	66	66	66	66	66	65	66	66	66	65	65	65
	MCSCWS	45	47	45	45	45	45	45	46	46	46	45	45
Other	A/C Temp.	190	190	190	190	189	195	196	201	204	205	204	203

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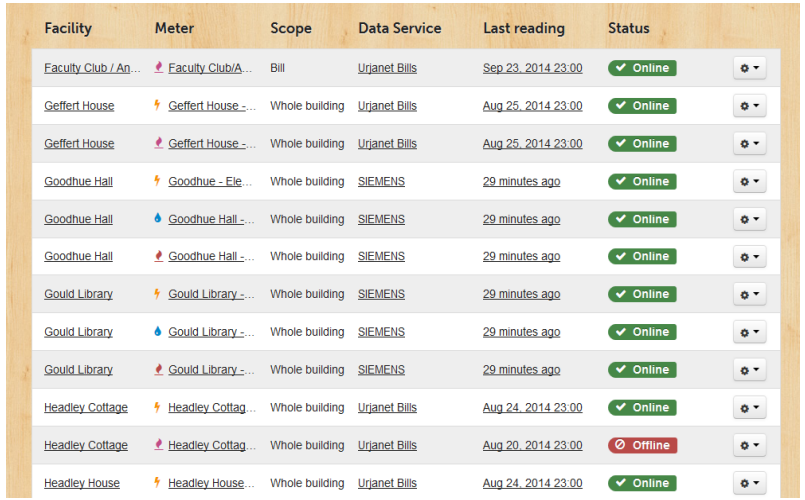
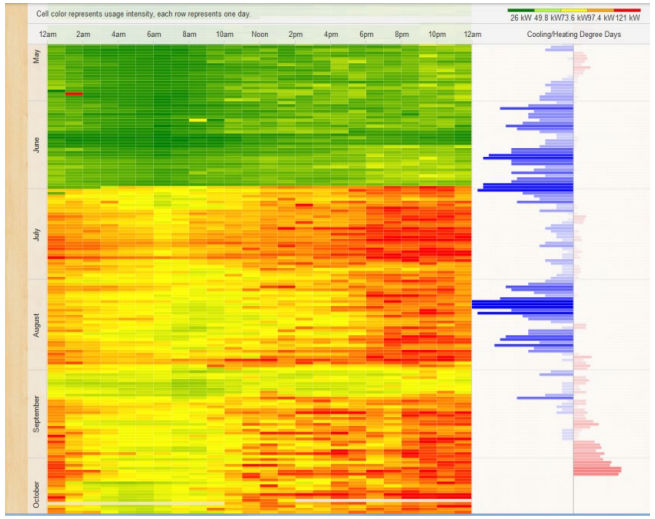
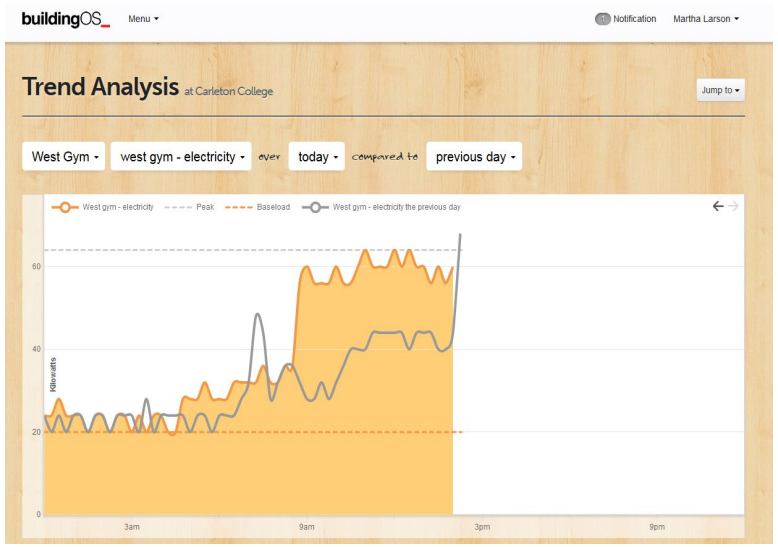
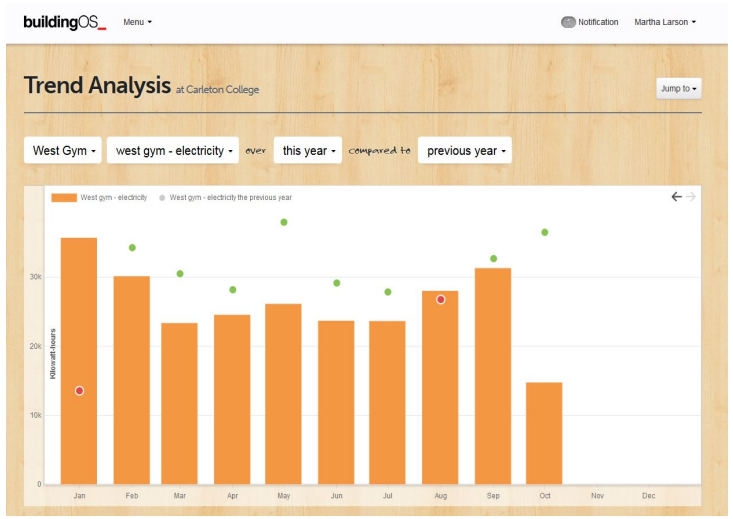
Data After: Really nice!



Facility	Meter	Scope	Data Service	Last reading	Status
Faculty Club / An...	Faculty Club/A...	Bill	Urjanet Bills	Sep 23, 2014 23:00	Online
Geffert House	Geffert House -...	Whole building	Urjanet Bills	Aug 25, 2014 23:00	Online
Geffert House	Geffert House -...	Whole building	Urjanet Bills	Aug 25, 2014 23:00	Online
Goodhue Hall	Goodhue - Ele...	Whole building	SIEMENS	29 minutes ago	Online
Goodhue Hall	Goodhue Hall -...	Whole building	SIEMENS	29 minutes ago	Online
Goodhue Hall	Goodhue Hall -...	Whole building	SIEMENS	29 minutes ago	Online
Gould Library	Gould Library -...	Whole building	SIEMENS	29 minutes ago	Online
Gould Library	Gould Library -...	Whole building	SIEMENS	29 minutes ago	Online
Gould Library	Gould Library -...	Whole building	SIEMENS	29 minutes ago	Online
Headley Cottage	Headley Cottag...	Whole building	Urjanet Bills	Aug 24, 2014 23:00	Online
Headley Cottage	Headley Cottag...	Whole building	Urjanet Bills	Aug 20, 2014 23:00	Offline
Headley House	Headley House...	Whole building	Urjanet Bills	Aug 24, 2014 23:00	Online

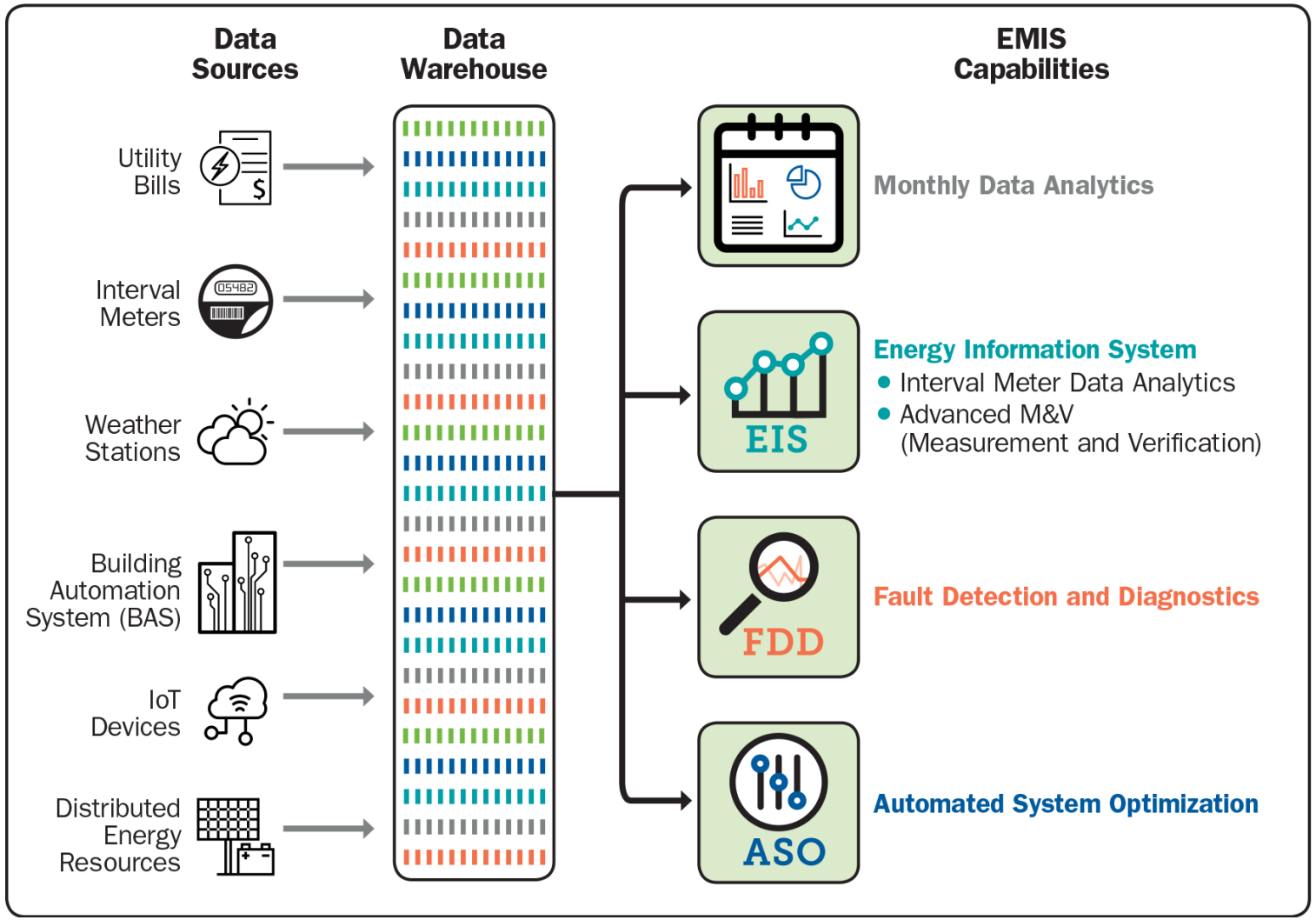




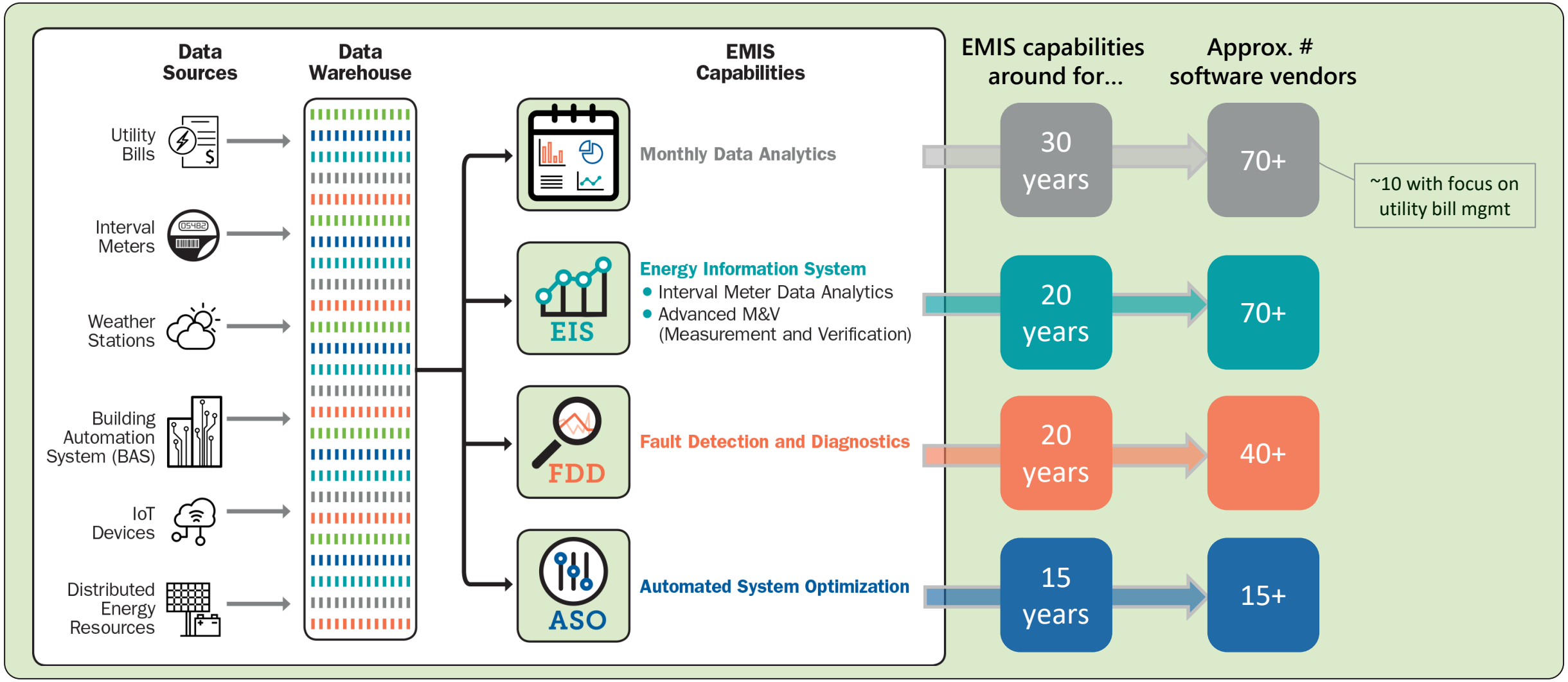


Source: Carleton College (Lucid BuildingOS)

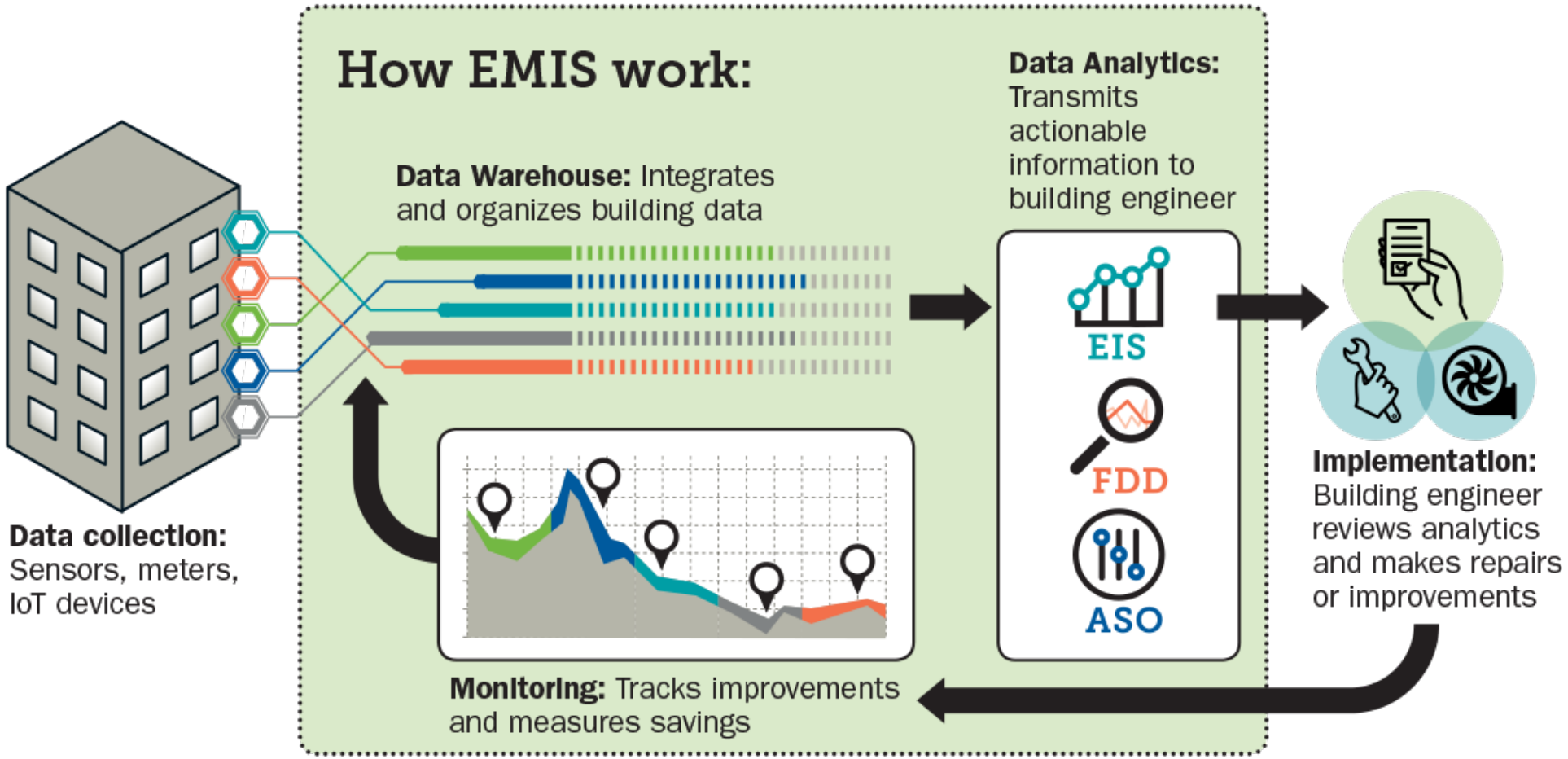
Energy Management and Information Systems (EMIS) Overview



Energy Management and Information Systems (EMIS) Overview



EMIS Tools in Action:
Monitoring-based Commissioning (MBCx) and other Energy Management Processes



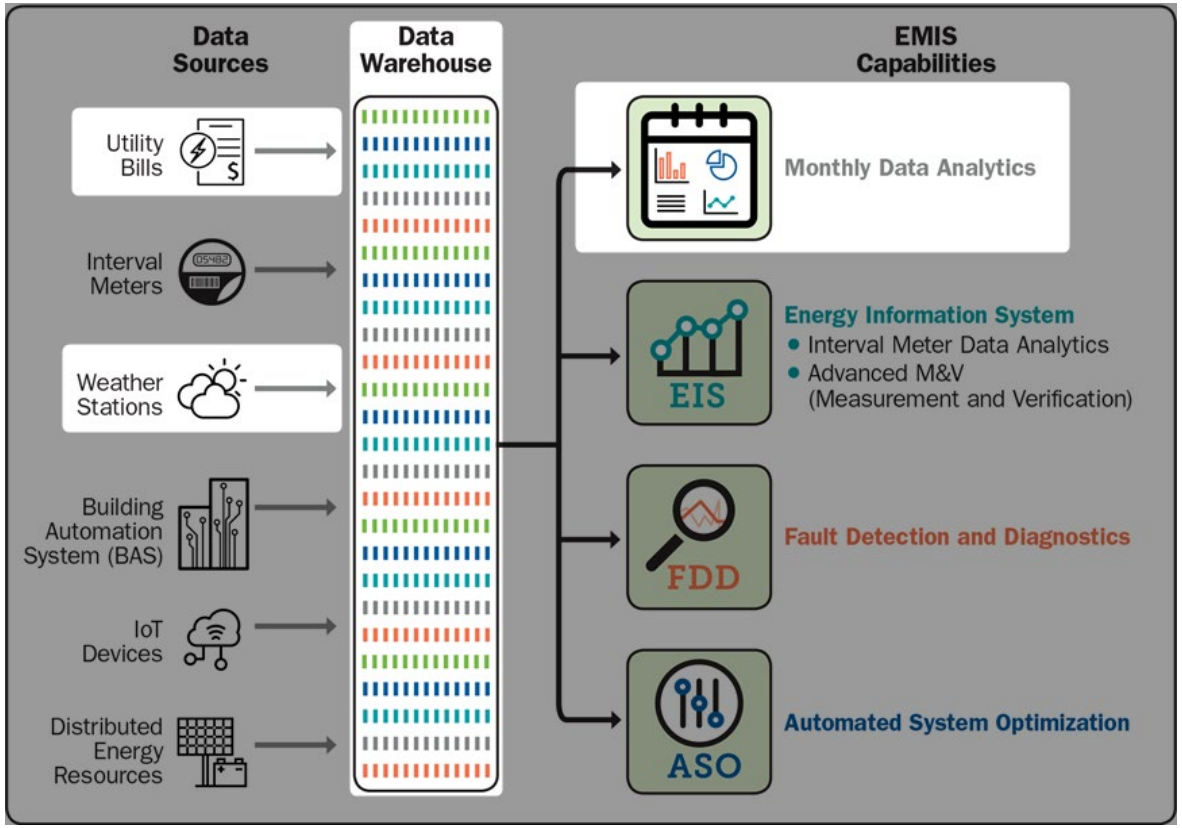
EMIS TOOLS: Energy information systems (EIS) help find energy waste using smart meter data. Fault detection and diagnostic tools (FDD) detect and prioritize HVAC system faults. Automated system optimization (ASO) includes control algorithms to minimize energy use across systems.

Monthly Data Analytics: Benchmarking and Monthly Utility Bill Analysis

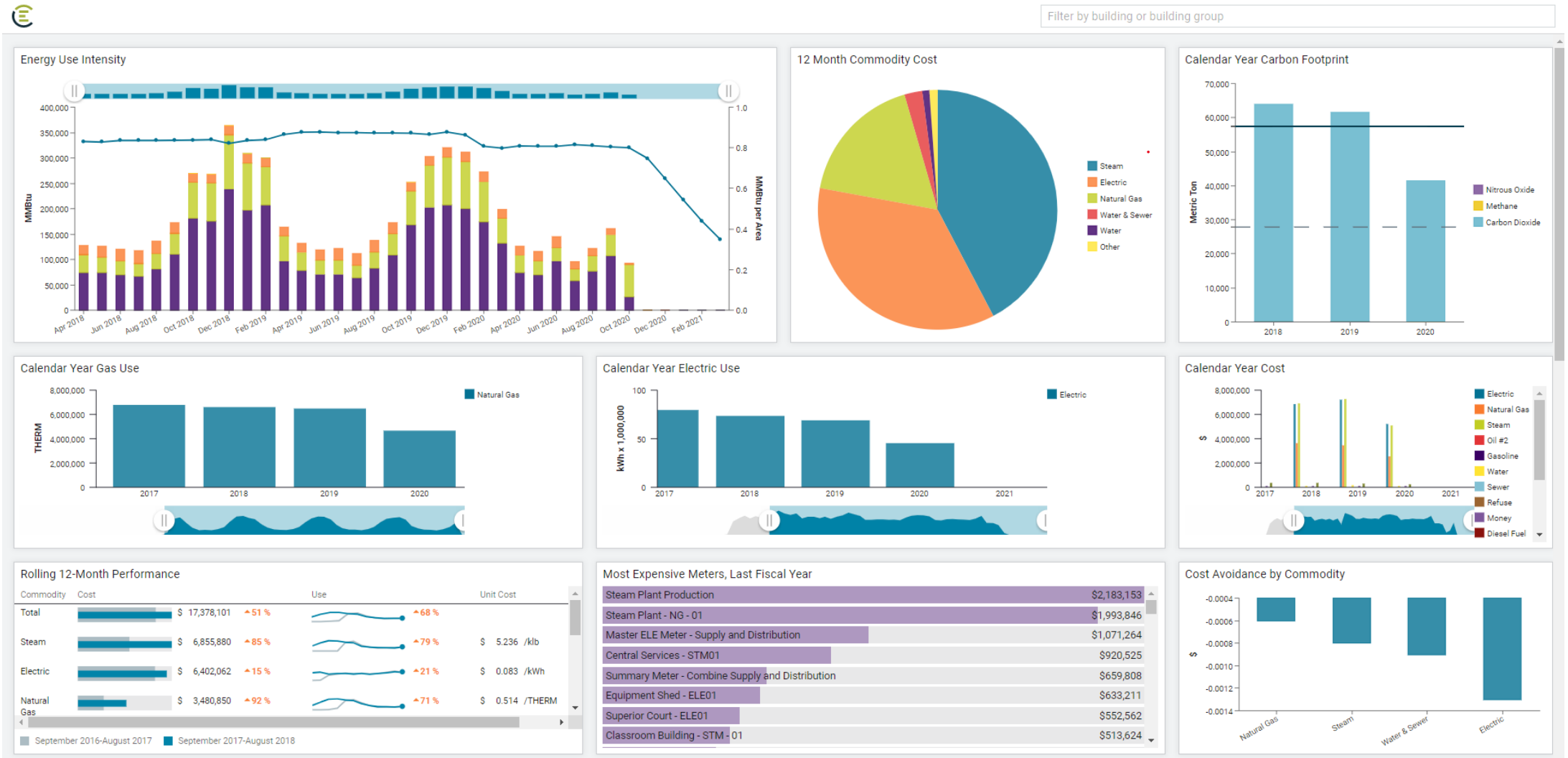
Software that compares a building's performance to peer groups or to historical performance using monthly utility bill data

Applications

- Energy use and cost tracking
- Benchmarking against a portfolio
- Link to ENERGY STAR Portfolio Manager
- Utility bill reconciliation

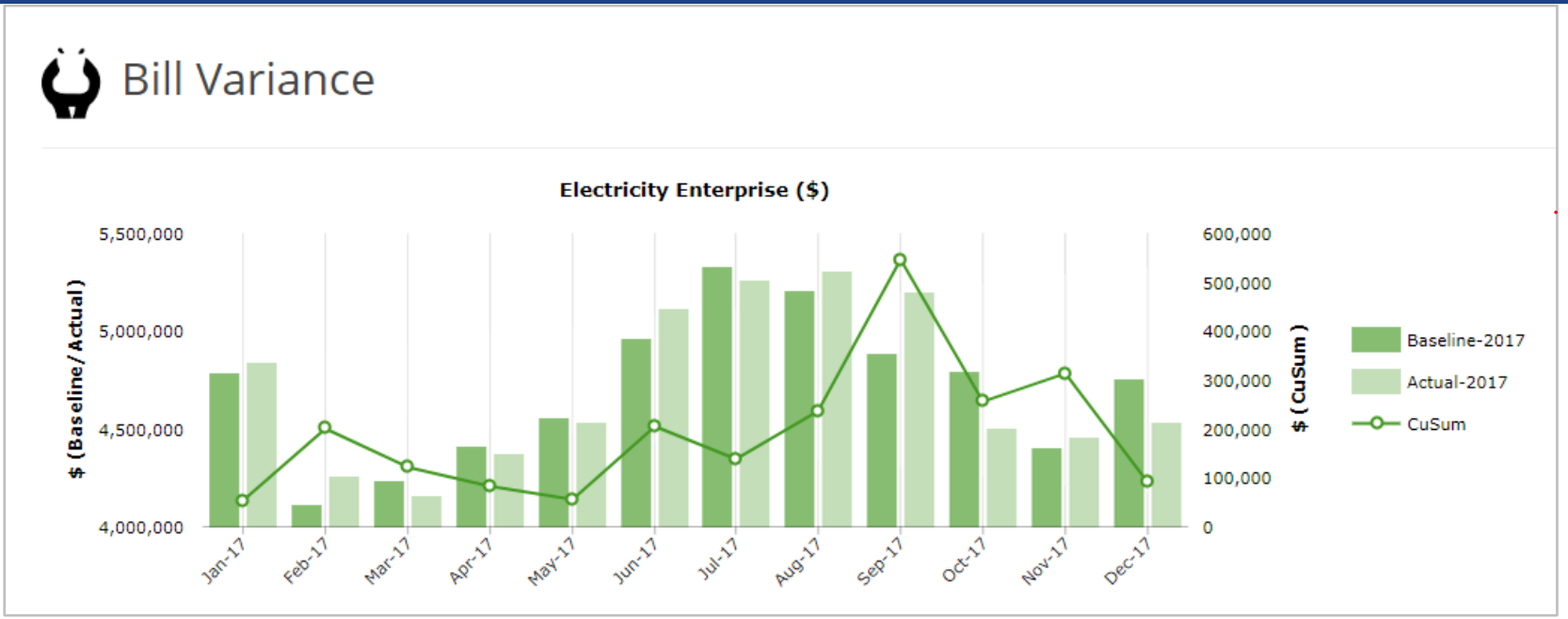


Monthly Data Analytics: Benchmarking and Monthly Utility Bill Analysis

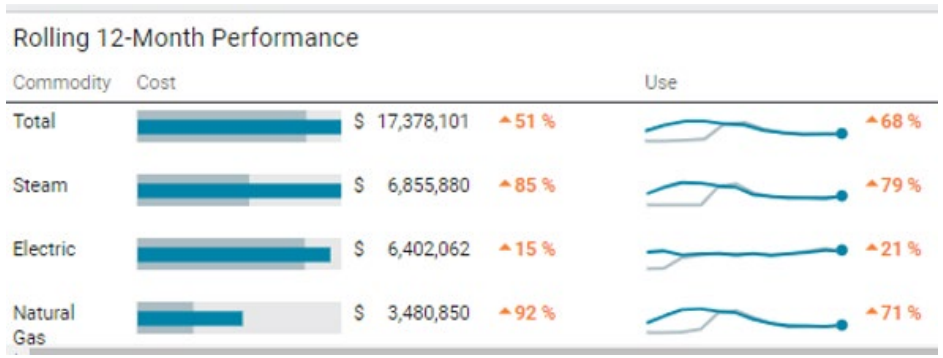


Source: EnergyCAP

Monthly Data Analytics: Benchmarking and Monthly Utility Bill Analysis



Source: Energy Hippo



Source: EnergyCAP

Source: Overview of ENERGY STAR for buildings and plants

Monthly Data Analytics: Benchmarking and Monthly Utility Bill Analysis

Examples

- ENERGY STAR Portfolio Manager (benchmarking)
- EnergyCAP
- Energy Hippo
- EnergyPrint
- EnergyWatch
- Enertiv
- ENGIE Impact
- JadeTrack
- Bill Identity
- Dude Solutions

Benefits

- Set energy goals and track progress
- Benchmark buildings to prioritize efforts (using internal and/or external comparisons)
- Streamline bill payment processing

Energy savings enabled with benchmarking

- Average annual energy savings of 2.4%[1]

Cost - **$-$$**

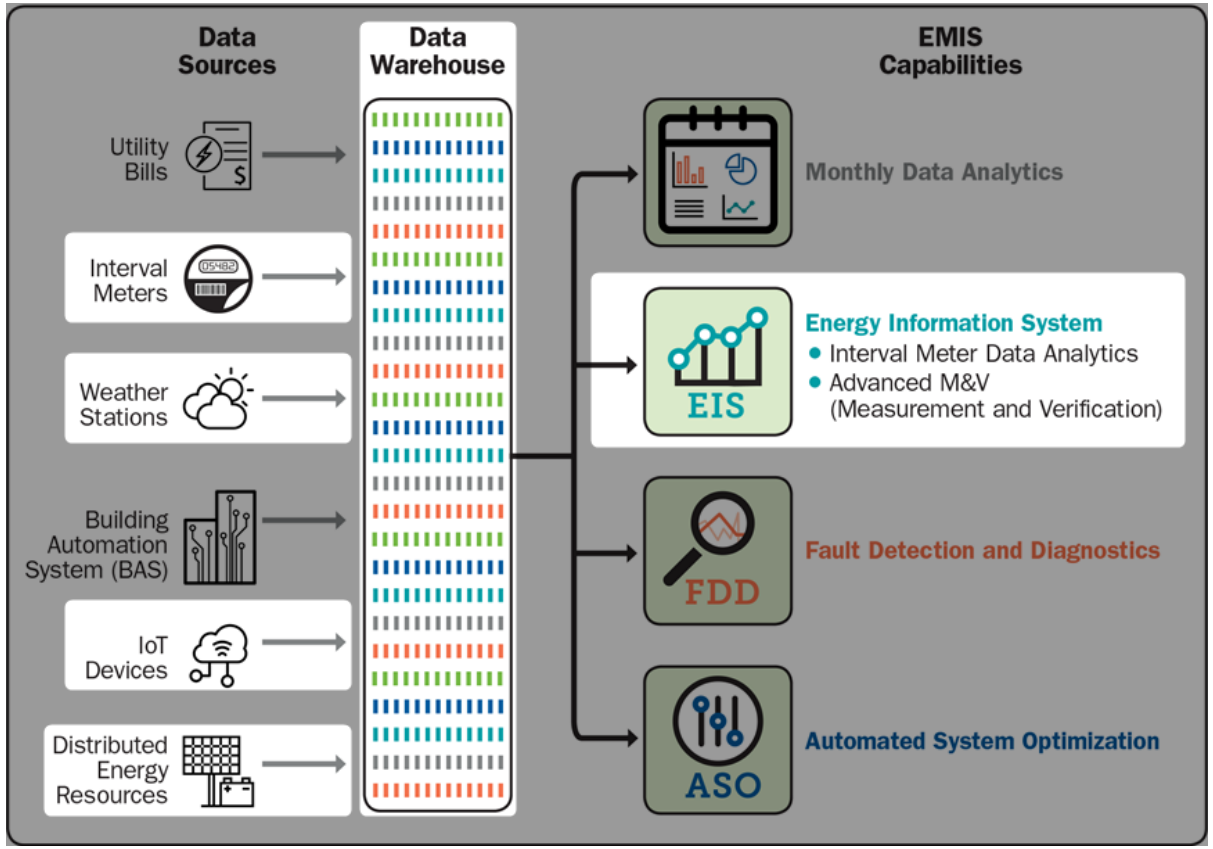
[1] EPA, DataTrends: Benchmarking and Energy Savings, 2012

Energy Information System (EIS)

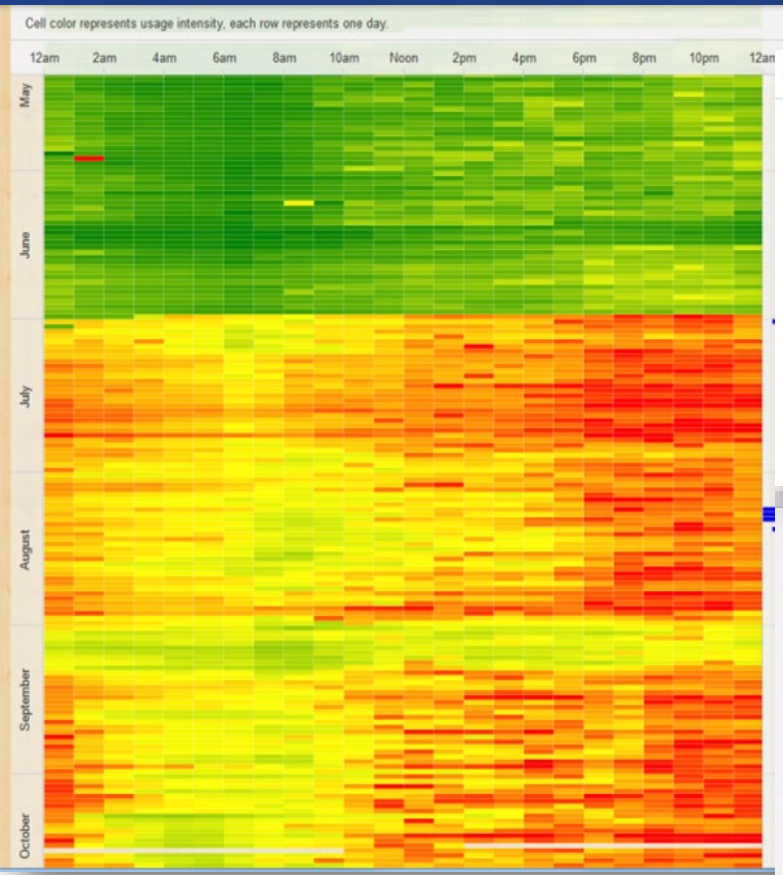
Software that displays and analyzes interval meter energy data

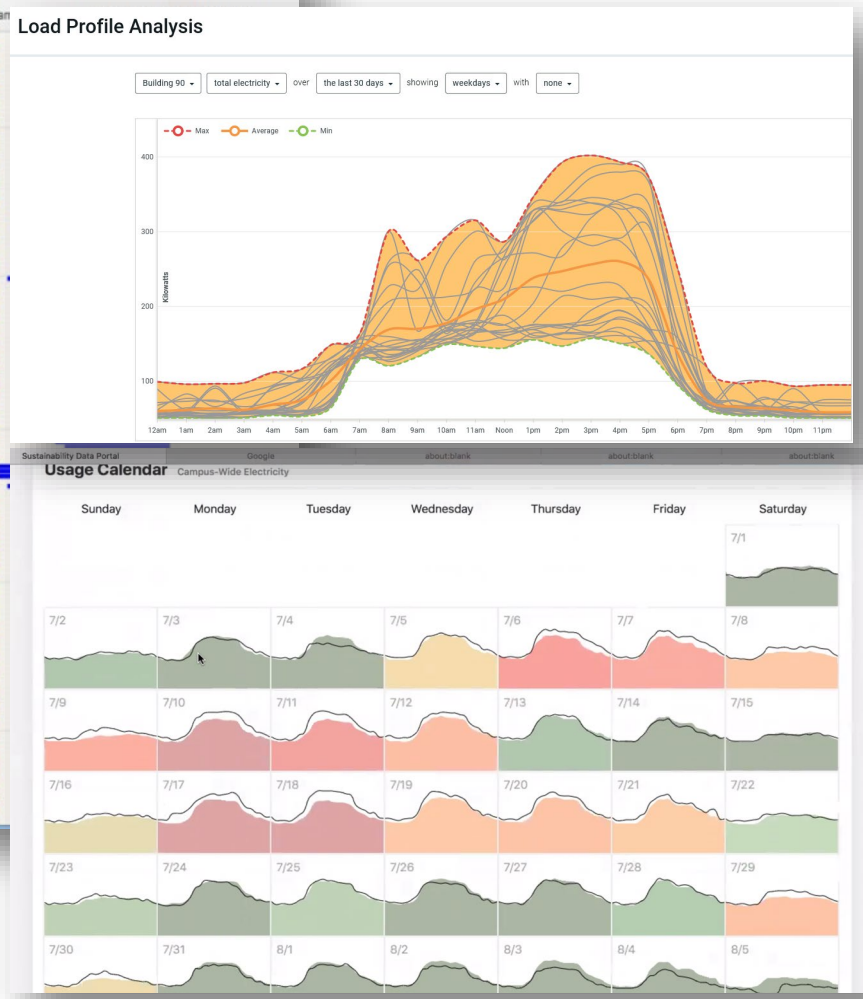
Applications

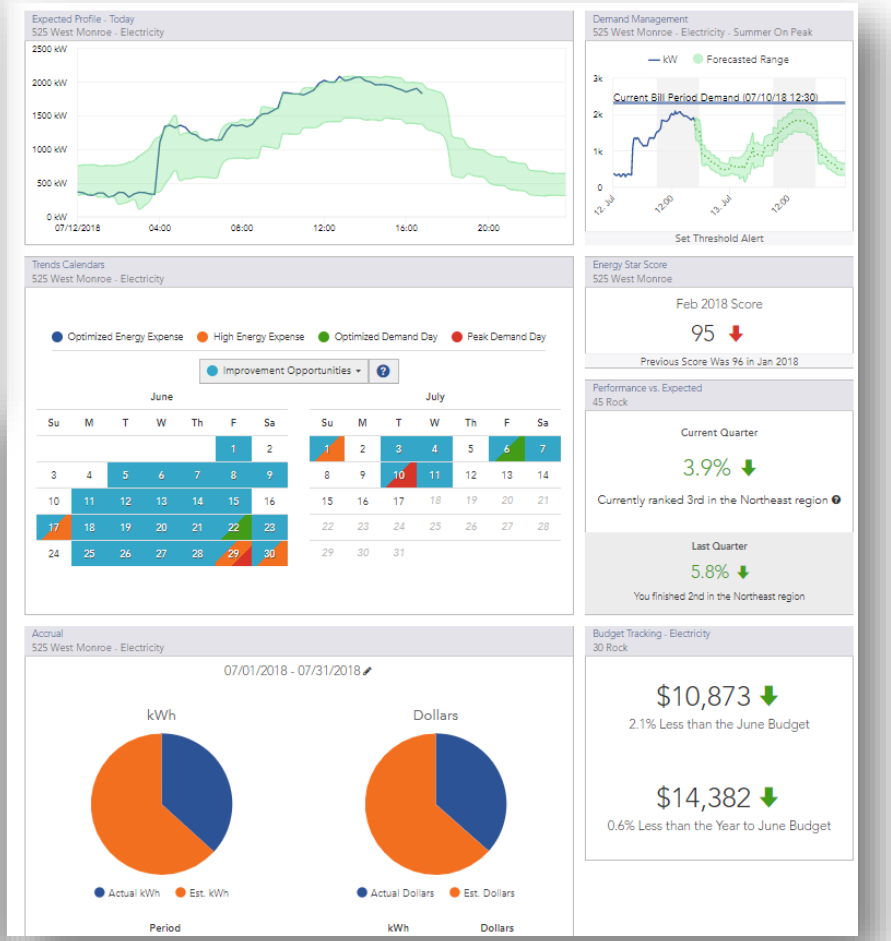
- Whole building & submeter level energy tracking & benchmarking
- Data visualization
- Peak load analysis
- Automated energy modeling
  - Energy anomaly detection (i.e. scheduling, changes in load profile, excessive energy use)
  - Project savings verification
  - Cumulative sum of savings



Energy Information Systems (EIS):
Find waste and verify savings using energy meter data

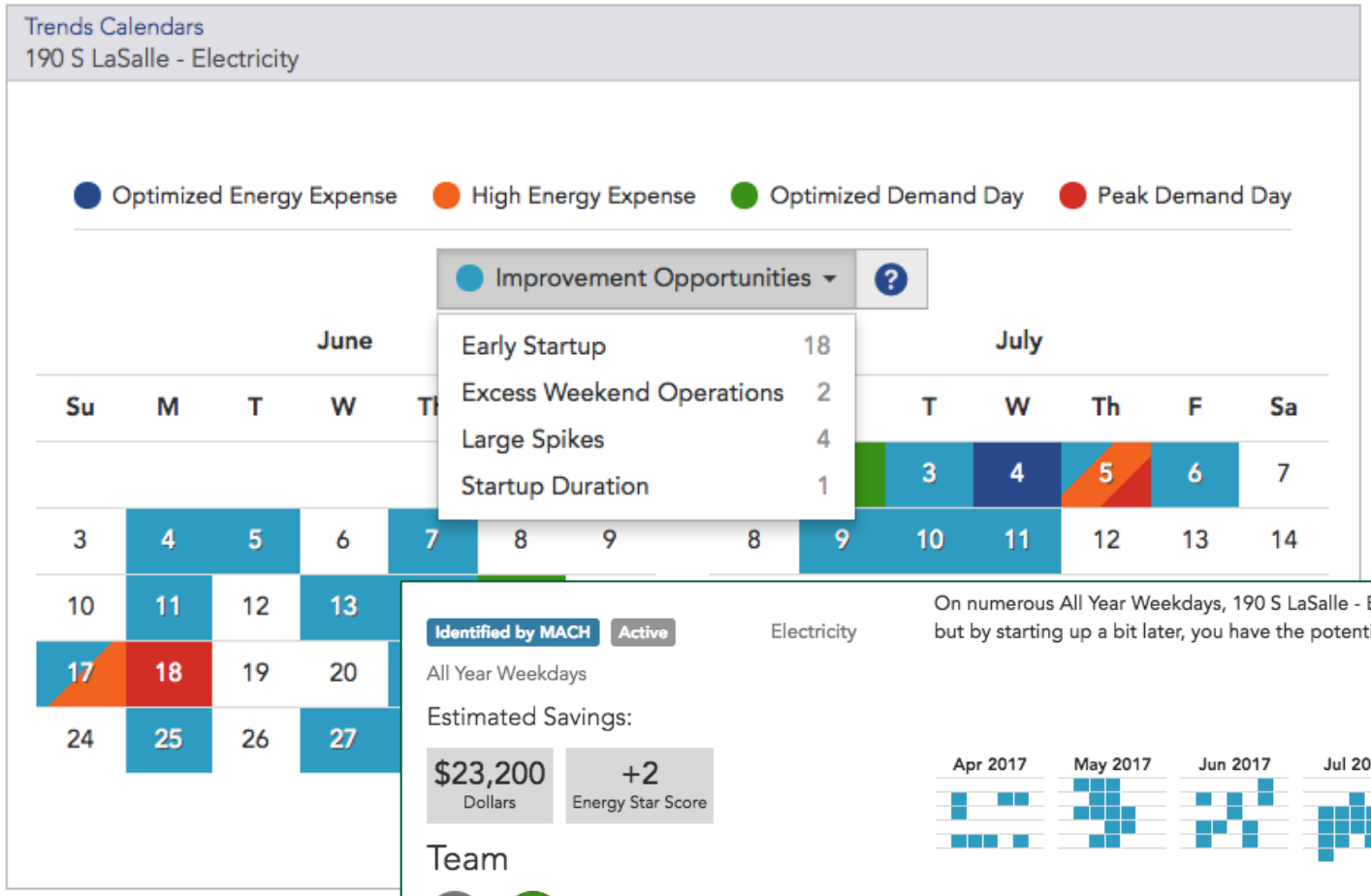




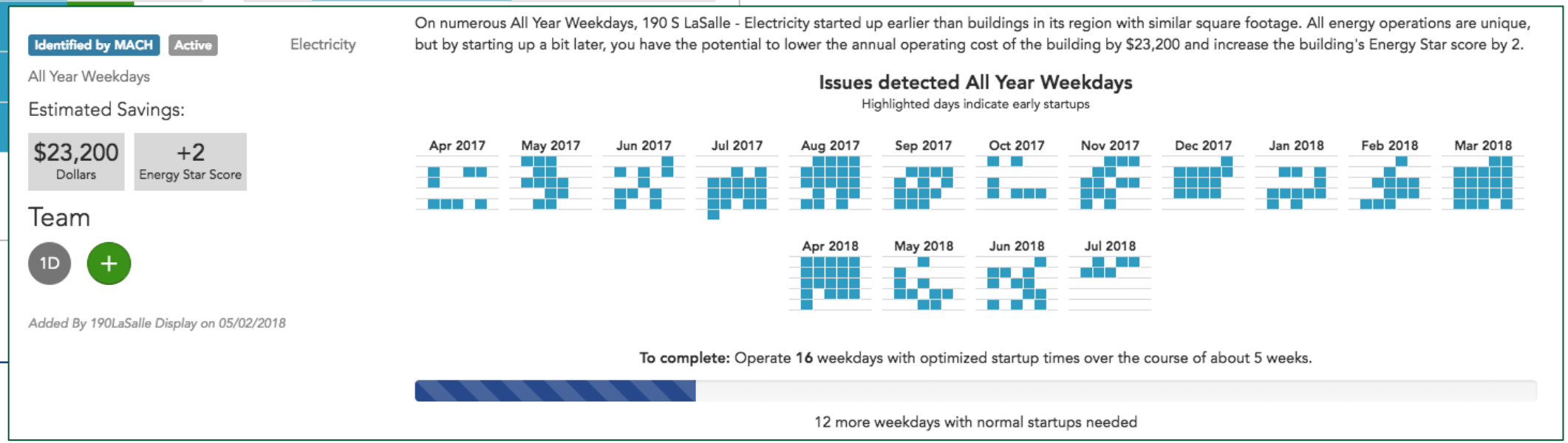


Images, left to right: Carleton College, LBNL, Macalester College, Tishman Speyer

Specific Improvement Opportunities through an EIS



- Detect operational anomalies
- Monetize issues to prioritize action
- Track performance toward process improvements



Source: Tishman Speyer (Mach Energy)

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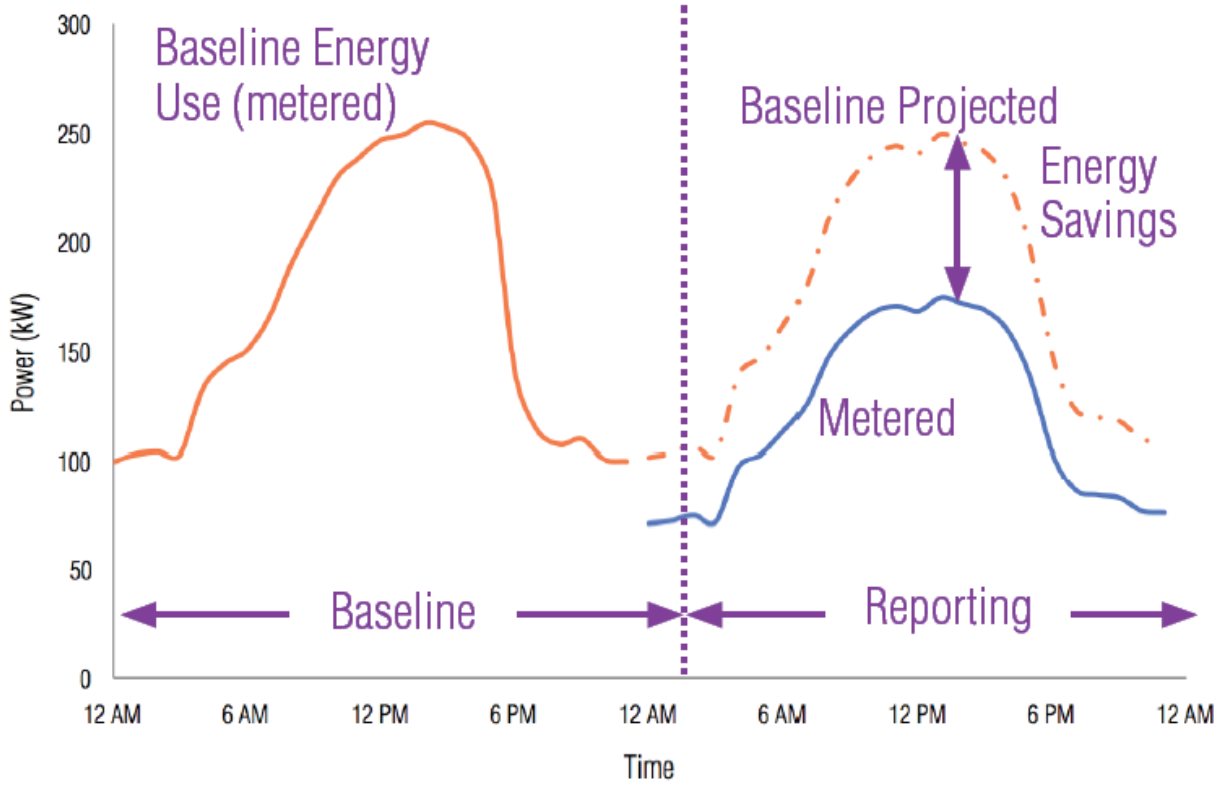
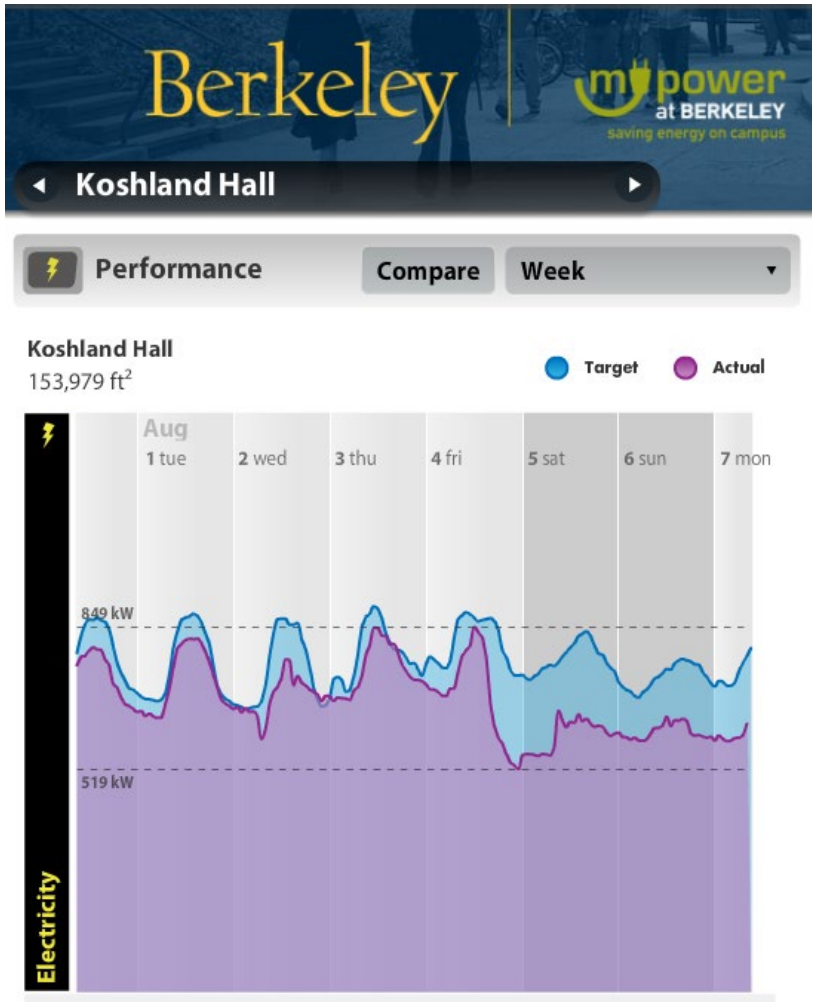
Forecasting: Predicted energy use vs. actual energy use to determine savings



Graphic Source: [Energy Information Handbook](#) (LBNL, 2011)



Graphic Source: [UC Berkeley](#) (Yardi Pulse)

Energy Information System (EIS)

Examples

- BuildingOS
- Aquicore
- Datakwip
- eSight
- Gridium
- Hatch Data
- Mach Energy
- Melrok
- Parasense
- Periscope
- Power Takeoff
- Powerhouse Dynamics
- Senseware
- Verdigris

- **Benefits**
  - Provide granular energy consumption history and patterns
  - Review & adjust electrical demand in real time
  - Alert when energy exceeds the expectation
  - Take weather and occupancy changes into account
- **Energy savings enabled with EIS[1]**
  - Median annual portfolio savings of 3%
- **Costs**
  - Base cost: $1500/bldg, $0.01/sf, $335/pt[1]
  - Recurring cost: $400/bldg, $0.01/sf, $150/pt[1]

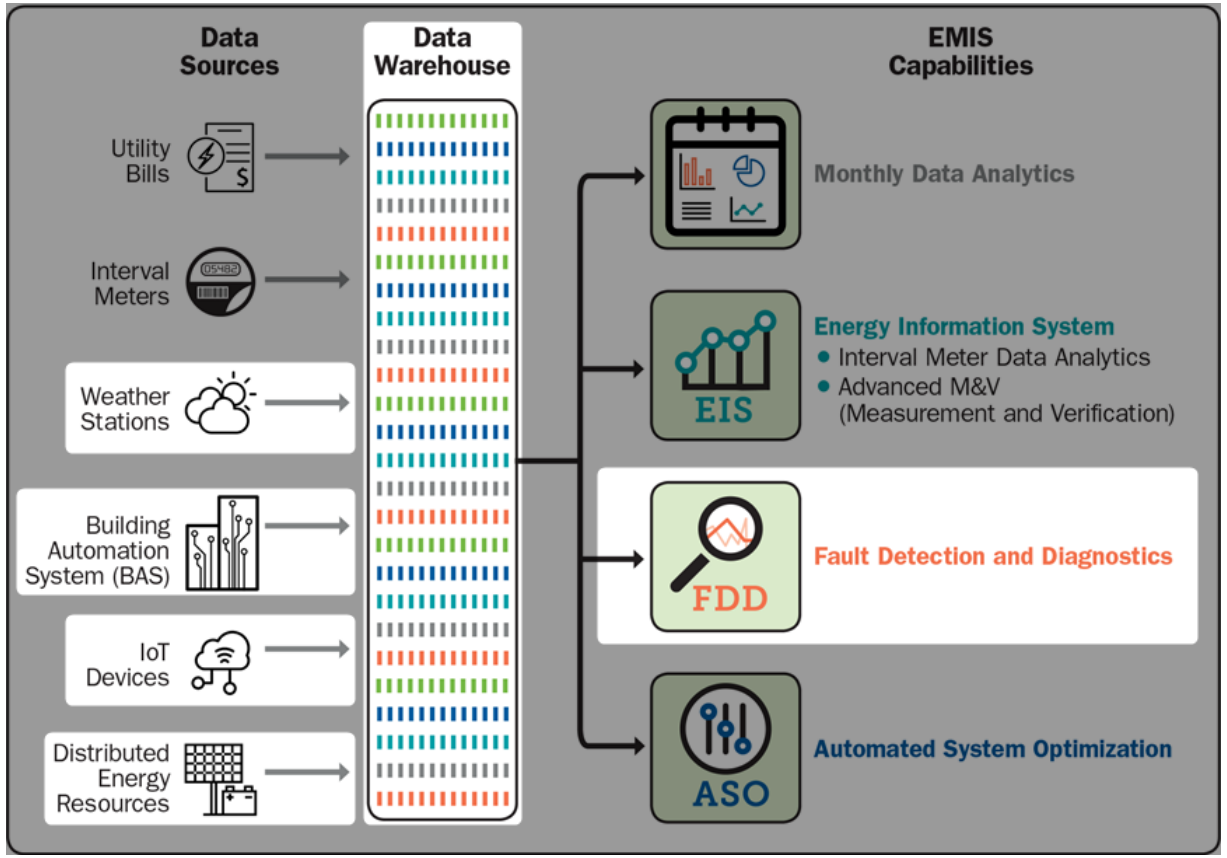
[1] Kramer, H., Lin, G., Curtin, C., Crowe, E., and Granderson, J. *Proving the Business Case for Building Analytics*. Lawrence Berkeley National Laboratory, October 2020.

Fault Detection and Diagnostics (FDD)

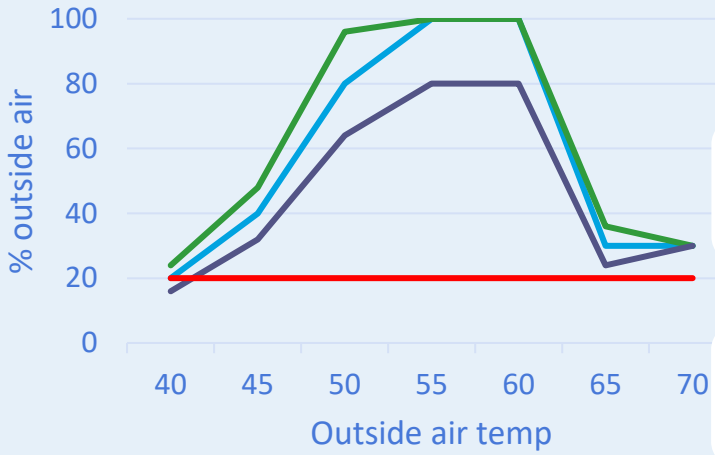
Software that automatically identifies HVAC system or equipment level faults and isolates root causes where possible

Applications for fault detection

- Find hidden energy waste and maintain improvements
- Improve comfort
- Systems with FDD applications include:
  - Chilled water and hot water plants
  - Air handlers (simultaneous heating and cooling, economizers, leaky valves)
  - Terminal unit operation
  - Detection of sensor issues

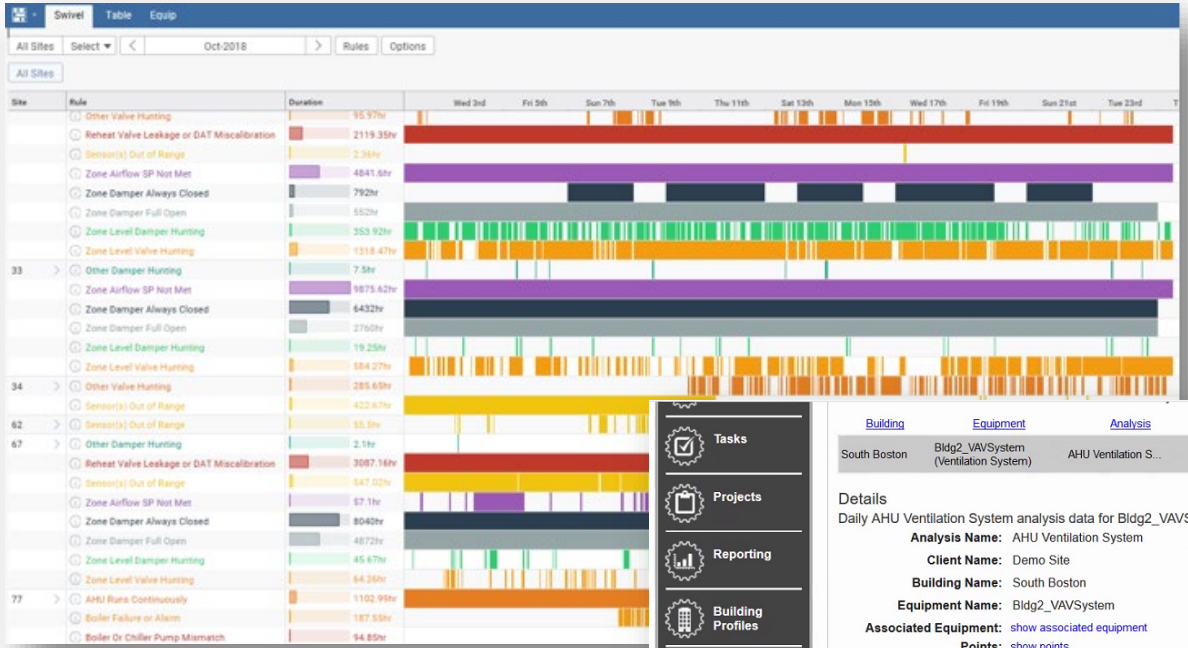


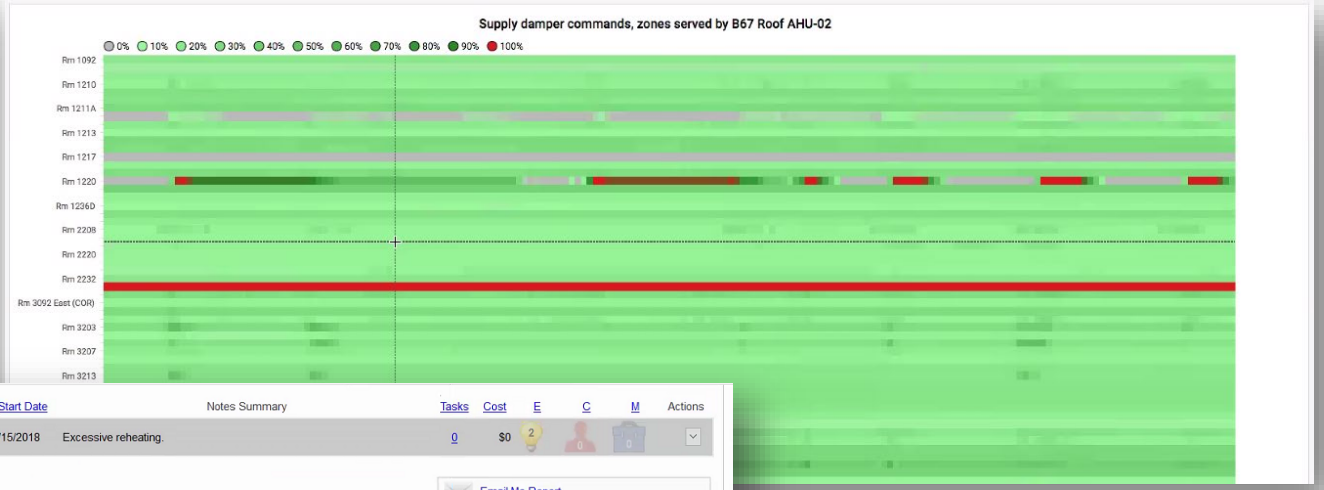
Fault Detection and Diagnostics (FDD)

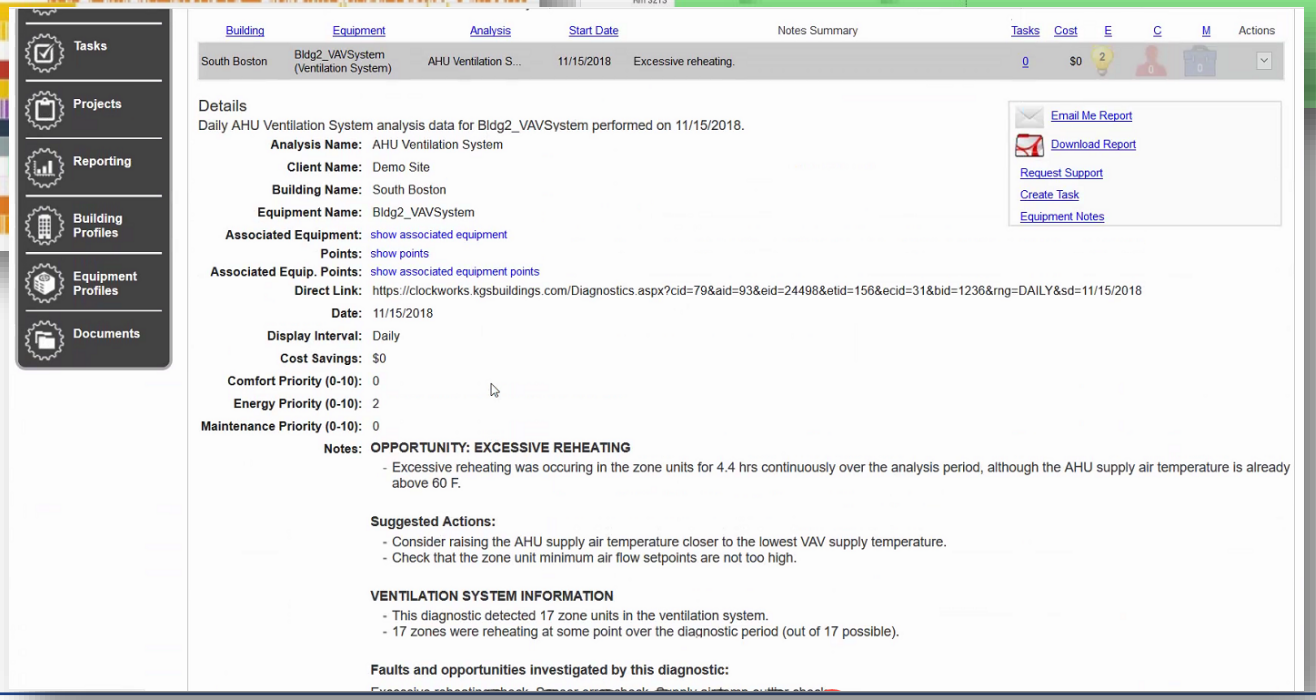
Data input	Detect differences from predicted operation (expert rules or model)	Diagnostics	Root cause
Real-time BAS data Static data & control parameters		Fault 1: Damper issue	• Investigate OA and RA dampers and actuators for root cause
		Fault 2: Controls	• Sequence of operation issue programmed incorrectly
		Fault 3: Sensor Issue	• Calibrate or replace sensors

Fix issue and verify with FDD

Fault Detection and Diagnostics (FDD): Detect, diagnose, and prioritize system faults







Images, left to right: LBNL, KGS Clockworks, LBNL

FDD Issues List helps prioritize ranking by energy cost waste

Top 5 Issues

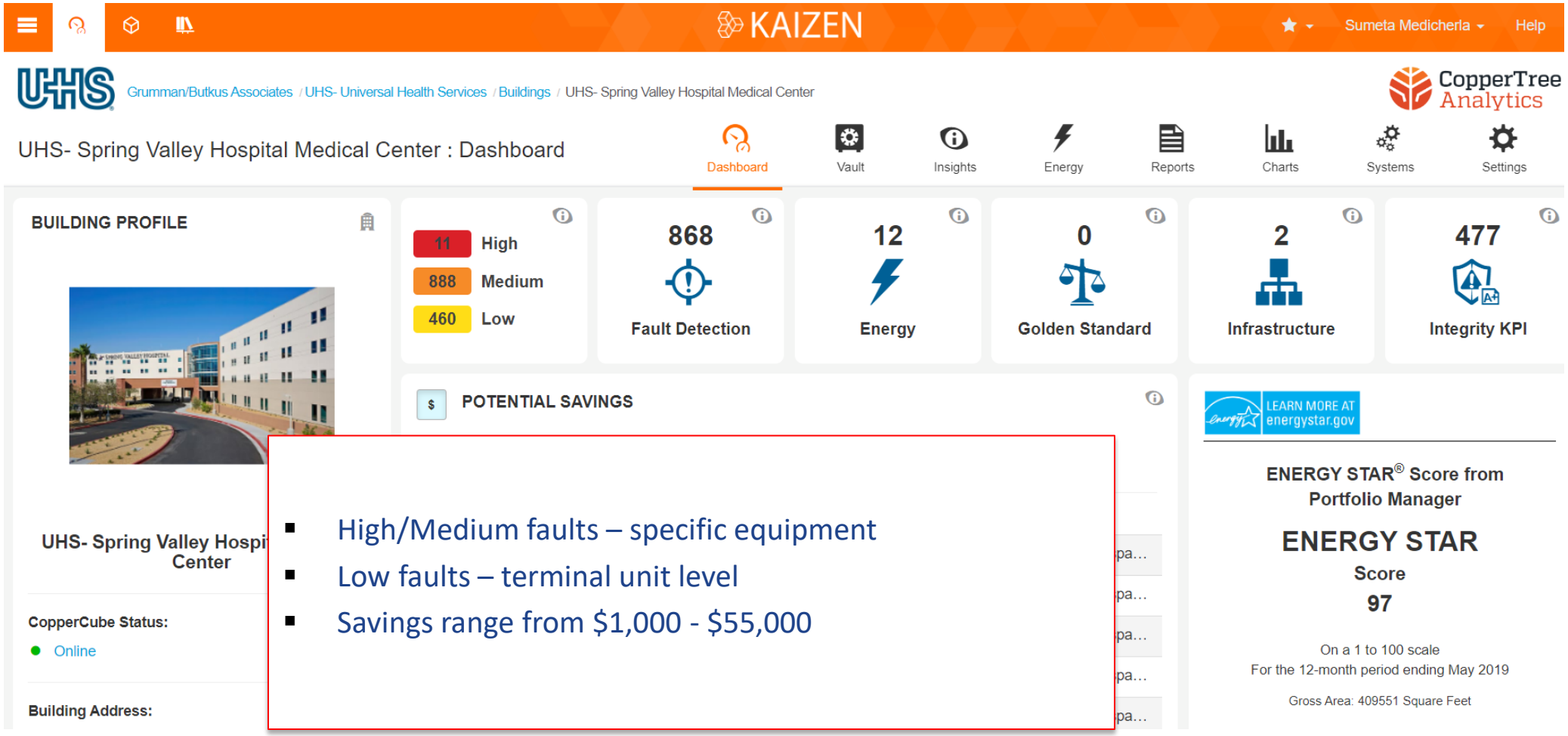
Energy

Building	Equipment	Notes	Cost/Qtr.
Anon Hospital	AHU_6_CAVs	Low Damper Position – opportunity for static pressure reset.	$11,120
Anon Hospital	AHU_11	No supply temp reset. Cooling valve issues.	$7,778
Anon Hospital	AHU_6	No supply temp reset. Cooling valve issues.	$6,163
Anon Hospital	AHU_5	Supply temp lower than setpoint. No supply temp reset. Cooling valve issues.	$5,029
Anon Hospital	AHU_4	Supply temp lower than setpoint. No supply temp reset. Cooling valve issues.	$4,318

Maintenance

Building	Equipment	Notes	Severity Priorty
Anon Hospital	AHU_11	Static pressure lower than setpoint. Supply fan speed constant. Return fan speed constant.	6
Anon Hospital	AHU_10	Static pressure lower than setpoint. Supply fan speed constant.	6
Anon Hospital	CAV8_2	Room temp lower than setpoint. Stuck reheat valve.	4
Anon Hospital	CAV5_82	Supply flow lower than setpoint. Stuck reheat valve. – May be sensor error.	4
Anon Hospital	CAV3_11	Sensor error. Stuck reheat valve.	4

Fault Detection and Diagnostics: Fault Dashboard



- High/Medium faults – specific equipment
- Low faults – terminal unit level
- Savings range from $1,000 - $55,000

Source: Universal Health Services in partnership with Grumman Butkus Associates (CopperTree Kaizen)

Fault Detection and Diagnostic Tools (FDD)

Examples

- BuildingLogix
- Cimetrics
- Clockworks Analytics
- Connexx Energy
- CopperTree Analytics
- Ecorithm
- Envizi
- Ezenics
- FacilityConneX
- ICONICS
- InSite
- Interval Data Systems
- Schneider Electric EcoStruxure
- SkySpark
- Switch Automation

- Benefits
  - Automatically detects problems with less analysis time
  - Move from reactive to proactive maintenance
- Energy savings enabled with FDD[1]
  - Median annual portfolio savings of 9%
- Costs
  - Data acquisition, FDD setup & tuning
  - Base cost: $12,500/bldg, $0.05/sf, $8/pt[1]
  - Recurring cost: $3,500/bldg, $0.02/sf, $5/pt[1]

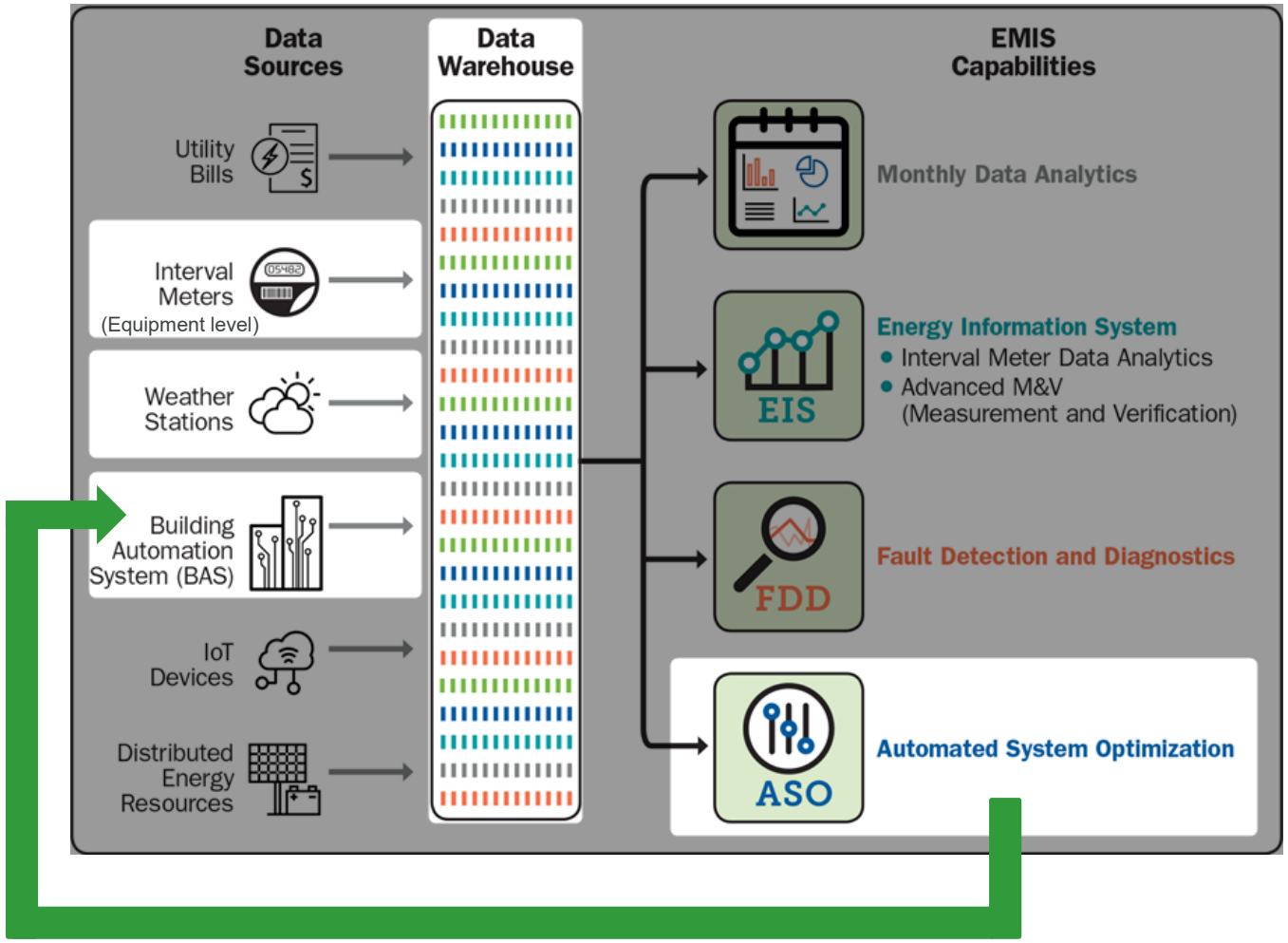
[1] Kramer, H., Lin, G., Curtin, C., Crowe, E., and Granderson, J. *Proving the Business Case for Building Analytics*. Lawrence Berkeley National Laboratory, October 2020.

Automated System Optimization (ASO)

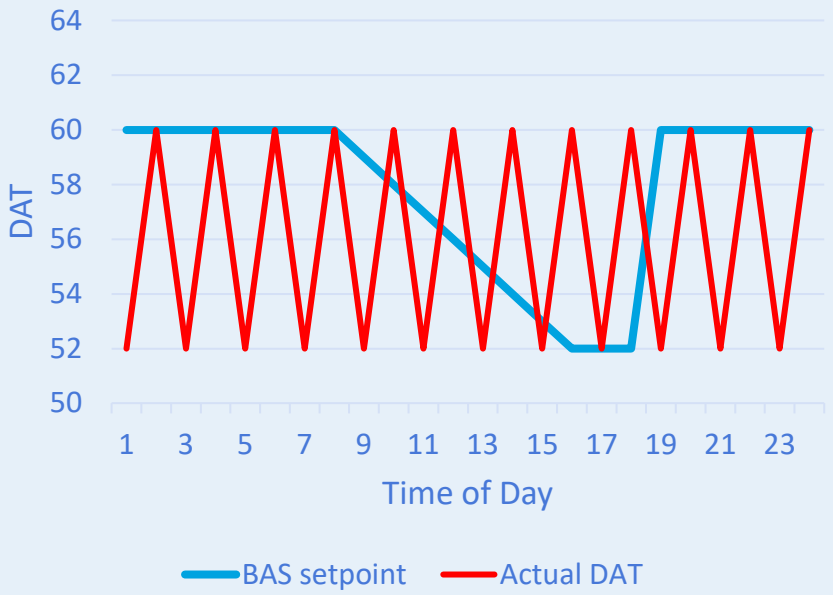
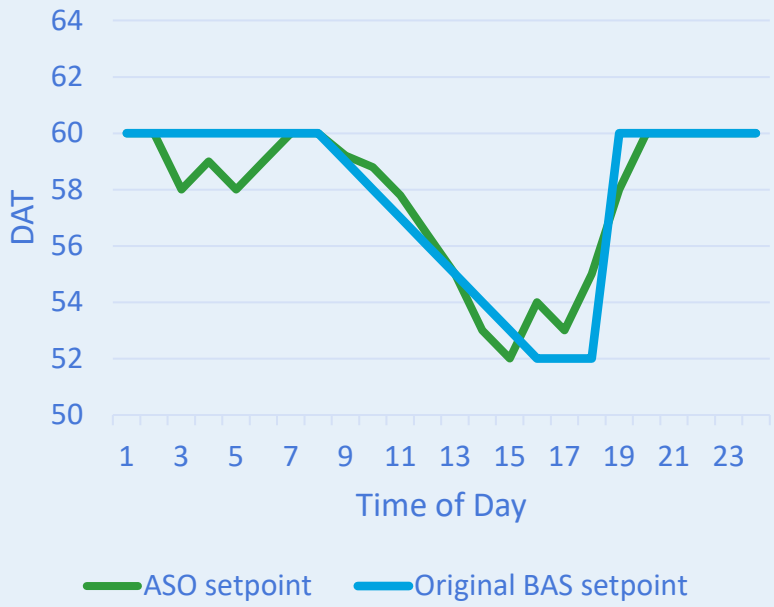
Supervisory control software that dynamically changes HVAC BAS settings to optimize system performance

Applications

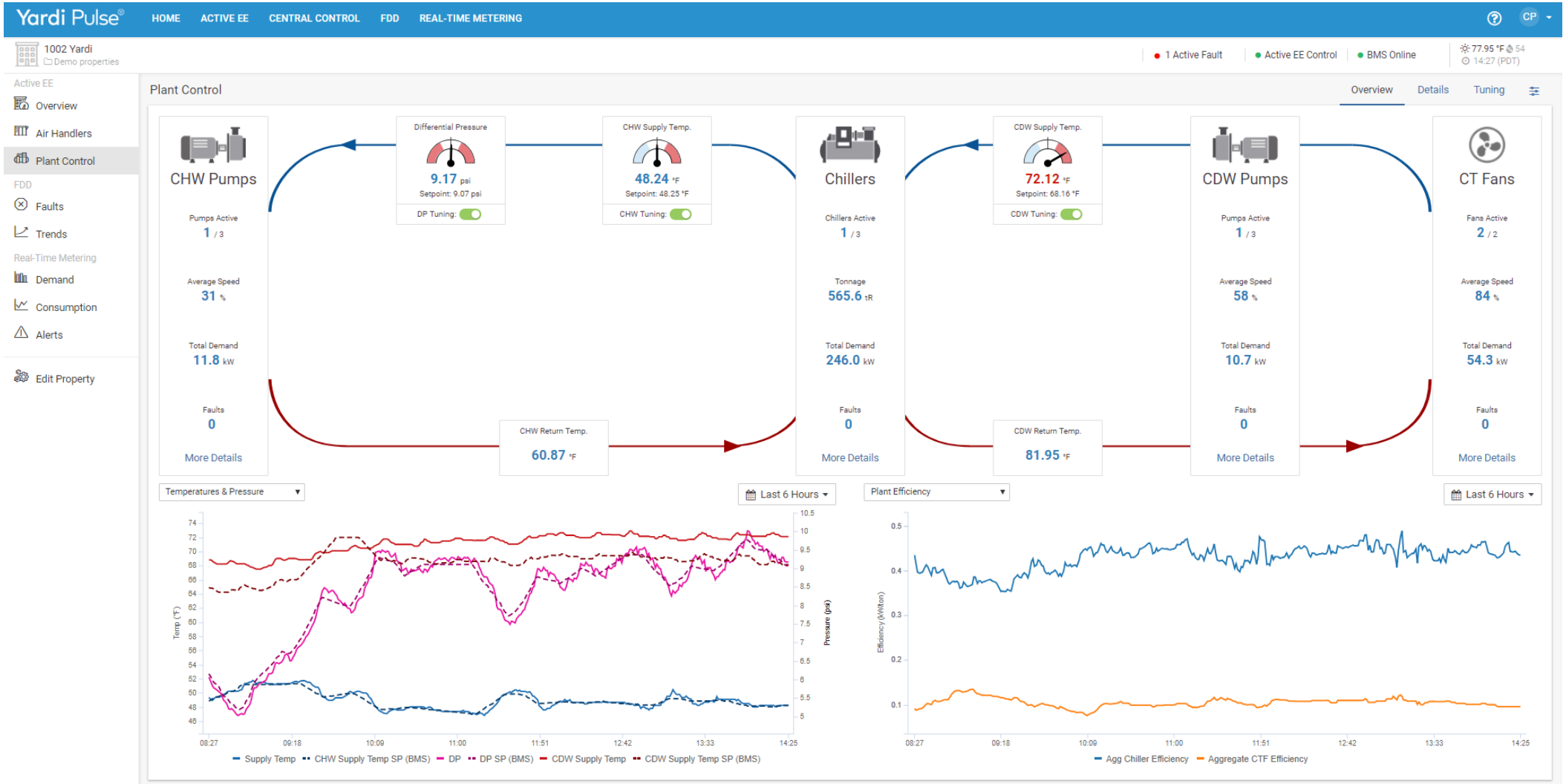
- Chilled water plant and AHU optimization
  - CHW supply temp reset
  - CW return temp reset
  - AHU duct static pressure reset
  - AHU discharge air temp reset
  - TOU pricing



Automated System Optimization (ASO)

Data input and detection		Automatic correction
Data	Fault detection & Opportunity for optimization	FDD flags DAT fault ASO runs predictive model and continuously writes optimized setpoints to BAS
Real-time BAS data Static data & control parameters		

Automated System Optimization (ASO):
Minimize energy use across systems through control optimization



Source : Yardi Pulse

Automated System Optimization

Examples

- BrainboxAI
- Optimum Energy
- Prescriptive Data
- QCoefficient
- Shift Energy
- tekWorx
- Vigilant
- Yardi Pulse

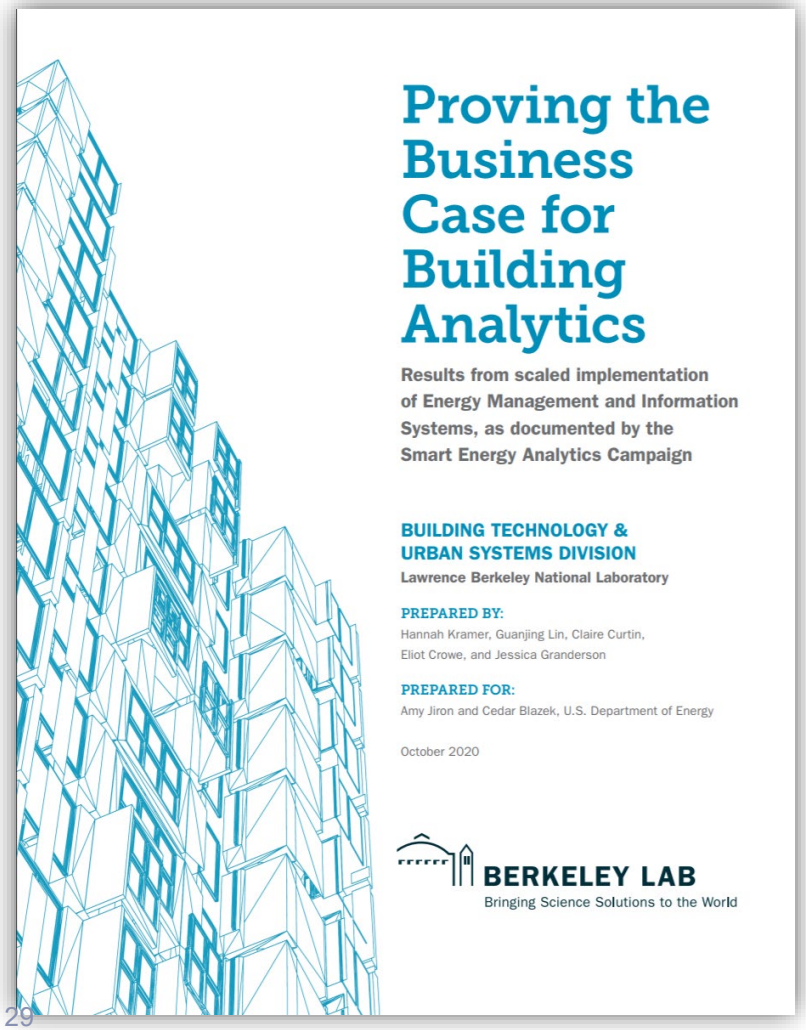
- Benefits
  - Detects and automatically corrects control problems
  - Optimize for energy cost, demand charges
- Energy savings enabled with ASO
  - Dependent on base system design
- Costs-**$$$**
  - May require variable flow air and hydronic systems (equipment upgrades)
  - Systematic collection of cost data not yet available

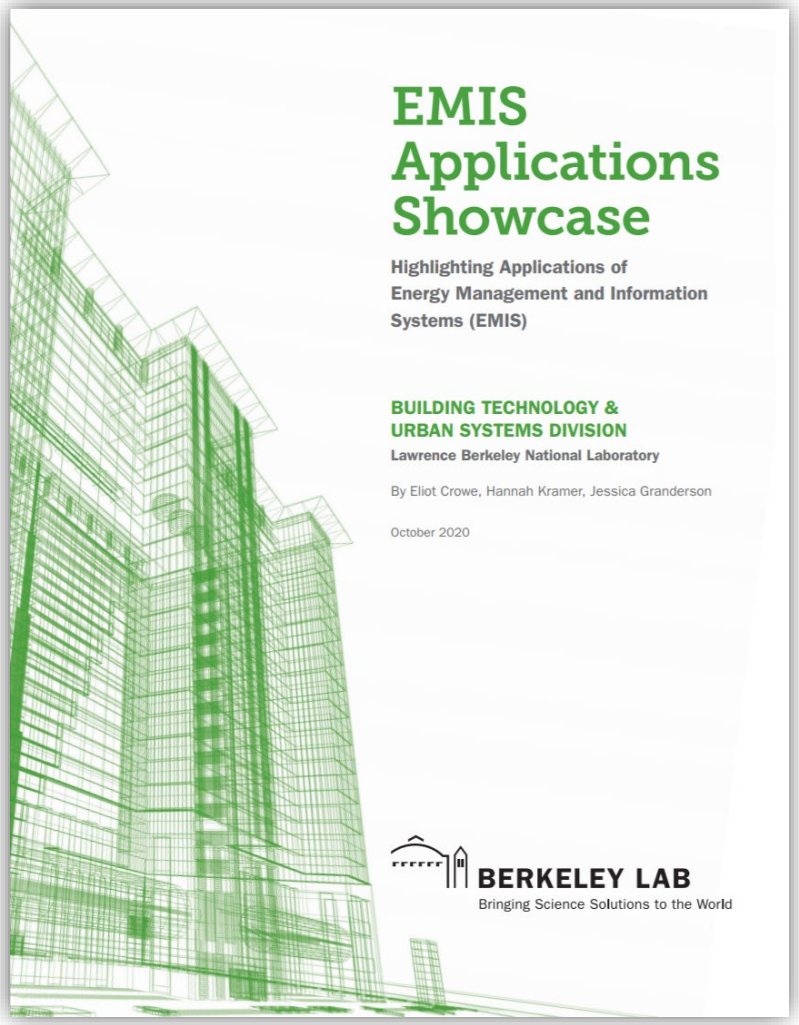
Summary of EMIS Tools

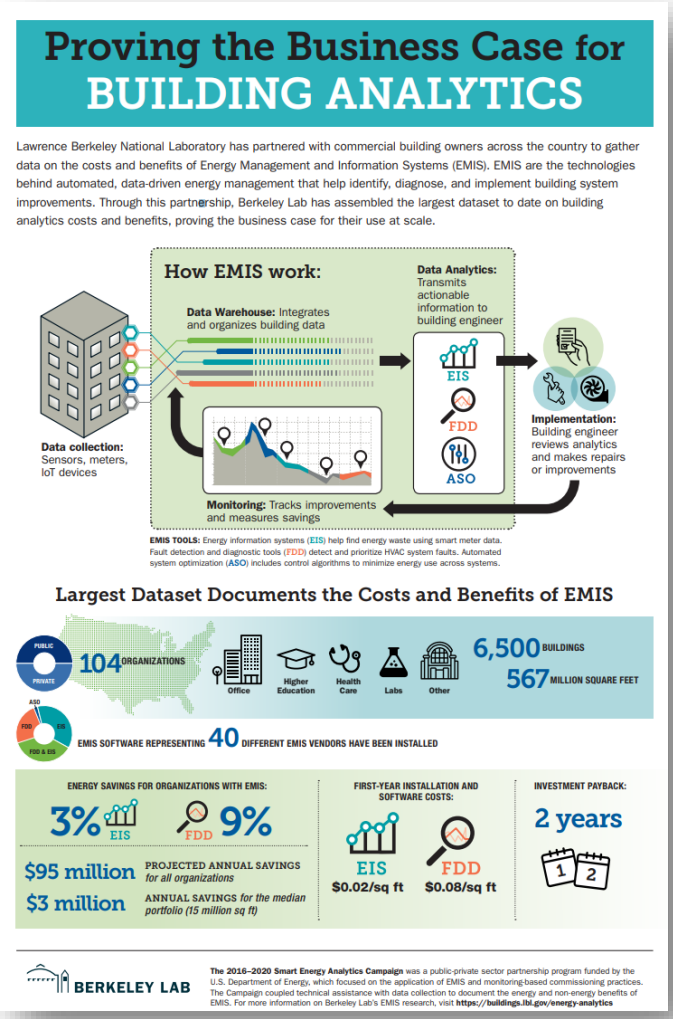
	EMIS Capability	Data scope	Key uses	Costs	Whole-building energy Savings
Whole building	**Monthly data analytics**	Monthly utility bills	▪ Peer-to peer comparison ▪ Utility bill data acquisition & analysis ▪ Budgeting ▪ Tenant billing	$-$$	2.4% median
Whole building & submeters	**Energy information system (EIS)**	Hourly or 15-min energy meter data	▪ Benchmarking & energy dashboard ▪ Building load analysis ▪ Energy anomalies alert ▪ Peak demand reduction ▪ Automated M&V	$$ Base: $0.01/sq ft Annual: $0.01/sq ft	3% median, portfolio-level $0.03/sq ft
System	**FDD**	15-min or less interval data from BAS and meters	▪ System-level performance tracking (KPIs) ▪ Automated fault detection & notification ▪ Fault causes identification ▪ Issues tracking	$$$ Base: $0.06/sq ft Annual: $0.02/sq ft	9% median, portfolio-level $0.24/sq ft
	ASO	15-min or less interval data from BAS and meters Supervisory control to BAS	▪ Optimal HVAC settings prediction	$$$$ Higher than FDD	Field validations in progress

Making the Business Case

smart-energy-analytics.org

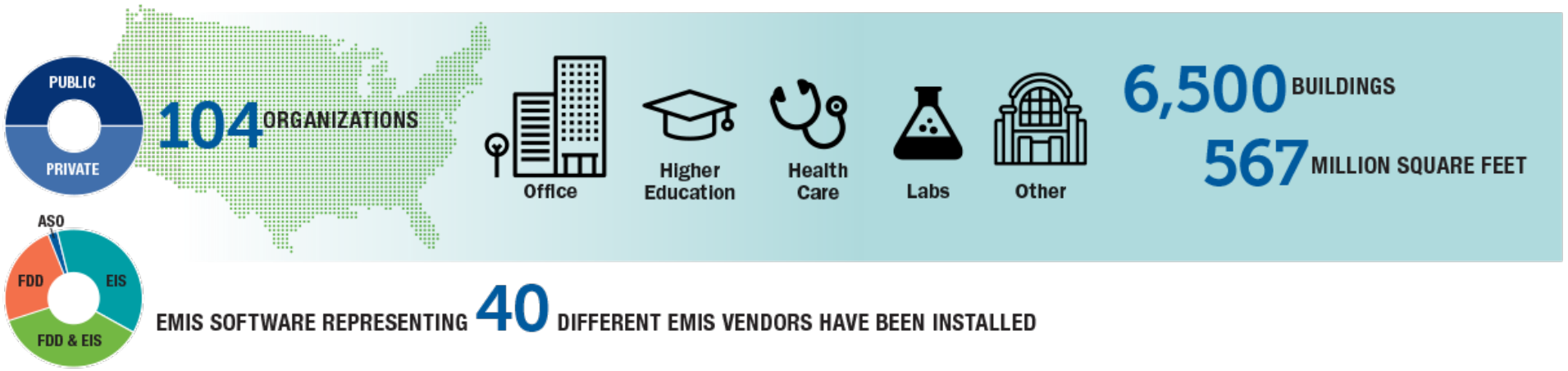






Smart Energy Analytics Campaign Results

Largest Dataset Documents the Costs and Benefits of EMIS



ANNUAL ENERGY SAVINGS FOR ORGANIZATIONS WITH EMIS:

3% EIS

FDD 9%

$3 million ANNUAL SAVINGS *for the median portfolio (15 million sq ft)*

$95 million PROJECTED ANNUAL SAVINGS *for all organizations*

FIRST-YEAR INSTALLATION AND SOFTWARE COSTS:

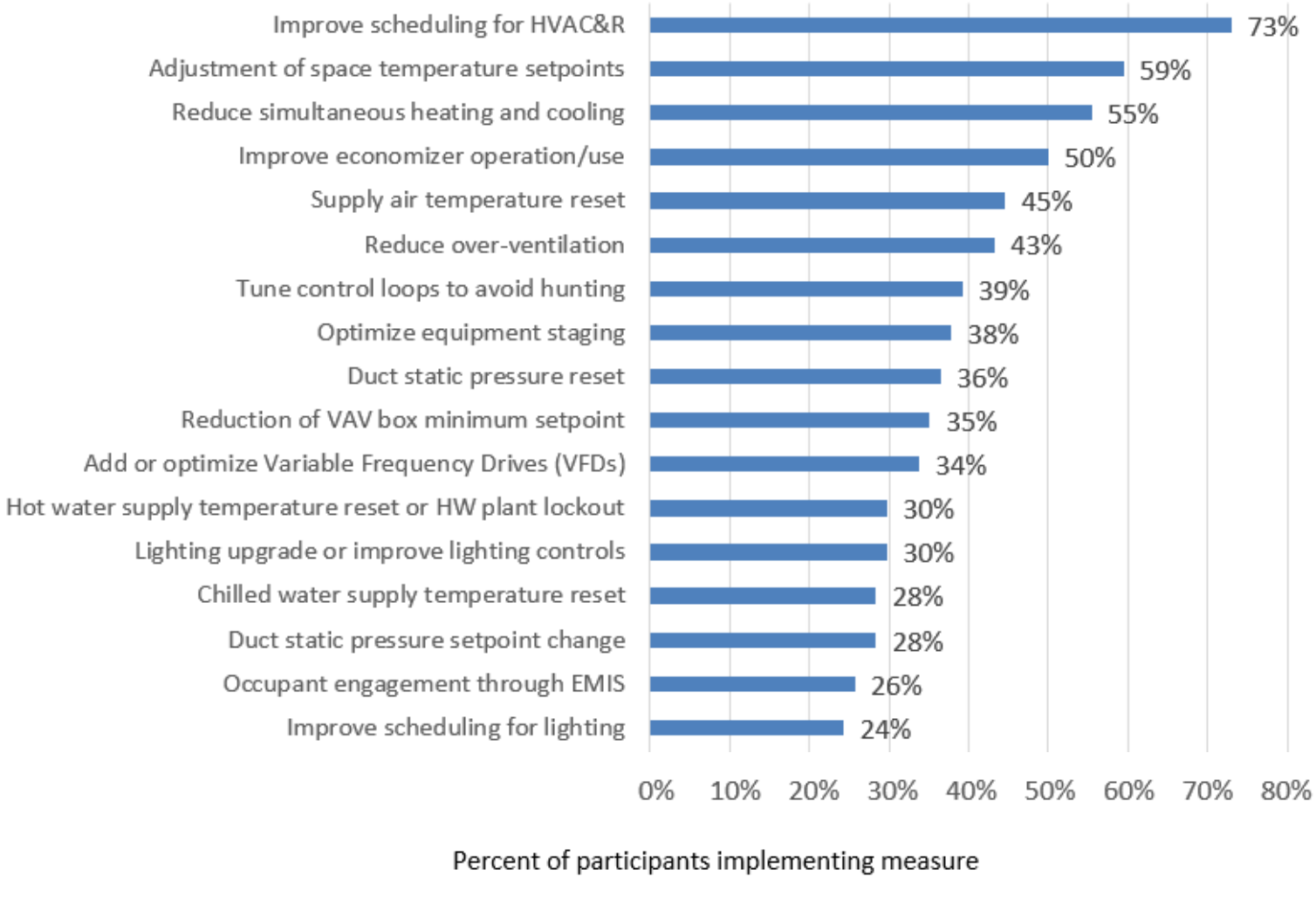
EIS **$0.02/sq ft**

FDD **$0.08/sq ft**

INVESTMENT PAYBACK:

2 years

Top Measures Implemented with Support of EMIS
(74 organizations, 452 million sq ft)

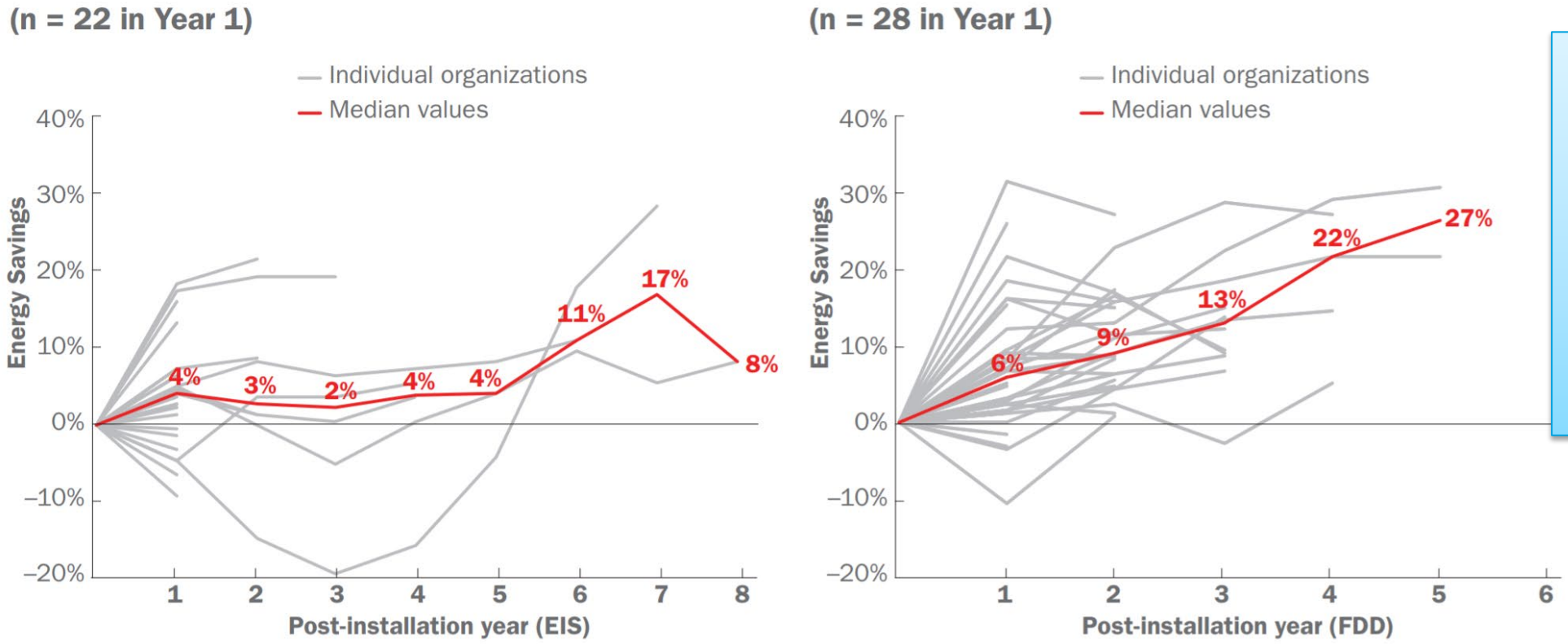


Energy Savings Since EMIS Installation

Energy Savings	EIS	FDD
Number of portfolios	10	18
Floor area (millions sq ft)	82	90
Median savings	3%	9%
Median savings ($/sf/yr)	$0.03	$0.24
Top 25% savings	11%–22%	15%–28%

Energy Savings Since EMIS Installation

FIGURE 9: Percent energy savings relative to the year before EMIS installation by organizations participating in the Smart Energy Analytics Campaign



Savings not exclusively attributable to EMIS

Participants report that EMIS instrumental in obtaining and sustaining savings over time

Median Costs

Type of Cost, by EMIS Type	Per point	Per building*	Per sq ft
EIS (n=35)			
Base software and installation (one-time cost)	$333	$1,500	$0.01
Annual software + MBCx service provider ($ per year)	$149	$408	$0.01
FDD (n=32)			
Base software and installation (one-time cost)	$8	$12,500	$0.05
Annual software + MBCx service provider ($ per year)	$5	$3,503	$0.02

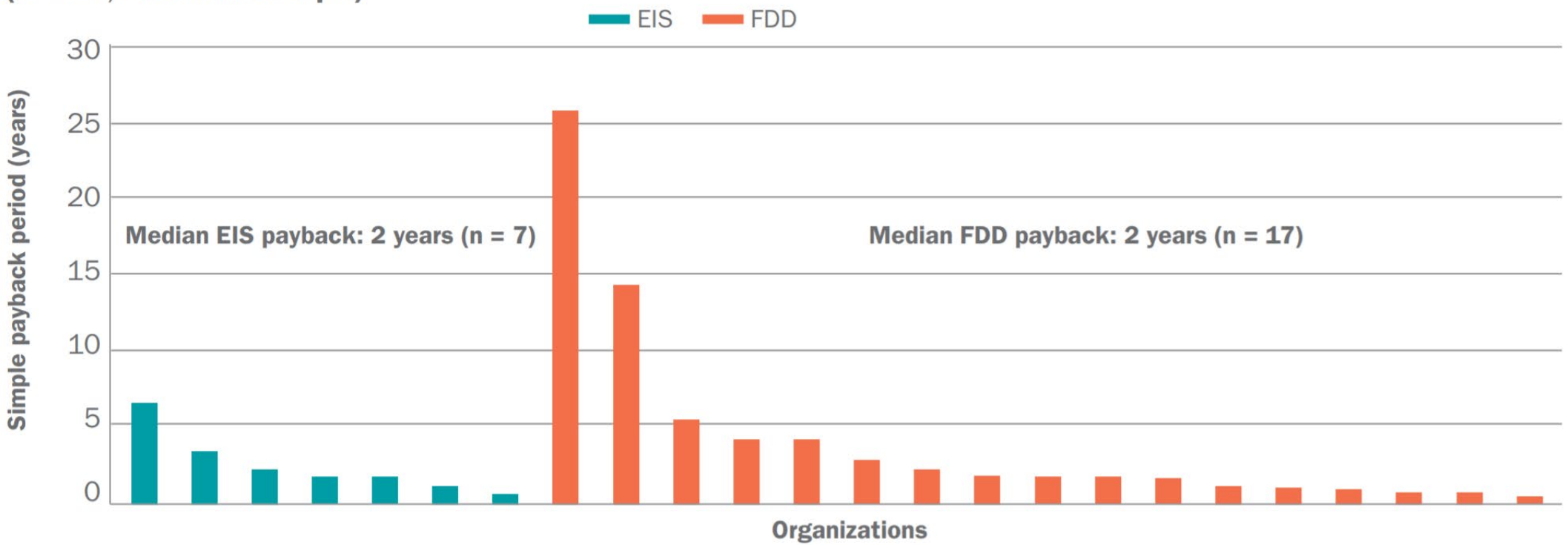
*For each participant, a 'per building" cost was established. The Per building column represents the median of the participant values. Since the median participant in the 'per building' and 'per sq ft" columns have different building sizes, the 'per building' and 'per sq ft' costs do not scale.

Cost-effectiveness

includes estimate of measure implementation cost; 24 organizations, 206 million sq ft

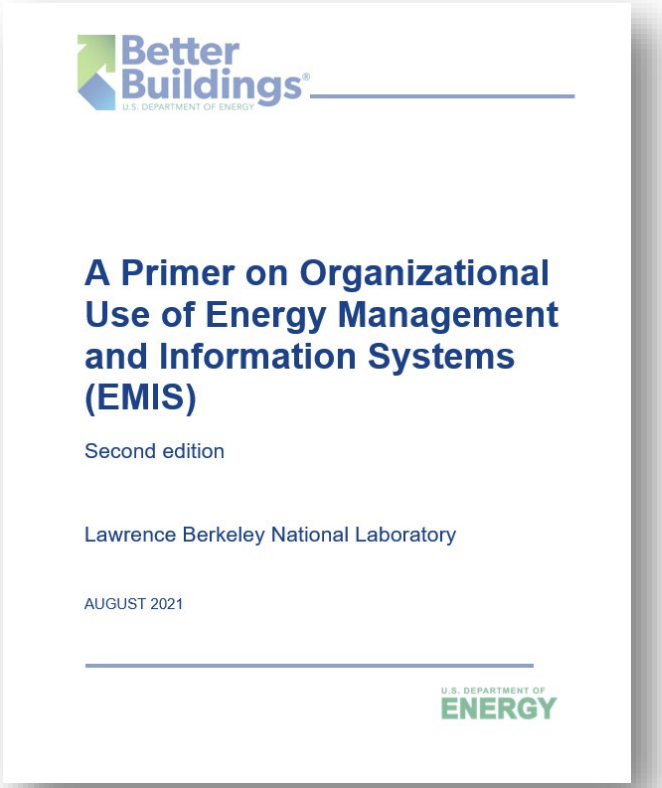
FIGURE 13: Estimated simple payback period by EMIS type

(n = 24, 206 million sq ft)



Key Points in the EMIS Journey

- **Planning**
  - Define activities and scope of the EMIS to meet your goals
  - Who will use it & how will it be used?
  - Build a Business Case using the latest research results
- **Implementation**
  - Specify an EMIS that supports specific needs
  - Provide system information to EMIS vendor
  - Configure and commission
  - Staff training
- **Ongoing Use**
  - Identify & Correct Issues: Reaping the rewards of the EMIS investment!



New Update - EMIS Primer

EMIS Use Best Practice: Scoping your EMIS

- **Selecting EMIS features**
  - Start with the features that you are most excited about using then add over time
  - Begin with the features that require existing data

- **Scaling up EMIS usage in a portfolio**
  - Begin with a pilot to demonstrate effectiveness, then expand it in the portfolio
  - Start with sites with high EUI or known operational problems
  - Standardization (e.g. data format, naming convention) is a key element

EMIS Use Best Practice: Managing Findings & Results

- Allocate sufficient labor hours to regularly review EMIS analysis and take action
- Integrate EMIS into standard business practices
  - Work order requests
  - Maintenance scheduling
- Use EMIS to quantify savings
- Communicate results to leadership

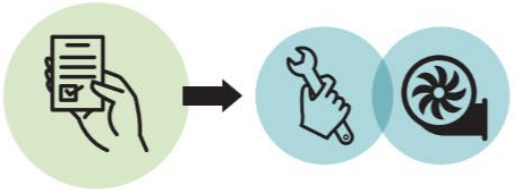
Service Providers Support EMIS Installation and Use

EMIS Installation and Commissioning

- Integrate data from a variety of sources
- Check data quality
- Develop diagnostic rules
- Configure EMIS user interface

Ongoing EMIS Data Review

- Prioritize findings
- Review BAS data to determine root cause
- Develop summary reports and action plans



Corrective Action and Verification

- Troubleshoot issues onsite
- Track corrective actions
- Verify faults have been corrected
- Estimate energy and cost savings

Increasing levels of support from MBCx service providers to operations staff

Get Started with the Better Buildings EMIS Toolkit

- Updated: EMIS Primer, 2nd edition
- Business Case Resources
  - Final Report: Proving the Business Case for Building Analytics
  - EMIS Applications Showcase
  - Success Stories
  - Infographic
- Selecting an EMIS and Implementing an MBCx Process
  - EMIS Procurement Specification
  - Example RFPs
  - MBCx Plan Template

Thank you

- Questions?
  - Hannah Kramer (hkramer@lbl.gov)
  - Eliot Crowe (ecrowe@lbl.gov)
  - Valerie Nibler (vnibler@lbl.gov)
- Get involved:
  - Building owners, operators, and managers: join the Better Buildings Alliance or contact bba@ee.doe.gov with questions
  - Join the EMIS Tech Team list: send request to emis@lbl.gov