

De-Carbonizing the Campus: Planning, Tools & Technologies

CampusEnergy2023

February 27 – March 2, 2023

Gaylord Texan Resort & Convention Center | Grapevine, Texas



INTERNATIONAL
DISTRICT ENERGY
ASSOCIATION



Energy Conservation vs. Campus Growth: Implementing Campus Utility Submetering

Michael Charlton, Ph.D., UT Health San Antonio

Major Jeff Davidson, UT Health San Antonio

Shannon McAuliffe, utiliVisor

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Outline

1. Background
2. Problem
3. Goals
4. Finding a Partner
5. Designing a Solution
6. Implementation
7. Results
8. Lessons Learned



- Facilities Management of Greehey Campus
- 1.4 million gross square feet of space over 14 buildings
- Two buildings currently under construction
 - Park West – 80,000-square-foot outpatient clinic
 - 144-bed multispecialty & research hospital
- Future construction of Center for Brain Health and Barshop expansion

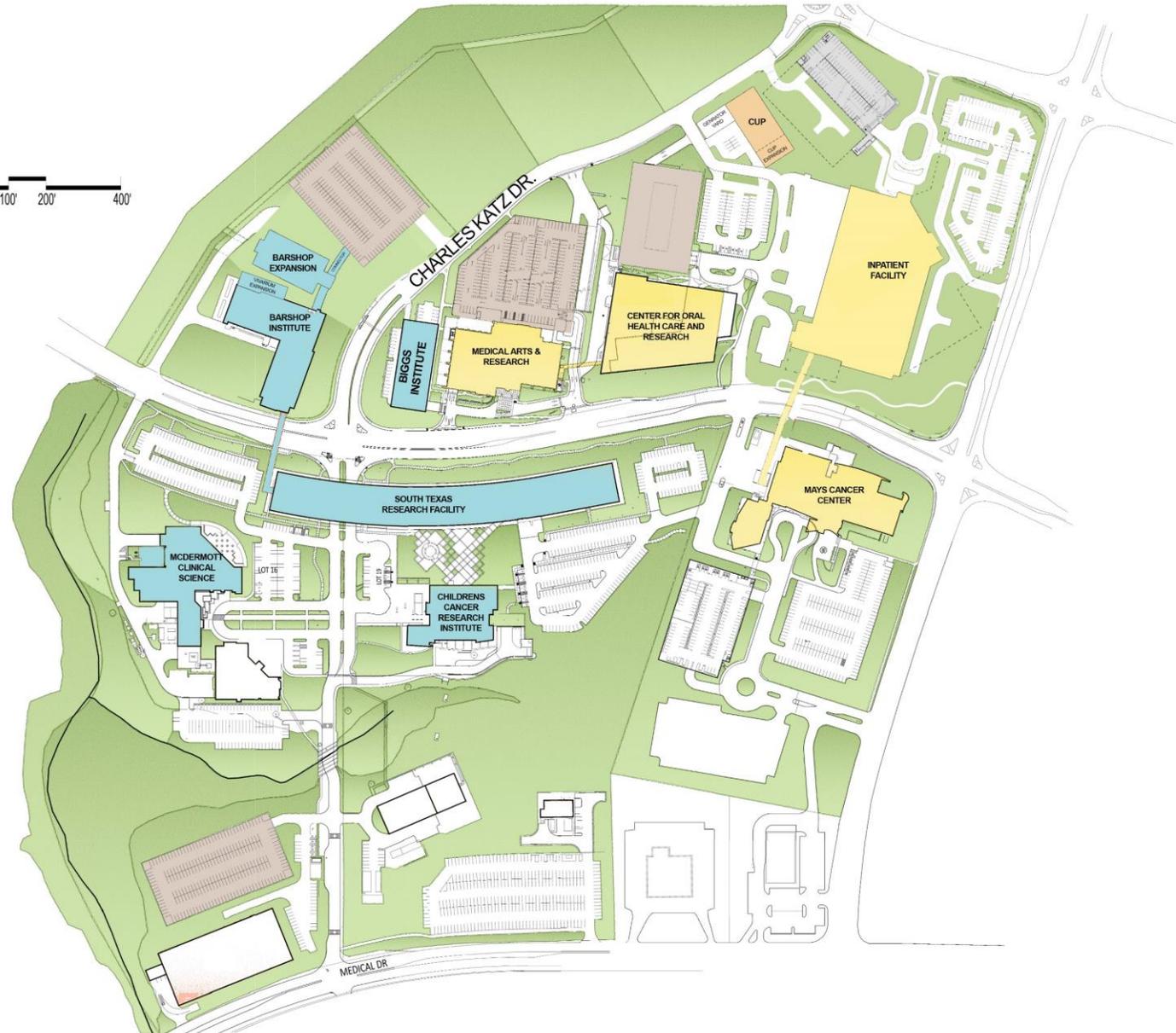
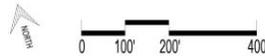


UT Health San Antonio

The University of Texas
Health Science Center at San Antonio

GREEHEY CAMPUS

- Legend
- Research
 - Clinical
 - Parking Garage
 - New Central Plant



BACKGROUND

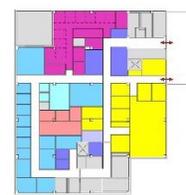


UT Health San Antonio

The University of Texas
Health Science Center at San Antonio



Level 1



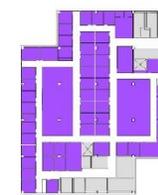
Level 2



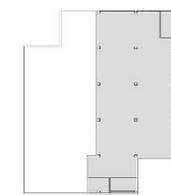
Level 3



Level 4



Level 5



Level 6

Legend:

- Community Engagement
- Administrative Space
- Clinical Research
- Lab
- Pharmacy
- Clinical Care - Multi Disciplinary
- Clinical Biggs
- Clinical Neurology
- Shared Between Biggs & Neurology
- I-fusion
- Ancillary Services
- Neuropsychology Clinic Space
- Imaging
- Shared Spaces
- Vertical Circulation/ Building Services

Section Diagram:



Exam Room/ Office Breakdown:

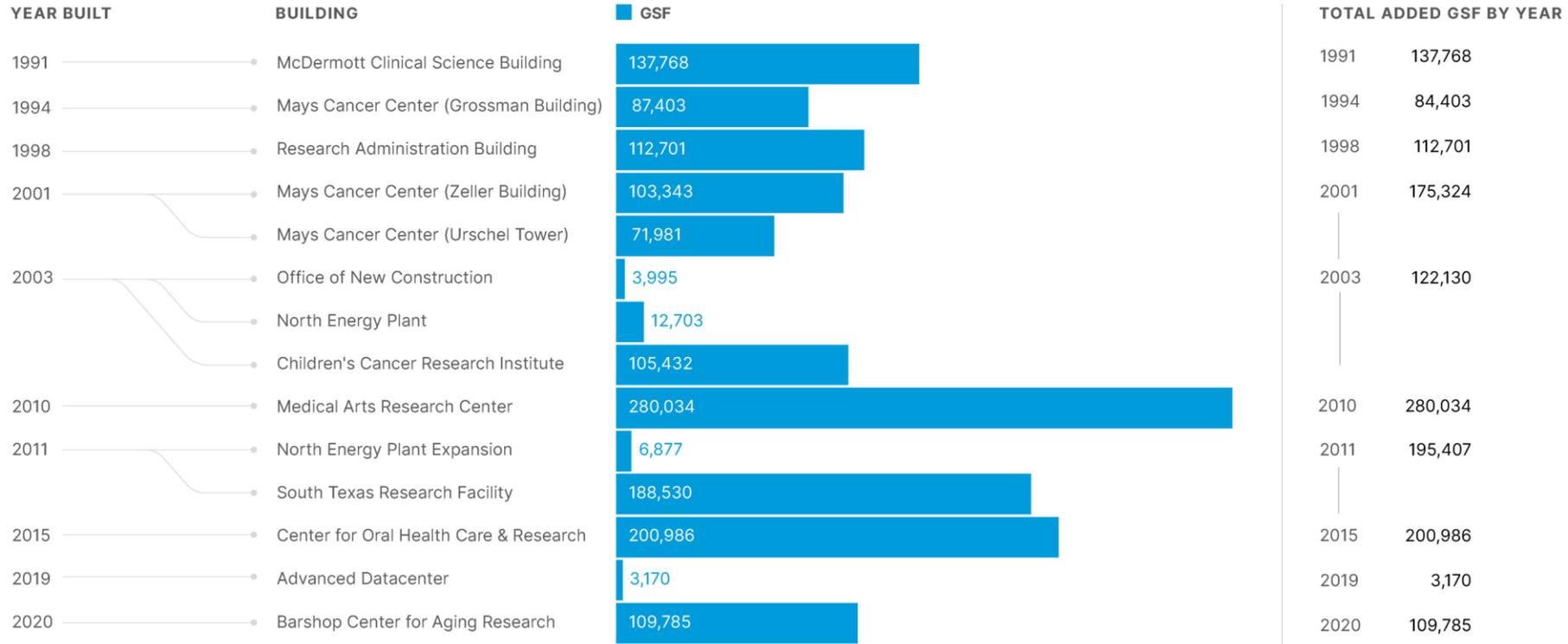
Shell Space (sf): 0
Exam Rooms: 104
Clinical Offices: 9
Admin Offices: 66
Workstations: 74

3D Massing Model:

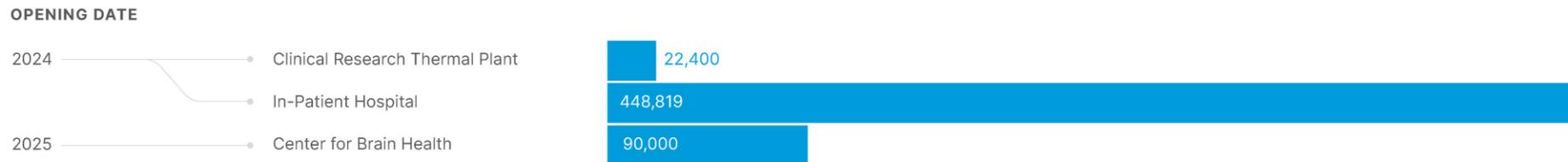


BACKGROUND

Greehey Campus



Total GSF
1,424,708



Upcoming GSF
541,219

PROBLEM

Lack of granular insight into operations

PROBLEM

1

Cumbersome data
collection processes

PROBLEM

2

Infrastructure gaps
& safety concerns

PROBLEM

3

Low system visibility
& deliverables

PROBLEM

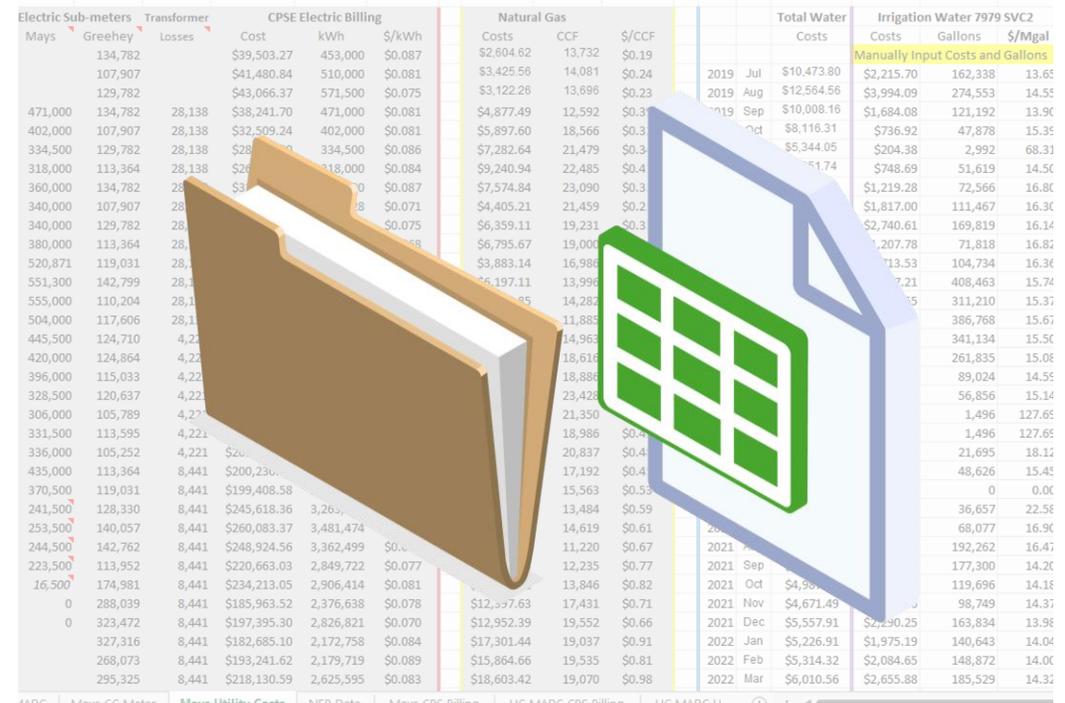
4

Lack of bandwidth,
resources, & expertise

PROBLEM

1: Cumbersome data collection processes

- * Once-monthly manual meter reads
- * 2 master spreadsheets
 - * 48 tabs
 - * 20,000 cells w formulas
- = Data management nightmare



Electric Sub-meters		Transformer	CPSE Electric Billing			Natural Gas			Total Water	Irrigation Water 7979 SVC2			
Mays	Greehey	Losses	Cost	kWh	\$/kWh	Costs	CCF	\$/CCF	Costs	Gallons	\$/Mgal		
	134,782		\$39,503.27	453,000	\$0.087	\$2,604.62	13,732	\$0.19					
	107,907		\$41,480.84	510,000	\$0.081	\$3,425.56	14,081	\$0.24	2019 Jul	\$10,473.80	\$2,215.70	162,338	13.65
	129,782		\$43,066.37	571,500	\$0.075	\$3,122.26	13,696	\$0.23	2019 Aug	\$12,564.56	\$3,994.09	274,553	14.55
471,000	134,782	28,138	\$38,241.70	471,000	\$0.081	\$4,877.49	12,592	\$0.39	2019 Sep	\$10,008.16	\$1,684.08	121,192	13.90
402,000	107,907	28,138	\$32,509.24	402,000	\$0.081	\$5,897.60	18,566	\$0.32	2019 Oct	\$8,116.31	\$736.92	47,878	15.35
334,500	129,782	28,138	\$28,000.00	334,500	\$0.086	\$7,282.64	21,479	\$0.34		\$5,344.05	\$204.38	2,992	68.31
318,000	113,364	28,138	\$28,000.00	318,000	\$0.084	\$9,240.94	22,485	\$0.41		\$1,717.4	\$748.69	51,619	14.50
360,000	134,782	28,138	\$3,000.00	360,000	\$0.087	\$7,574.84	23,090	\$0.33		\$1,219.28	\$72,566	16.80	
340,000	107,907	28,138	\$3,000.00	340,000	\$0.071	\$4,405.21	21,459	\$0.21		\$1,817.00	\$11,467	16.30	
340,000	129,782	28,138	\$3,000.00	340,000	\$0.075	\$6,359.11	19,231	\$0.33		\$2,740.61	\$169,819	16.14	
380,000	113,364	28,138	\$3,000.00	380,000	\$0.065	\$6,795.67	19,000	\$0.35		\$1,207.78	\$71,818	16.82	
520,871	119,031	28,138	\$3,000.00	520,871	\$0.065	\$3,883.14	16,986	\$0.22		\$713.53	\$104,734	16.30	
551,300	142,799	28,138	\$3,000.00	551,300	\$0.065	\$6,197.11	13,996	\$0.44		\$7.21	\$408,463	15.74	
555,000	110,204	28,138	\$3,000.00	555,000	\$0.065	\$6,197.11	13,996	\$0.44		\$35	\$311,210	15.37	
504,000	117,606	28,138	\$3,000.00	504,000	\$0.065	\$11,885.00	11,885	\$0.99		\$386,768	\$15.67		
445,500	124,710	4,221	\$2,000.00	445,500	\$0.045	\$14,963.00	14,963	\$0.99		\$341,134	\$15.50		
420,000	124,864	4,221	\$2,000.00	420,000	\$0.048	\$18,616.00	18,616	\$0.99		\$261,835	\$15.08		
396,000	115,033	4,221	\$2,000.00	396,000	\$0.051	\$18,886.00	18,886	\$0.99		\$89,024	\$14.55		
328,500	120,637	4,221	\$2,000.00	328,500	\$0.061	\$23,428.00	23,428	\$0.99		\$56,856	\$15.14		
306,000	105,789	4,221	\$2,000.00	306,000	\$0.065	\$21,350.00	21,350	\$0.99		\$1,496	\$127.65		
331,500	113,595	4,221	\$2,000.00	331,500	\$0.065	\$18,986.00	18,986	\$0.99		\$1,496	\$127.65		
336,000	105,252	4,221	\$2,000.00	336,000	\$0.060	\$20,837.00	20,837	\$0.99		\$21,695	\$18.11		
435,000	113,364	8,441	\$200,236.00	435,000	\$0.462	\$17,192.00	17,192	\$0.99		\$48,626	\$15.45		
370,500	119,031	8,441	\$199,408.58	370,500	\$0.538	\$15,563.00	15,563	\$0.99		\$0	\$0.00		
241,500	128,330	8,441	\$245,618.36	241,500	\$1.017	\$13,484.00	13,484	\$0.99		\$36,657	\$22.58		
253,500	140,057	8,441	\$260,083.37	253,500	\$1.026	\$14,619.00	14,619	\$0.99		\$68,077	\$16.90		
244,500	142,762	8,441	\$248,924.56	244,500	\$1.018	\$11,220.00	11,220	\$0.67	2021 May	\$192,262	\$16.47		
223,500	113,952	8,441	\$220,663.03	223,500	\$0.987	\$12,235.00	12,235	\$0.77	2021 Sep	\$177,300	\$14.20		
16,500	174,981	8,441	\$234,213.05	16,500	\$0.081	\$13,846.00	13,846	\$0.82	2021 Oct	\$4,980	\$119,696	\$14.18	
0	288,039	8,441	\$185,963.52	0	\$0.078	\$12,337.63	17,431	\$0.71	2021 Nov	\$4,671.49	\$98,749	\$14.37	
0	323,472	8,441	\$197,395.30	0	\$0.070	\$12,952.39	19,552	\$0.66	2021 Dec	\$5,557.91	\$2,290.25	\$163,834	\$13.98
327,316	8,441	\$182,685.10	2,172,758	\$0.084	\$17,301.44	19,037	\$0.91	2022 Jan	\$5,226.91	\$1,975.19	\$140,643	\$14.04	
268,073	8,441	\$193,241.62	2,179,719	\$0.089	\$15,864.66	19,535	\$0.81	2022 Feb	\$5,314.32	\$2,084.65	\$148,872	\$14.00	
295,325	8,441	\$218,130.59	2,625,595	\$0.083	\$18,603.42	19,070	\$0.98	2022 Mar	\$6,010.56	\$2,655.88	\$185,529	\$14.33	

PROBLEM

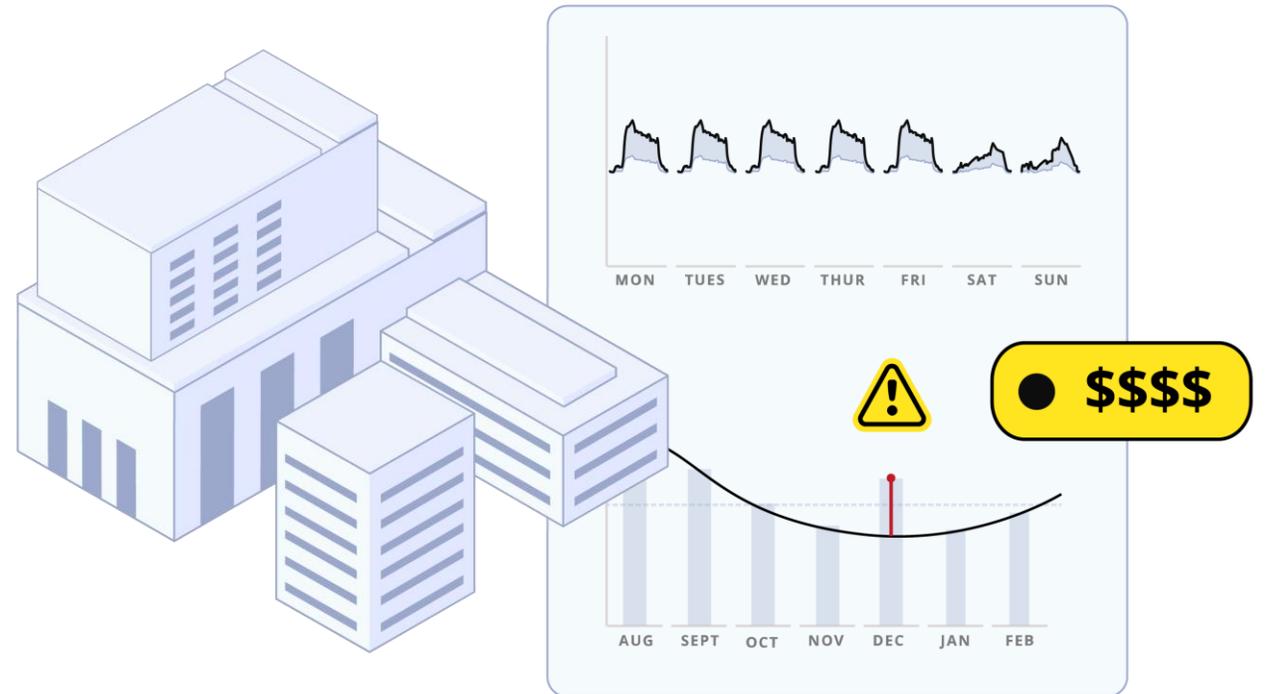
2: Infrastructure gaps & safety concerns

- Insufficient meter coverage
- Outdated equipment that cannot network
- No primary system to capture, store, or display data
- Safety concerns and system impacts when reading meters
- Outage notifications



3: Low system visibility & deliverables

- No granular data for baseline evaluation
- No real-time dynamic alerting
- Inability to identify drift or effectiveness of energy conservation measures
- No detailed deliverables for tenants



4: Lack of bandwidth, resources & expertise

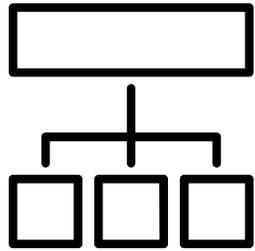
- Need time and resources (people and technology) associated with investigating interval data and making it actionable
- Existing BAS systems must have the ability and functionality for utility evaluation
- Staff have to focus on utility niche in addition to daily responsibilities
- Exporting data and creating customized graphs and tools to help diagnose electrical usage is a specialized skill

Without these tools & team, it would just be a report sitting on a shelf. It's nice to get information translated onto a system and operations center that makes the data actionable.

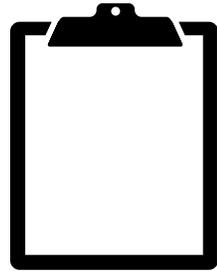
– Major Jeff Davidson

PROBLEM

Net Results of Legacy Submetering Process



Underbilling of department utility costs



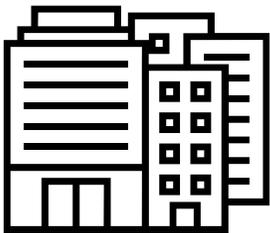
Laborious, time-intensive process that can't be delegated



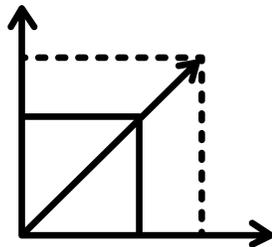
Difficulty in troubleshooting data errors or anomalies



No ability to substantiate ECMs/ROIs and building drift



No baseline building consumption for comparison



Inability to scale with campus additions and changes



No data for informed decision-making as the campus grows



Tenants unable to visualize their electrical consumption

GOALS

Goals of New Submetering Process

- Transparency
- Utility costs per building
- Cost per degree program
- Data for campus planning
- Account for transmission loss & inaccurate readings
- Budgeting and allocating utility costs
- Environmental & sustainability planning
- Compliance with stricter reporting and decarbonization goals



IMPLEMENTATION



Voltages ranging from the incoming 35kV level to the 480V distribution level switchgear



Integration of electric metering from different manufacturers



Collecting data from various buildings and transmitting integral data through the JACE

1

Audit / Procure

2

Install / Replace

3

Test

4

Capture Data

5

Validate

Outcomes

Pre-Implementation [UTHSCSA]

- Manual period read meters
- Record in spreadsheet
- Allocate costs
- Cross-reference utility bills
- Submit to accounting/billing for payment

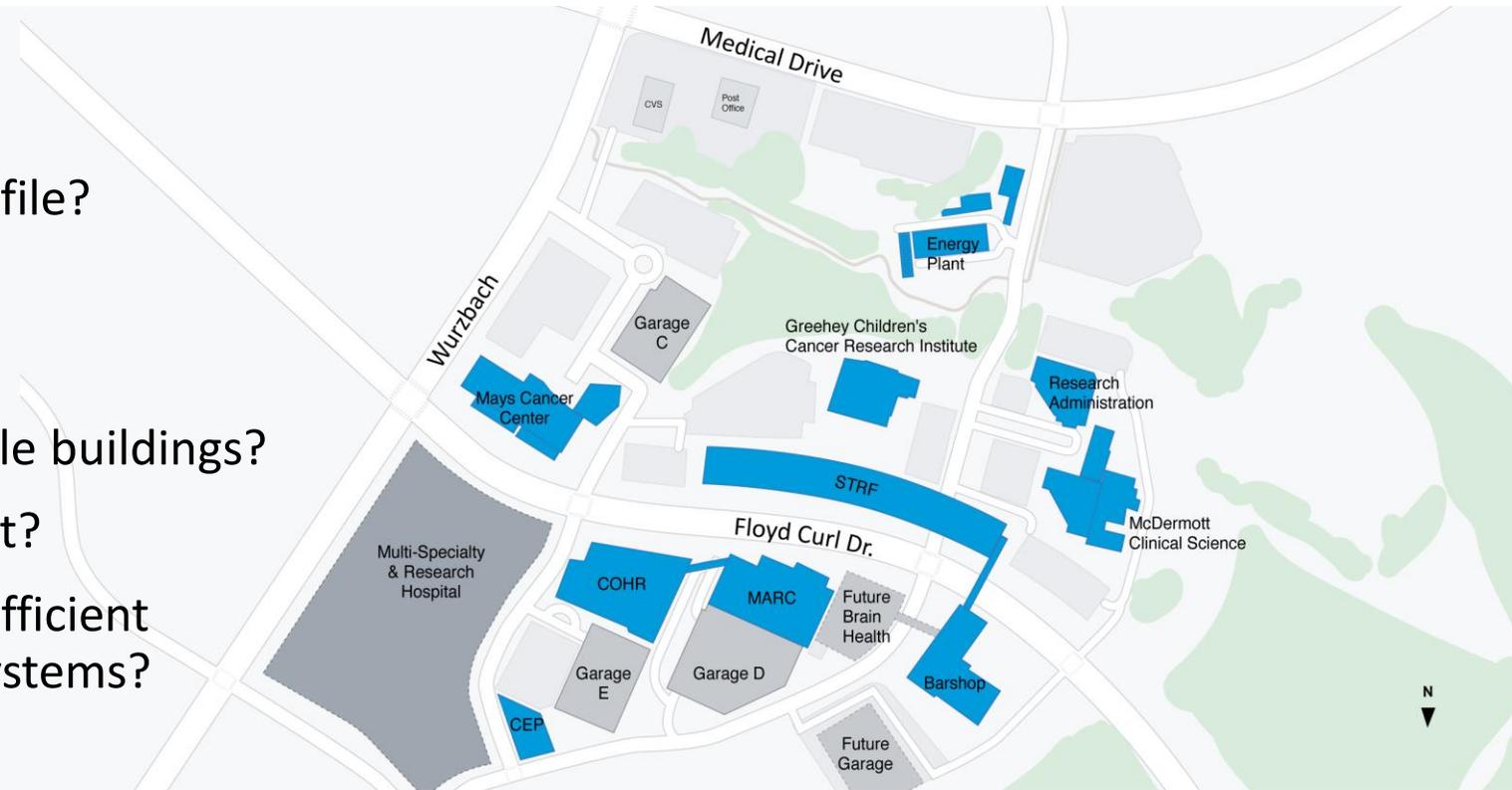
Post-Implementation [utiliVisor]

- Automatic interval readings
- Validation of utility fee structure
- Ability to pull utility reports and readings for any date & time interval
- Cross-reference of costs for similar building usage
- Utility bill reconciliation
- Continuous oversight of utilities consumption from an operations center
- Alerts for high electrical usage & anomalies
- Dynamic notifications from operations team
- Billing package & deliverables

Full Oversight Capability

Metrics for Future Growth & Decarbonization Decisions

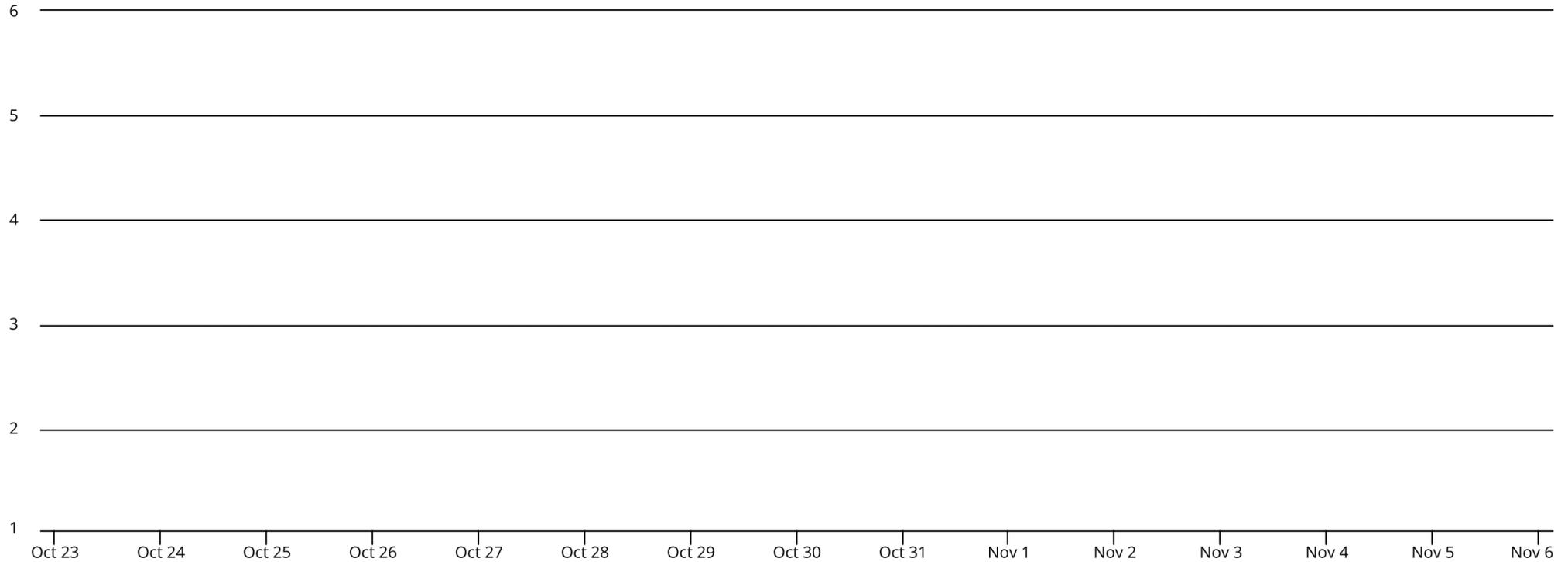
- Where are electrical loads constant?
- What is each building's electrical profile?
- What is the cost per square foot?
- What are peak load characteristics?
- Is watts/sq. foot similar to comparable buildings?
- What is our baseline carbon footprint?
- What is the best basis of design for efficient building materials and mechanical systems?



RESULTS

Full Campus Visibility

BUILDING WATTS / SQ. FT



● MARC Watts/Sqft ● CCRI Watts/Sqft ● STRF Watts/Sqft ● MCD Watts/Sqft ● COH Watts/Sqft ● GSMN Watts/Sqft ● RAB Watts/Sqft

De-Carbonizing the Campus: Planning, Tools & Technologies

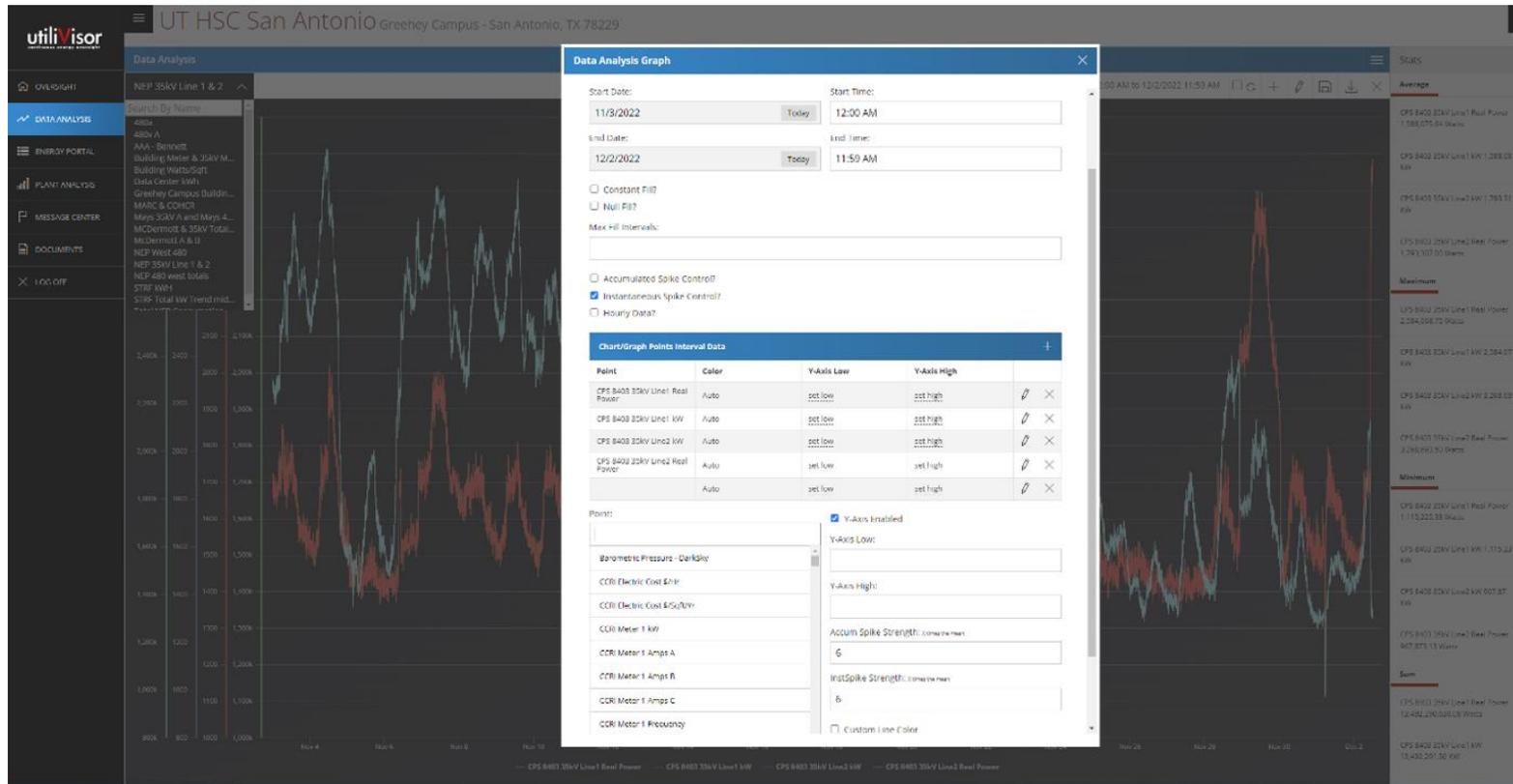
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Full Campus Analysis



- User access to create charts / graphs
- User-defined performance metrics
- Setup by an experienced operations team
- Access control
- Download to Excel

RESULTS

Full Campus Analysis

The screenshot shows an Excel spreadsheet with the following data:

	C	D	E	F	G	H	I	J	K	L	M	N	O	P
3					MIN	1,115.225	1,115.225	967.873	967.873					
4					MAX	2,584.069	2,584.069	3,268.694	3,268.694					
5					AVERAGE	1,588.187	1,588.187	1,793.250	1,793.250					
6	00:00:00	2022	11	5	0	1,724.526	1,724.526	2,315.970	2,315.970					
7	00:05:00	2022	11	5	0	1,702.090	1,702.090	2,262.630	2,262.630					
8	00:10:00	2022	11	5	0	1,698.820	1,698.820	2,273.125	2,273.125					
9	00:15:00	2022	11	5	0	1,677.032	1,677.032	2,297.860	2,297.860					
10	00:20:00	2022	11	5	0	1,700.364	1,700.364	2,261.814	2,261.814					
11	00:25:00	2022	11	5	0	1,725.394	1,725.394	2,243.821	2,243.821					
12	00:30:00	2022	11	5	0	1,654.614	1,654.614	2,279.434	2,279.434					
13	00:35:00	2022	11	5	0	1,689.805	1,689.805	2,290.454	2,290.454					
14	00:40:00	2022	11	5	0	1,702.580	1,702.580	2,272.198	2,272.198					
15	00:45:00	2022	11	5	0	1,682.234	1,682.234	2,242.115	2,242.115					
16	00:50:00	2022	11	5	0	1,715.770	1,715.770	2,264.873	2,264.873					
17	00:55:00	2022	11	5	0	1,700.180	1,700.180	2,276.451	2,276.451					
18	01:00:00	2022	11	5	1	1,699.334	1,699.334	2,279.835	2,279.835					
19	01:05:00	2022	11	5	1	1,639.145	1,639.145	2,221.748	2,221.748					
20	01:10:00	2022	11	5	1	1,678.492	1,678.492	2,248.217	2,248.217					
21	01:15:00	2022	11	5	1	1,674.360	1,674.360	2,219.535	2,219.535					
22	01:20:00	2022	11	5	1	1,644.288	1,644.288	2,251.200	2,251.200					
23	01:25:00	2022	11	5	1	1,653.725	1,653.725	2,240.553	2,240.553					
24	01:30:00	2022	11	5	1	1,694.651	1,694.651	2,191.758	2,191.758					
25	01:35:00	2022	11	5	1	1,656.542	1,656.542	2,213.789	2,213.789					
26	01:40:00	2022	11	5	1	1,678.955	1,678.955	2,275.455	2,275.455					
27	01:45:00	2022	11	5	1	1,693.258	1,693.258	2,255.753	2,255.753					
28	01:50:00	2022	11	5	1	1,664.750	1,664.750	2,218.033	2,218.033					
29	01:55:00	2022	11	5	1	1,656.691	1,656.691	2,207.221	2,207.221					
30	02:00:00	2022	11	5	2	1,713.763	1,713.763	2,257.573	2,257.573					

- User access to create charts / graphs
- User-defined performance metrics
- Setup by an experienced operations team
- Access control
- Download to Excel

RESULTS

Increased Building Visibility

Example Building Metrics

STRF Building

COST / SQ. FT
\$2.88

WATTS / SQ. FT
3.9255

ELECTRIC COST / HR
\$49.39

AS OF **12/27/22**



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RESULTS

Increased Building Visibility

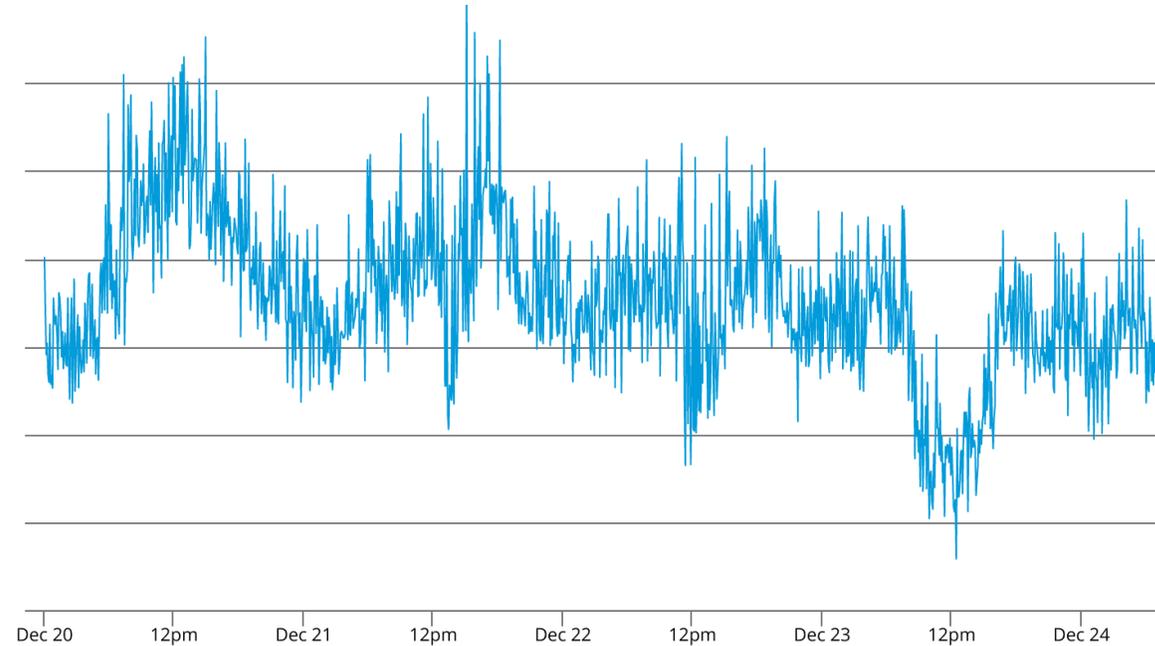
MONTHLY READING



STRF December

VS

REAL-TIME READINGS



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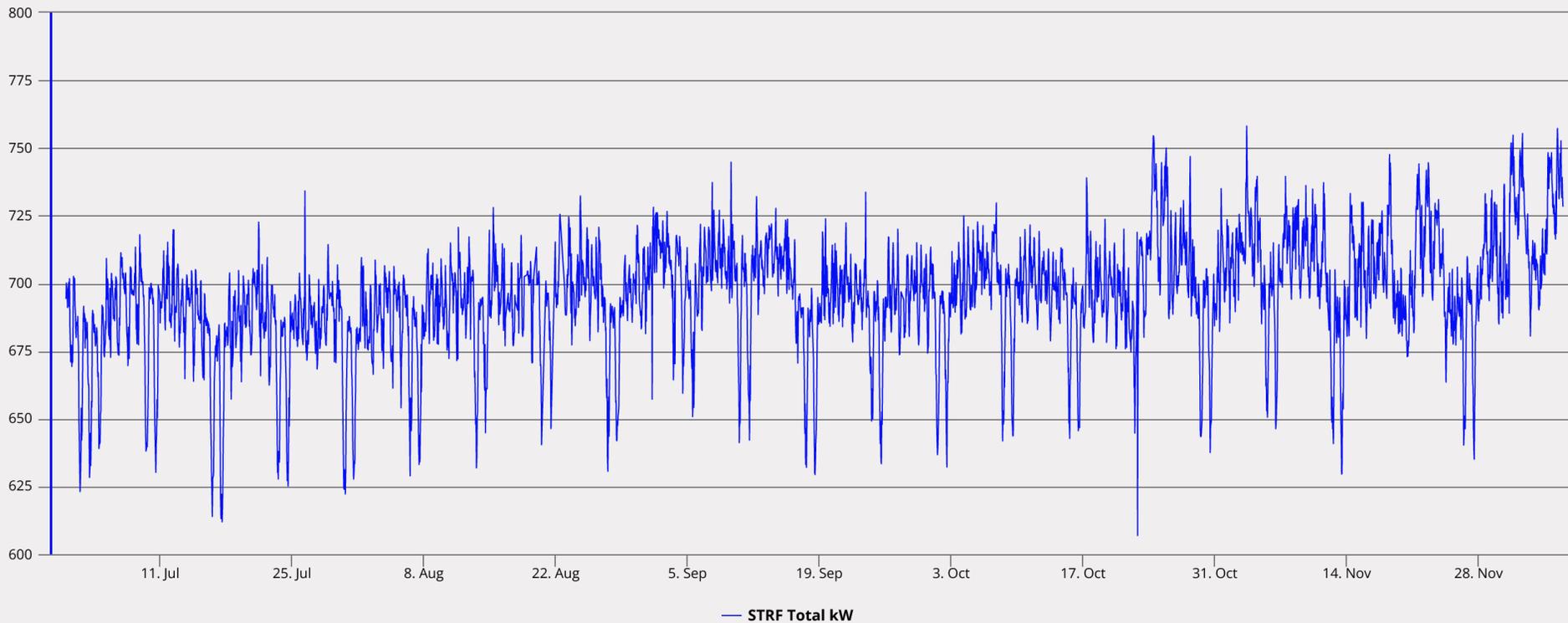


Example: STRF Total kW Trend Anomaly



ERICH HESS

Senior Systems Engineer at utiliVisor



RESULTS

Early Successes

RESULT

5 min

Interval meter data

RESULT

Real-time

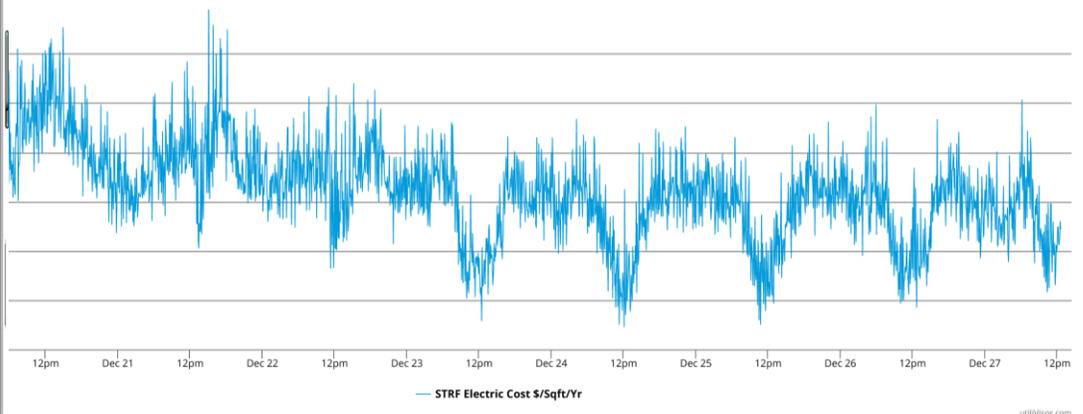
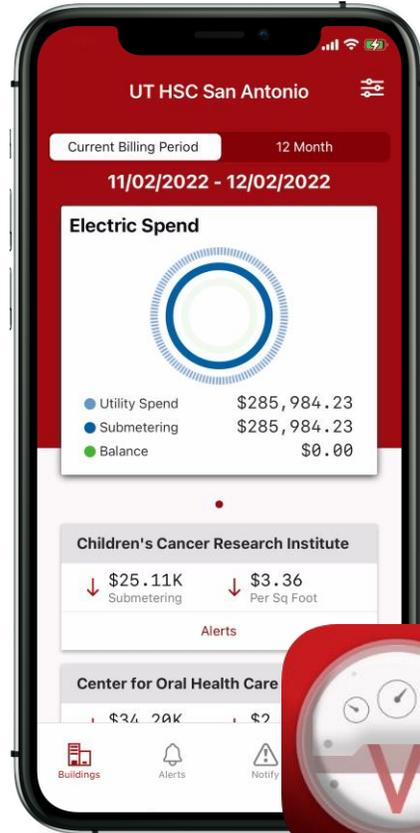
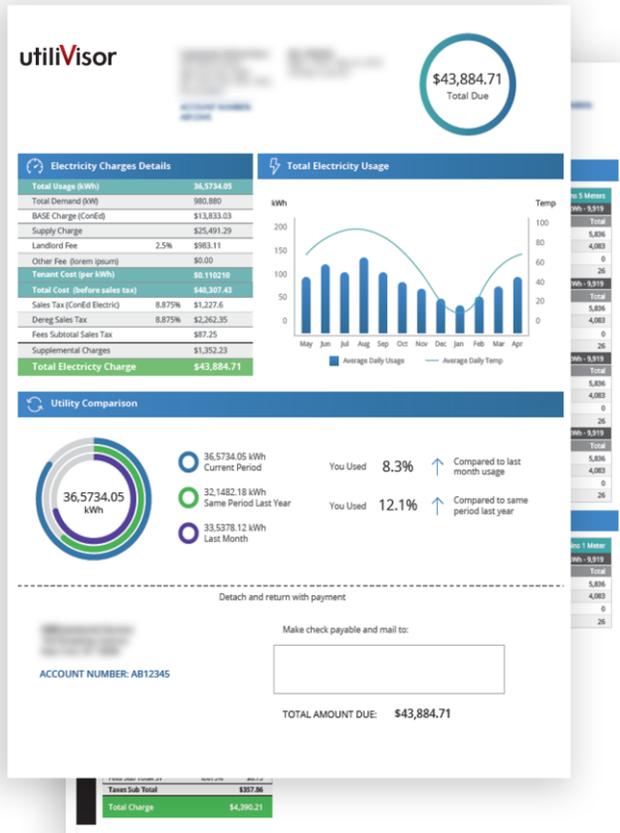
Outage alerts

RESULT

\$427K saved in 3 mo.

Utility overbilling

Continuous Energy Oversight



How can we help shortcut your learning curve?

1. Coordinate across all shareholders (Especially campus electrical and IT departments) early and often.
2. Expect delays to occur periodically.
3. Partner with a metering expert that has a turnkey reading, billing, and performance monitoring solution.
4. Provide guidance on meter selection.

Questions?

Michael Charlton, Ph.D.

Major Jeff Davidson



Shannon McAuliffe

utiliVisor

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