



2020 Energy Education Offerings

- ▶ Energy Management Trainings - For time being, we will be offering 2-3hr Webinars
- ▶ Seminar 26: ASHRAE Learning Institute; instructor & dates are still being worked
 - ▶ Evaluation Methods for High-Performance Green Buildings
 - ▶ How Smart, Efficient, Sustainable Systems Lead to Improved Resilience

- ▶ Building Science Principles Certificate of Knowledge
 - ▶ Online course and exam, created by Building Performance Institute
 - ▶ Reference Guide and online course with self-paced video + section quizzes
 - ▶ Arkansas' Online Course Content being developed currently; will launch program this quarter
 - ▶ Geared towards those persons who work with residential and light commercial buildings
 - ▶ Home Inspectors/Auditors; Service Providers; Equipment/Window installers; K-12 Facilities personnel; homeowners, renters; Sales Reps; Remodelers and Home Improvement contractors; Realtors; Architects

- ▶ Building Operator Certification
 - ▶ Licensing Agreement was signed (late March) and marketing plans and logistics are in the works

Energy Information: The Foundation for Sustainability Effectiveness



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2013 AEE Int'l Energy Engineer of the Year

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Today's Agenda

Introduction

Energy Information value streams, why is it important?

Methods to capture and track energy information

Overview of typical energy information sustainability features

Degree Days (used in weather normalizations), what's a degree day?

Interval Data, what types of problems can you spot?

M&V: Measurement & Verification of Savings, why is it important?

Today, energy makes modern society possible.
Cheap and plentiful energy has replaced human labor.

Annual U.S. energy consumption of about 100 quadrillion BTU is the equivalent of _____ BTU per day for every man, woman and child.

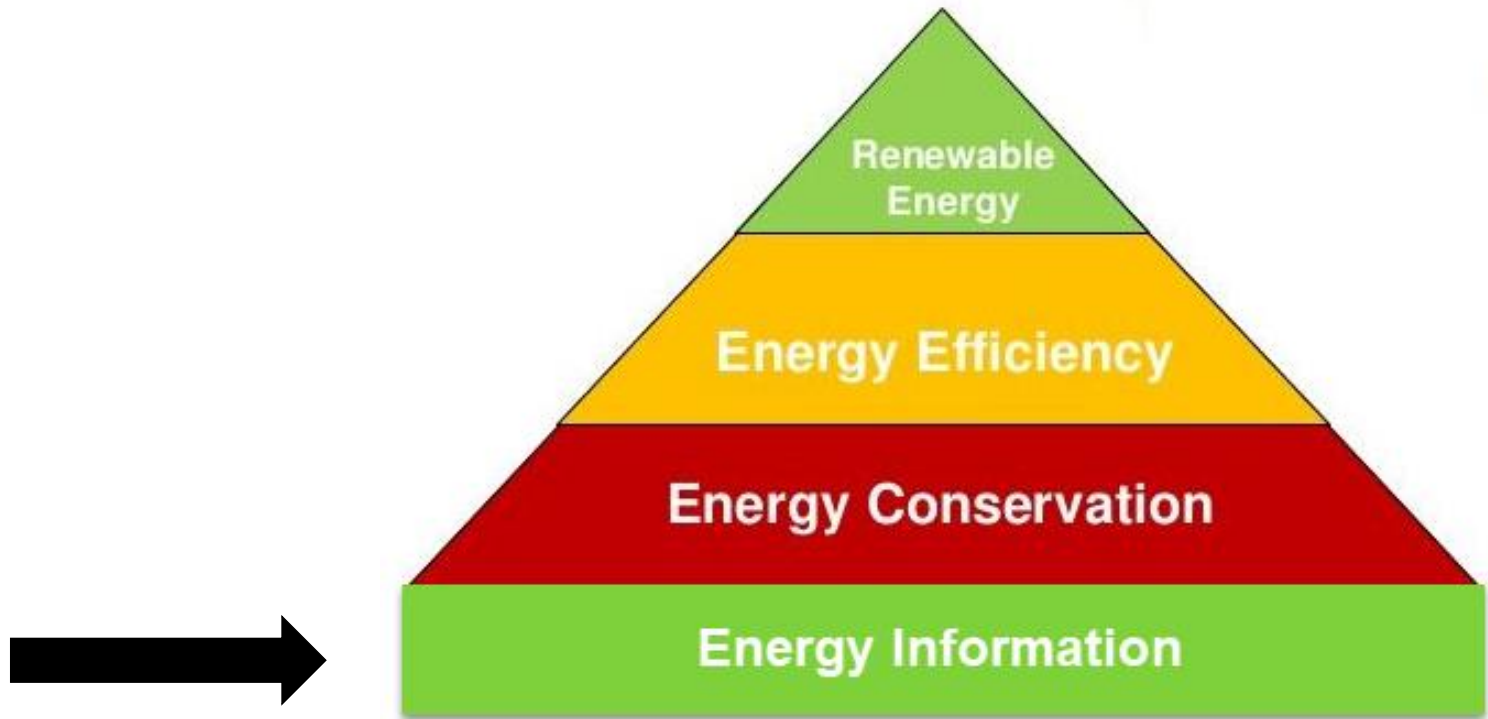
At ____ BTU per food calorie, that's the equivalent of every person having a support staff of _____ laborers working just for you seven days a week.

one million

four

100

Energy Information is Foundational to...Everything Else






Utility Bill Accounting

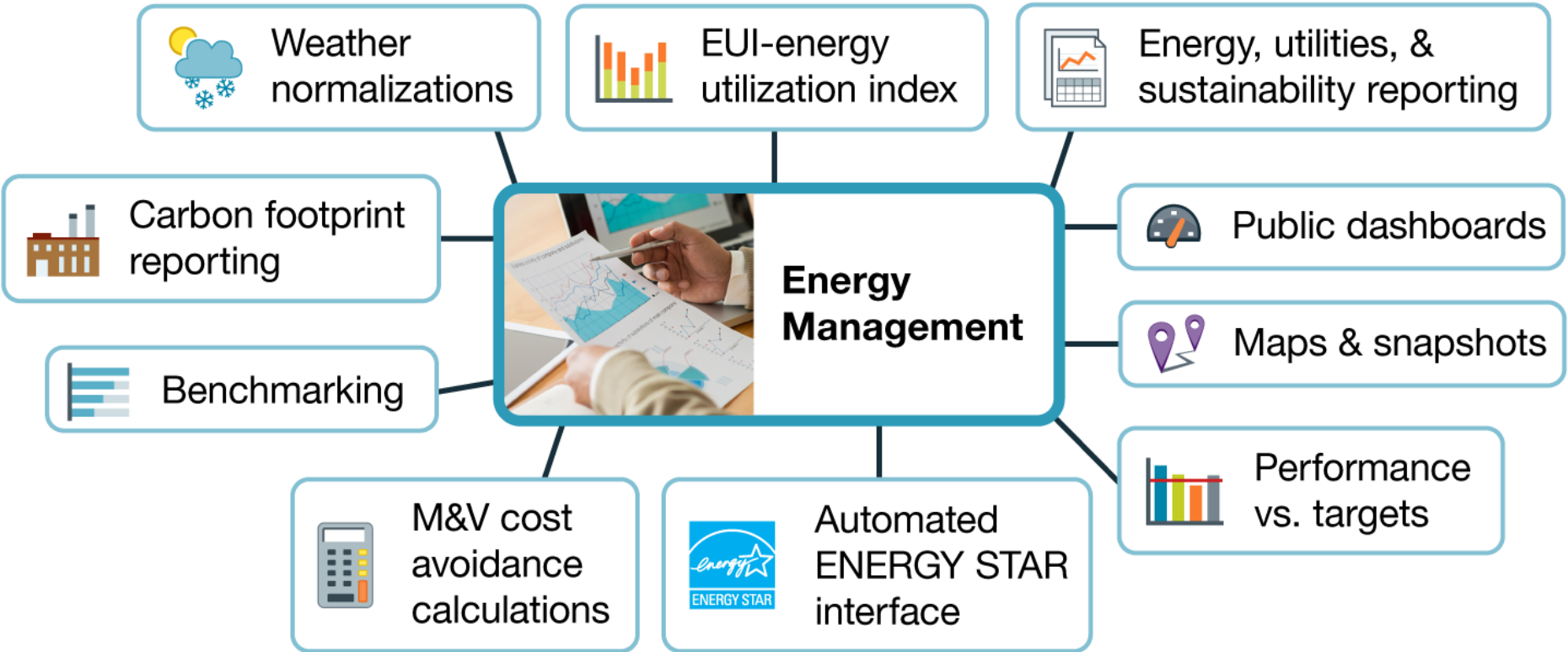


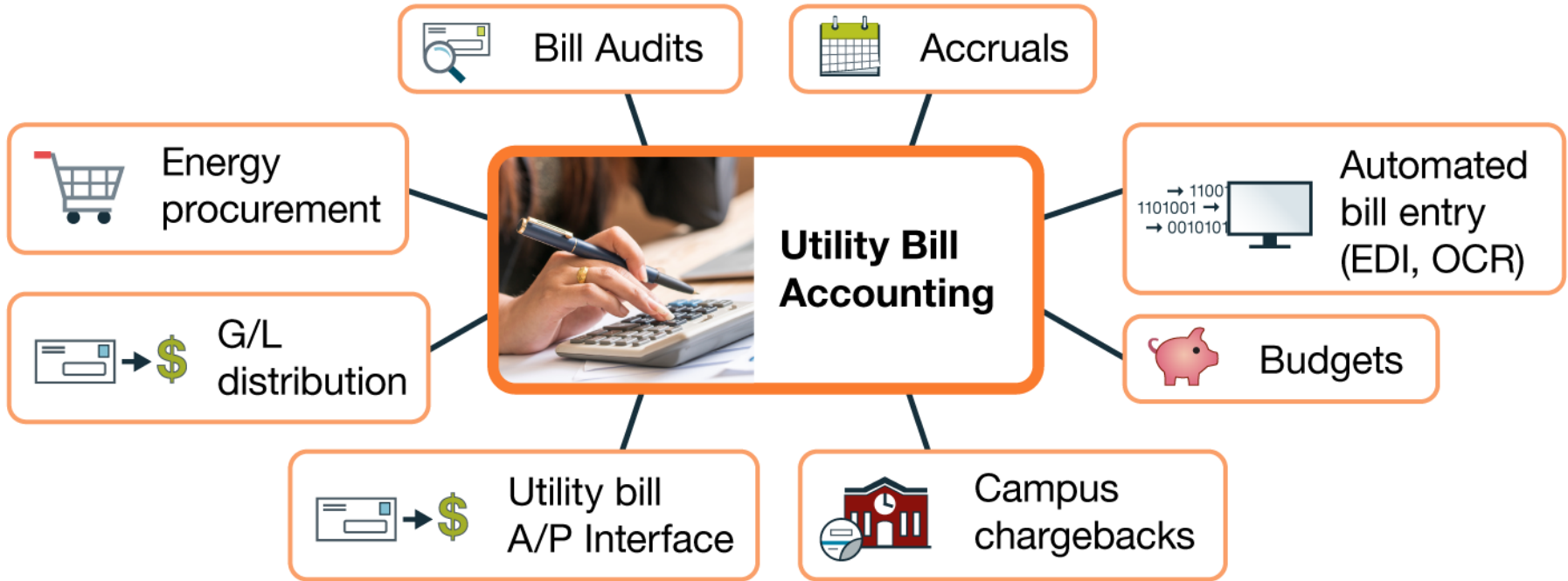
Energy Management

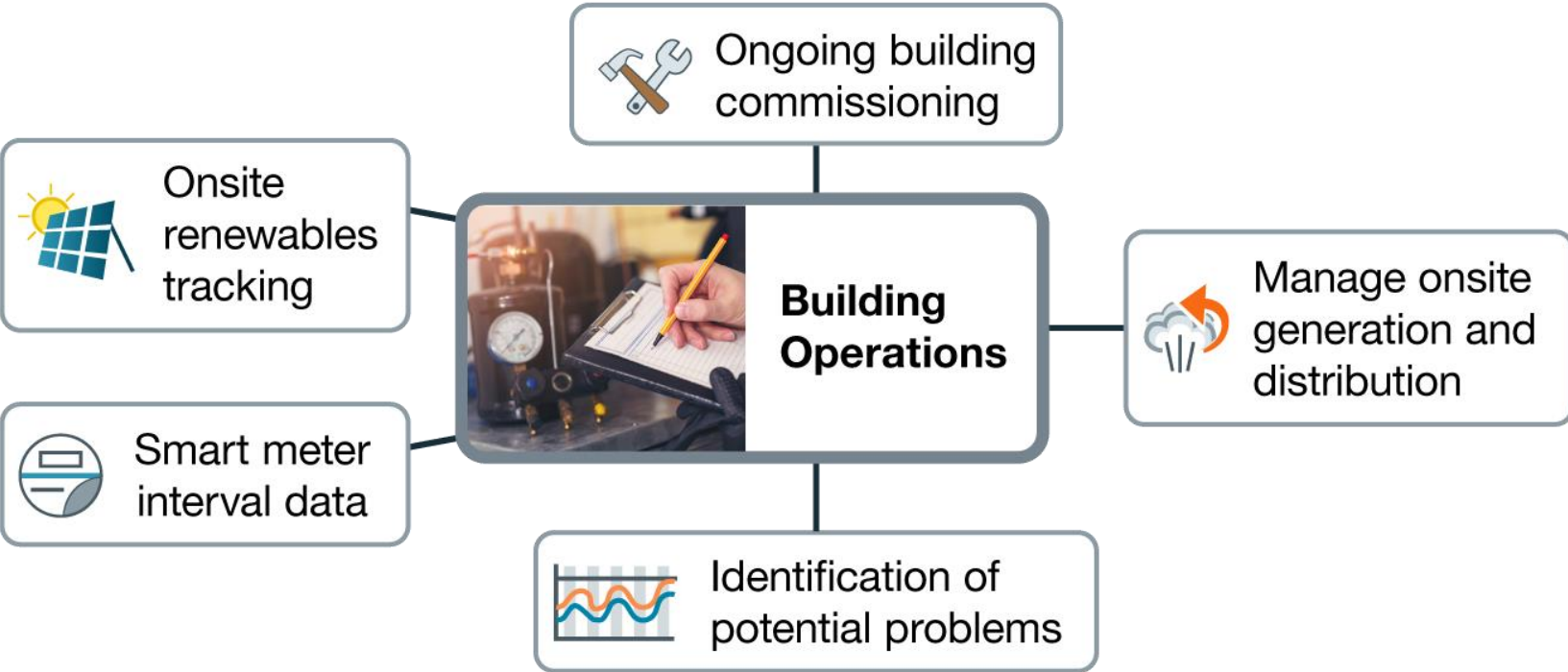
EnergyCAP[®]
derives value from
Energy Information



Building Operations







Bill Processing

Bill Formats: EDI or flat files, paper, scanned images, website capture, etc...



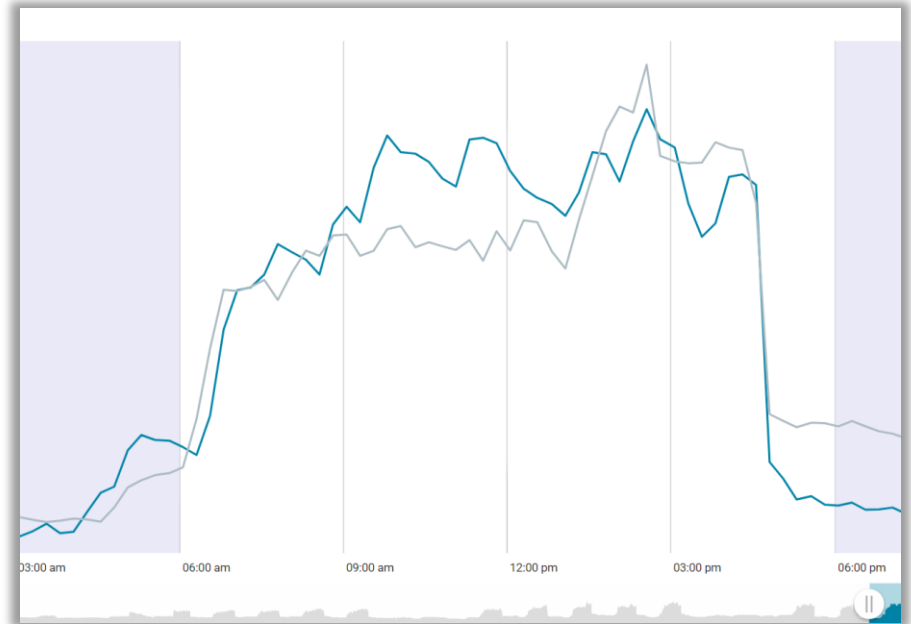
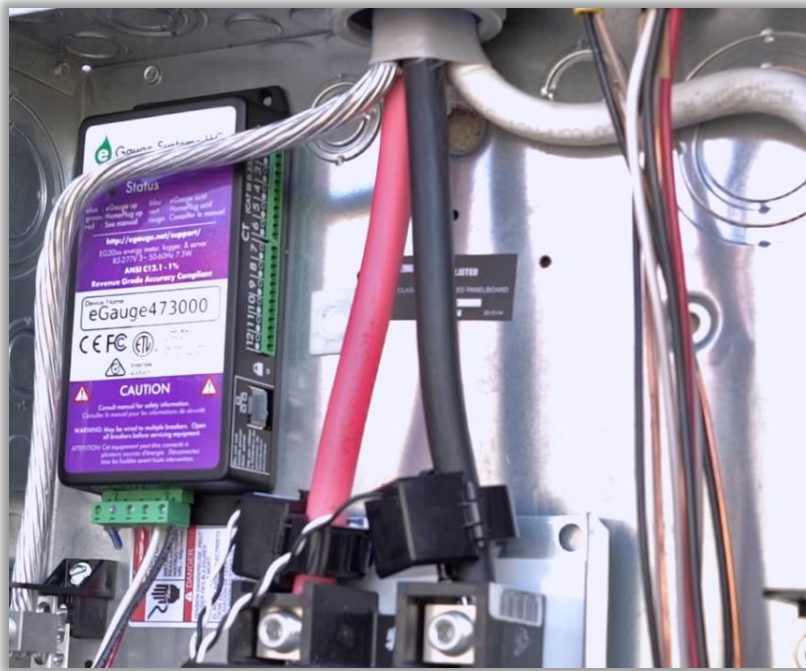
Bill line items are associated with meters and accounts to form bill records

Account	Eversource (CL&P) [EVERSOURCE] Vendor	Batch	06/18/2019-07/18/2019 30 days
	5136962505819071801110 Invoice number	07 2019 Accounting period	07/18/2019 Statement date
Service address	9165694_EVERSOURCE_51369625058_20190718 Control code	871573 Bill ID	
Total Cost <small>due 09/16/2019</small>			\$ 238.71
GENERATION SRVC CHRG <small>Generation Use</small>	1227 kWh	\$	93.99
TOTAL SUPPLIER SERVICES <small>Info_Cost</small>		\$	93.99
TRANSMISSION CHRG <small>Info_Use</small>	490.8 kWh	\$	13.34
TRANSMISSION CHRG <small>Info_Use</small>	736.2 kWh	\$	21.56
DISTR CUST SRVC CHRG <small>Customer Charge</small>		\$	9.44
DISTR CHRG PER KWH <small>Info_Use</small>	1227 kWh	\$	70.42
ELECTRIC SYS IMPROVEMENTS <small>Info_Use</small>	490.8 kWh	\$	1.07
ELECTRIC SYS IMPROVEMENTS <small>Info_Use</small>	736.2 kWh	\$	1.81
REVENUE ADJ MECHANISM <small>Info_Use</small>	490.8 kWh	\$	0.89
REVENUE ADJ MECHANISM <small>Info_Use</small>	736.2 kWh	\$	-0.08
CTA CHRG PER KWH <small>Info_Use</small>	1227 kWh	\$	-0.71
FMCC DELIVERY CHRG <small>Use</small>	490.8 kWh	\$	4.98
FMCC DELIVERY CHRG <small>Use</small>	736.2 kWh	\$	6.55
COMB PUBLIC BENEFIT CHRG <small>Info_Use</small>	1227 kWh	\$	15.45
TOTAL DELIVERY SERVICES <small>Info_Cost</small>		\$	144.72
Meter Subtotal	1227 kWh	\$0.195 / kWh	\$ 238.71
PREVIOUS BALANCE <small>Prior Balance</small>		\$	783.31
TOTAL SUPPLIER SERVICES <small>Info_Cost</small>		\$	93.99
TOTAL DELIVERY SERVICES <small>Info_Cost</small>		\$	144.72
Current Charges (ECBC) <small>Info_Cost</small>		\$	238.71
Amount Due (ECBC) <small>Total Pay Amount</small>		\$	238.71
Account Subtotal		\$	0.00

Time Series Data

Comes from: Submetering systems, utility company databases, file uploads, manual keying of meter reads

And is used in interval data charts, reports, chargebacks



Audits & Flags

Validate bill data, assign flags, report on cost recoveries.

The screenshot displays the 'Edit Bill' interface for account 525 HURLEY AV - ELE [GOV-110 084 305 009]. The billing period is set to 01/20/2016 to 02/16/2016, which is highlighted as being outside the bill's start and end dates. The interface includes an account history table, electric charges breakdown, and a flag details popup.

Period	Amount
02/16/2016-03/20/2016	\$ 6,667.64
01/20/2016-02/16/2016	\$ 6,084.51
12/18/2015-01/20/2016	\$ 8,454.11
11/18/2015-12/18/2015	\$ 7,912.18
10/17/2015-11/18/2015	\$ 6,634.58
09/17/2015-10/17/2015	\$ 6,958.31

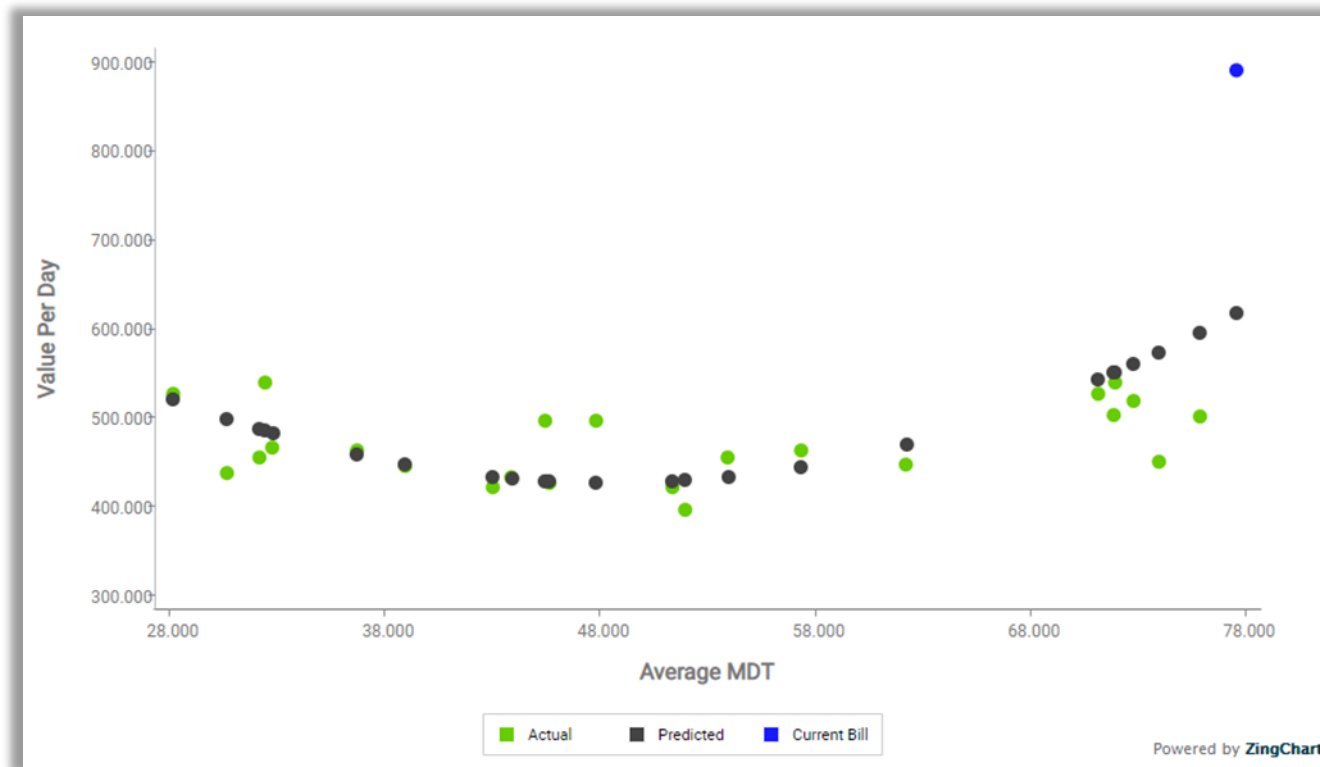
Category	Value	Unit	Amount
Electric charges	2924.65	\$	2924.65
Maximum Demand	129	kW	
WGL Energy Svcs electric charges	53376	kWh	\$ 3159.86
Energy Tax			\$ 1111.90

Flag Details:

- SYSTEM** 07/24/2019
- Bill flagged as Audit Exception.
- Billing period is outside the bill's start and end dates

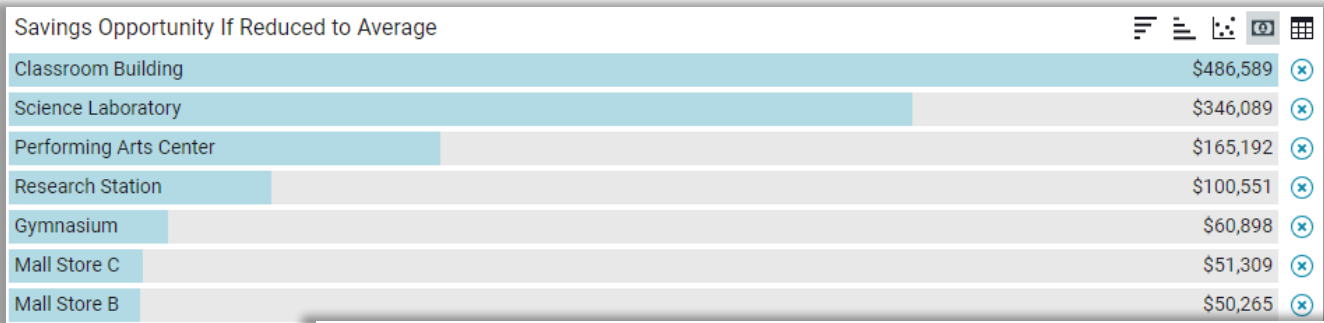
Audits & Flags

True positives vs. false positives are a challenge!



Benchmarking

Compare buildings and meters using extended benchmarking.



Meter Name	Meter Code	Calendarized Unit Cost (\$/MMBtu)	Jan 2017 - Dec 2017	Jan 2018 - Dec 2018	% Difference
Vacant - ELE01	VACANT-ELE01		\$78.619	\$0.000	-100.0 %
Capitol Complex - NG02	GOV-BUILDING_A-NG02		\$78.021	\$85.691	9.8 %
Central Campus (Main) - ELE01	CENTRAL_CAMPUS-MAIN-ELE01		\$42.007	\$34.412	-18.1 %
Building J - ELE01	PROP-BUILDING_J-ELE01		\$42.007	\$36.078	-14.1 %
Maintenance Office - ELE01	GOV-BUILDING_H-ELE01		\$41.060	\$37.966	-7.5 %
Building H - ELE01	PROP-BUILDING_H-ELE01		\$41.060	\$37.966	-7.5 %
Building J - Common Area Share - ELE	SPLT-BLDG J-COMM AREA SHR-ELE		\$40.389	\$36.065	-10.7 %
Building I - Common Area Share - ELE	SPLT-BLDG I-COMM AREA SHR-ELE		\$40.388	\$36.066	-10.7 %
Barracks - ELE01	GOV-BUILDING_F-ELE01		\$40.388	\$36.632	-9.3 %
Anderson - ELE01	MFG-BUILDING_F-ELE01		\$40.388	\$36.632	-9.3 %
Common Area - ELE01	PROP-COMMON_AREA-ELE01		\$40.388	\$36.632	-9.3 %
Building H - Common Area Share - ELE	SPLT-BLDG H-COMM AREA SHR-ELE		\$40.385	\$36.056	-10.7 %
Research Station - ELE01	GOV-BUILDING_J-ELE01		\$39.865	\$30.886	-22.5 %



Arkansas

Arkansas Act 1494 of 2009



Policy Description: Arkansas Act 1494 of 2009 requires all state agencies that pay utility bills to submit benchmarking reports through Energy Star Portfolio Manager.

Authority in Charge: Arkansas Energy Office
Tool Name: ENERGY STAR Portfolio Manager
Relevant Links: [Arkansas Act 1494 of 2009](#)

Building Types Affected	Size	Compliance Deadline
Public/Government	ALL	2017-03-16

Transparency:

Required Transparency: No

Reporting:

Required Reporting: No

Utility Requirements/Support:

Utility Requirements/Support: No

Verification:

Verification: No

Compliance:

Compliance Enforcement: Yes

Area of Buildings in Compliance: 25,000,000 Sq. Feet

Additional Program Information:

Audits: Yes

The Arkansas Energy Office was required to conduct an energy audit of every state agency within 5 years of the legislation's adoption.

Jurisdiction Updates

There are no updates for this jurisdiction.

Related Documents

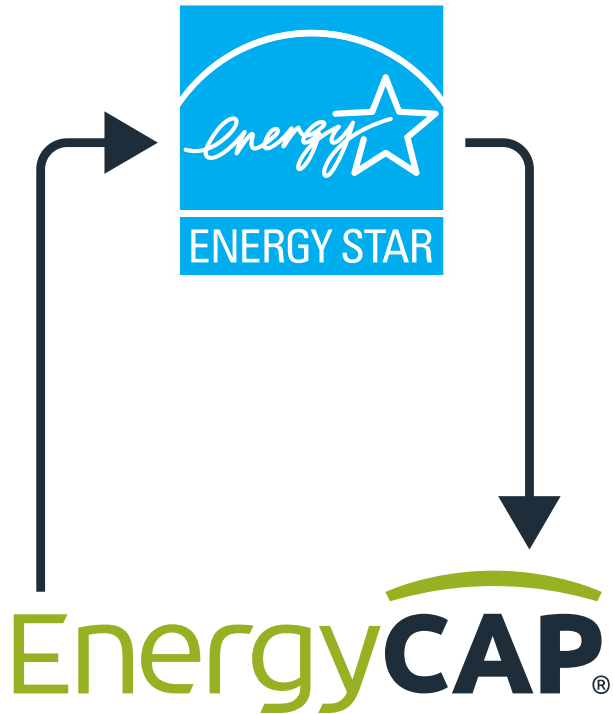
There are no updates for this jurisdiction.

Partners



ENERGY STAR

Automatically submit building data to Portfolio Manager.



Actual Data | Calendarized Data | Normalized Data | Savings | Properties

Summary | Commodity | Monthly | Greenhouse Gas | **ENERGY STAR**

Updated 9 months ago

ENERGY STAR

90

Current rating

Rating Trend

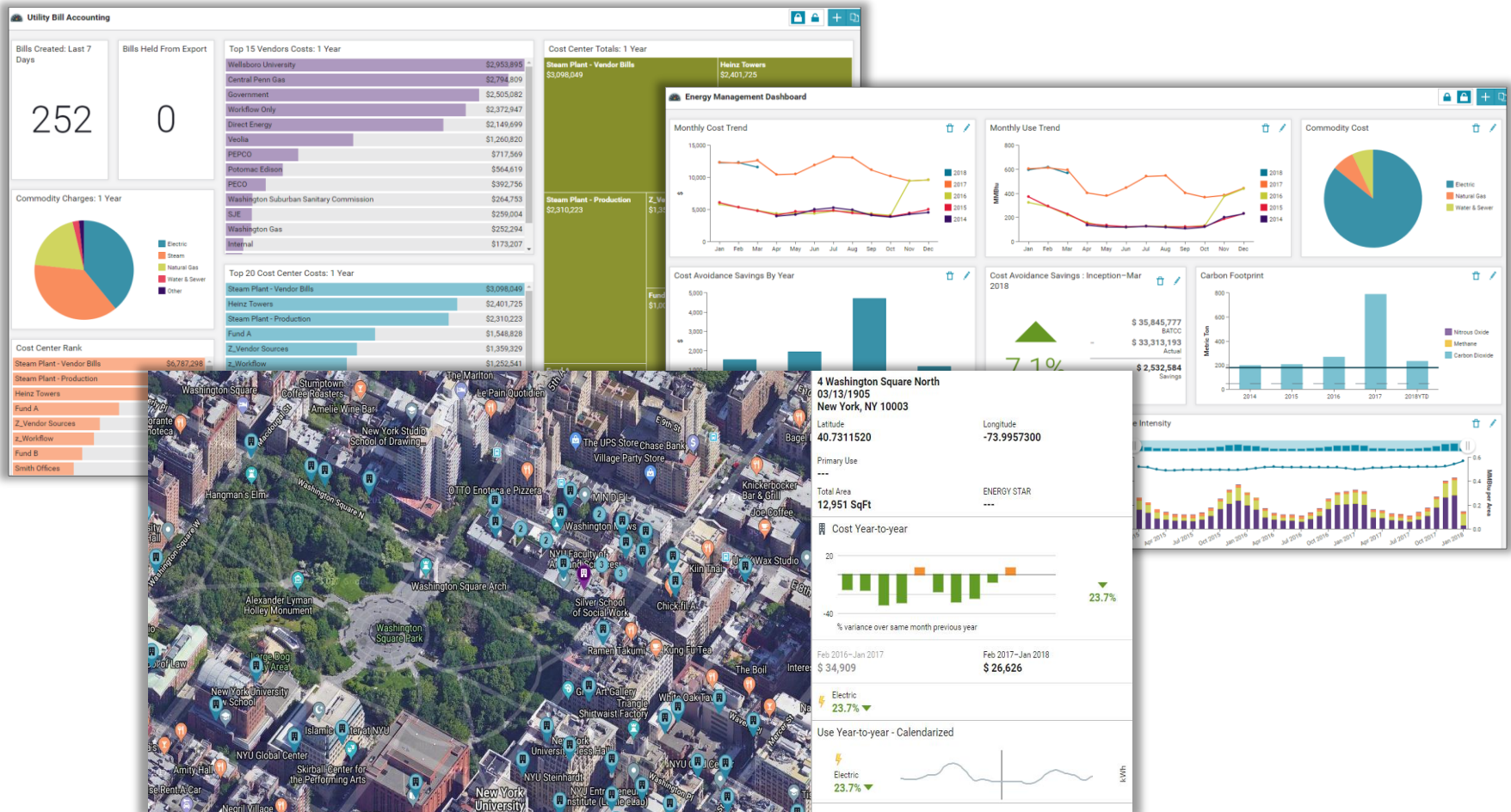
Month	Rating
Dec 2015	85
Feb 2016	88
Apr 2016	90
Jun 2016	92
Aug 2016	95
Oct 2016	90
Dec 2016	92
Feb 2017	90
Apr 2017	90

Rating History with Messages

Rating	Month	Year	Rating Date	Bldg kbtu/SF non-wthr	Bldg kbtu/SF for a 75	Bldg kbtu/SF wthr	Label Eligible	Source kbtu/SF non-wthr
90	Apr	2017	04/25/2017	82.2		83.8	false	137.0
92	Mar	2017	03/25/2017	80.6		82.2	false	134.3
90	Feb	2017	02/25/2017	82.2		83.9	false	137.1
91	Jan	2017	01/25/2017	81.4		83.0	false	135.7
92	Dec	2016	12/25/2016	80.6		82.2	false	134.4
86	Dec	2015	11/30/2016	87.2		89.1	false	152.2
90	Dec	2015	11/30/2016	82.8		84.8	false	138.6
0	Dec	2015	11/29/2016				false	
0	Dec	2015	11/29/2016				false	
91	Nov	2016	11/25/2016	81.4		83.1	false	135.7
90	Oct	2016	10/25/2016	82.2		83.9	false	137.1

Dashboards

Communicate and manage via user-configurable dashboards.



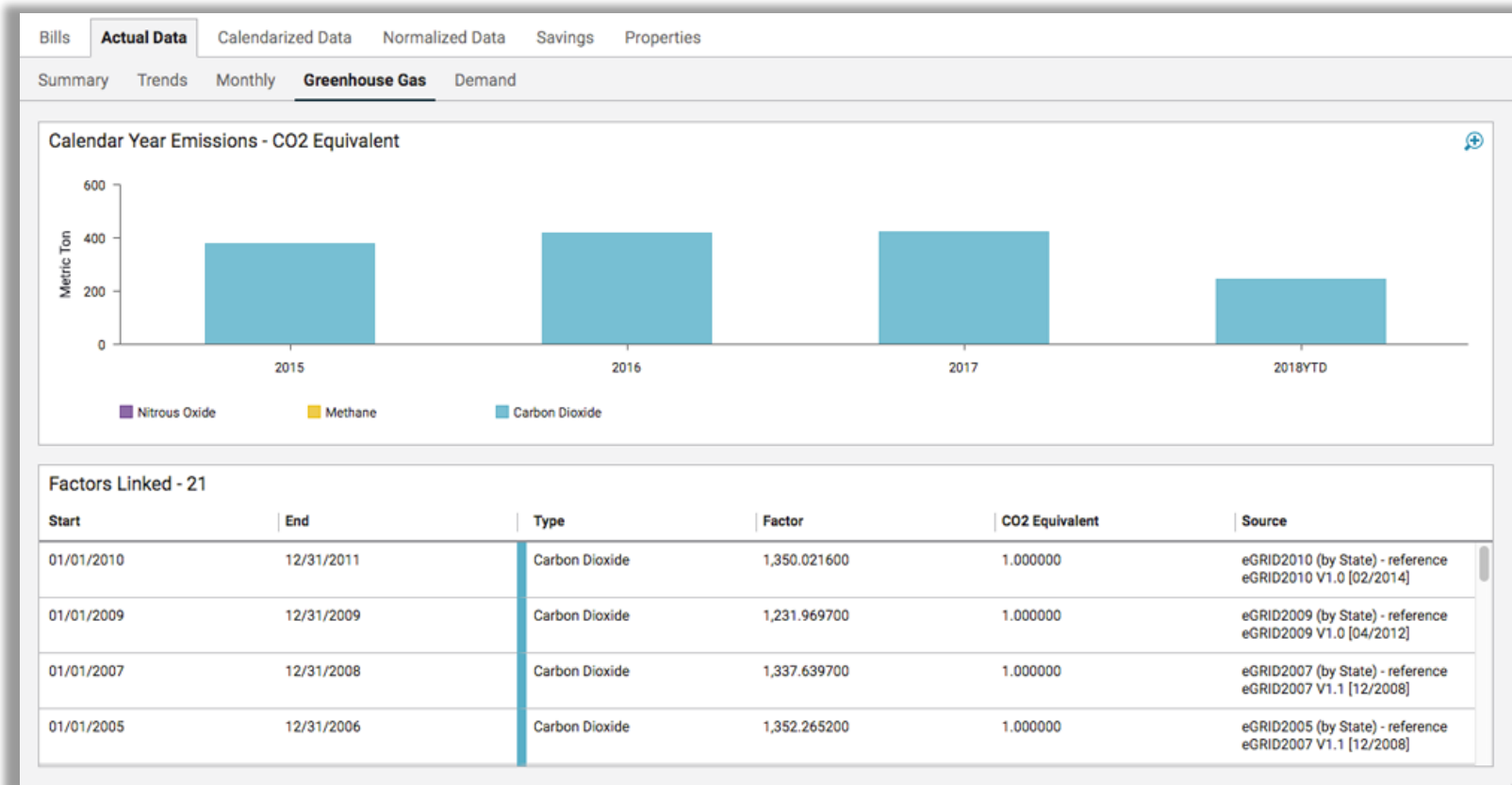
A Kiosk or Screen in the lobby to encourage and motivate conservation?



Of those who tried it, a survey showed twice as many said *“ineffective and quickly ignored”* as said *“a valuable energy conservation initiative.”*

Carbon Footprint

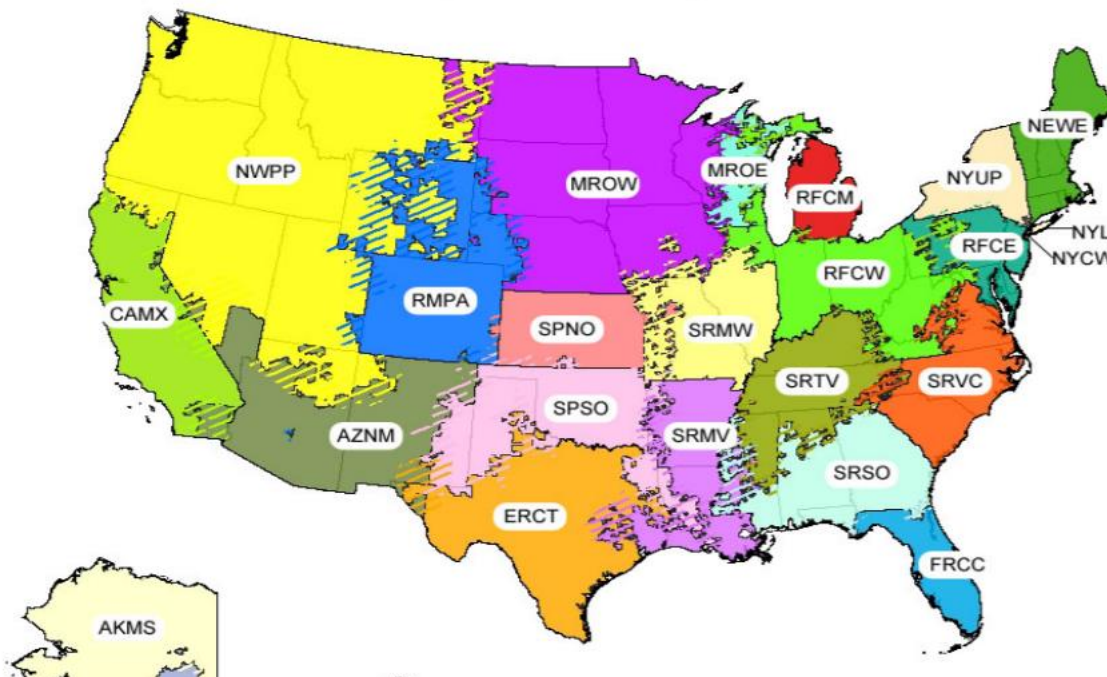
Calculate carbon footprint using provided EPA emission factors or use your own factors.



EPA eGRID

How clean is your electricity?

Map of eGRID Subregions



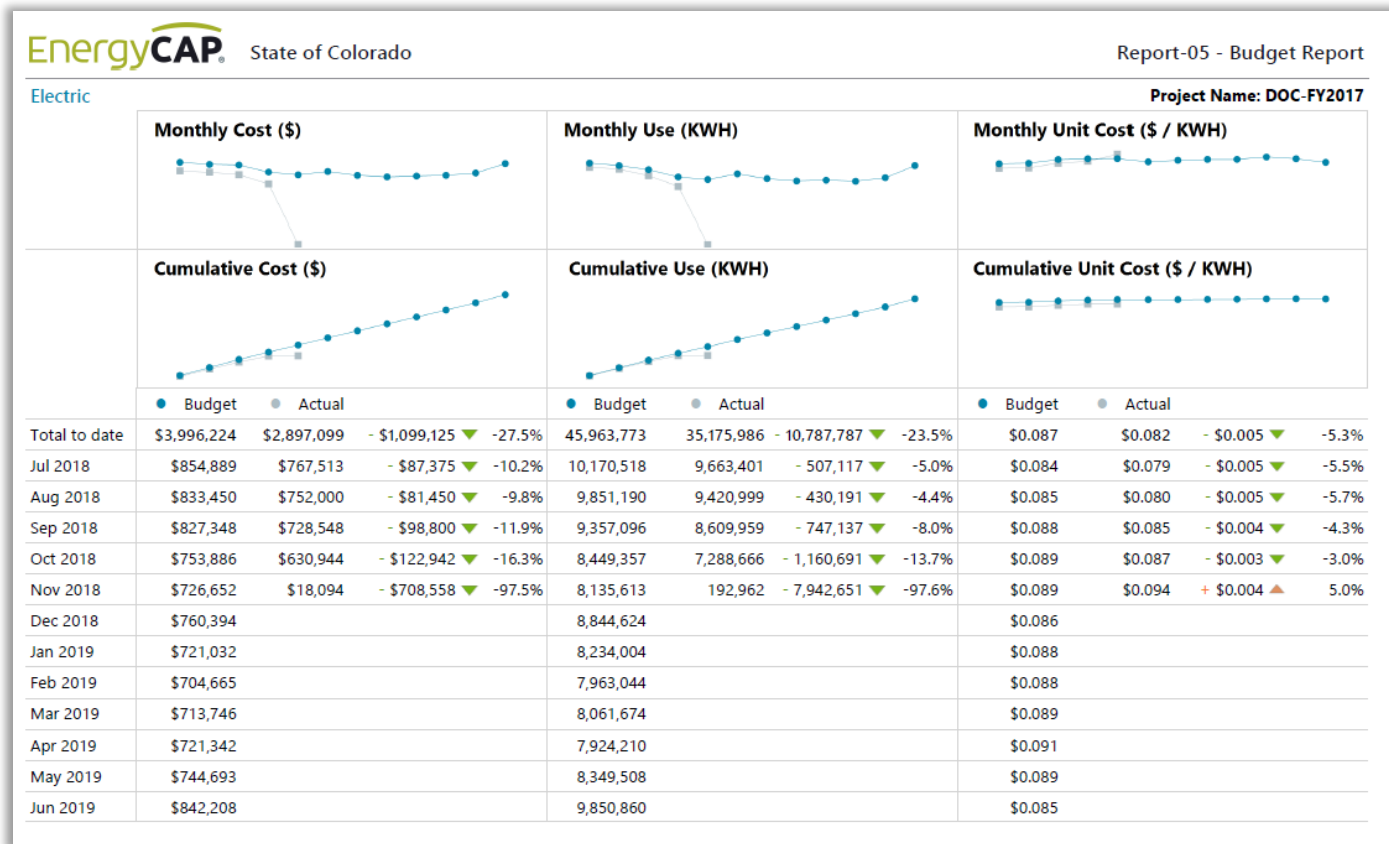
https://www.epa.gov/sites/production/files/2018-02/documents/egrid2016_summarytables.pdf

1. Subregion Output Emission Rates (eGRID2016)

eGRID subregion acronym	eGRID subregion name	Total output emission rates							Non-baseload output emission rates							Grid Gross Loss (%)
		lb/MWh							lb/MWh							
		CO ₂	CH ₄	N ₂ O	CO ₂ e	Annual NO _x	Ozone Season NO _x	SO ₂	CO ₂	CH ₄	N ₂ O	CO ₂ e	Annual NO _x	Ozone Season NO _x	SO ₂	
AKGD	ASCC Alaska Grid	1,072.3	0.077	0.011	1,077.3	6.5	6.5	0.5	1,367.8	0.110	0.016	1,375.0	6.8	6.7	0.7	5.25%
AKMS	ASCC Miscellaneous	503.1	0.023	0.004	504.9	7.0	6.5	0.6	1,533.8	0.068	0.012	1,538.9	21.8	20.8	2.0	5.25%
AZNM	WECC Southwest	1,043.6	0.079	0.012	1,049.0	1.0	0.9	0.3	1,384.8	0.097	0.014	1,391.2	1.3	1.1	0.4	4.23%
CAMX	WECC California	527.9	0.033	0.004	529.9	0.6	0.5	0.1	942.9	0.045	0.006	945.6	0.8	0.8	0.1	4.23%
ERCT	ERCOT All	1,009.2	0.076	0.011	1,014.1	0.5	0.6	1.0	1,402.8	0.108	0.015	1,409.8	0.8	0.7	1.6	4.89%
FRCC	FRCC All	1,011.7	0.075	0.010	1,016.4	0.5	0.5	0.4	1,188.5	0.078	0.011	1,193.3	0.6	0.6	0.4	4.49%
HIMS	HICC Miscellaneous	1,152.0	0.095	0.015	1,158.7	7.4	7.0	4.5	1,530.0	0.147	0.023	1,540.2	11.8	11.3	4.5	5.35%
HIOA	HICC Oahu	1,662.9	0.181	0.028	1,675.2	3.4	3.2	8.6	1,637.5	0.153	0.024	1,648.3	4.1	4.2	8.1	5.35%
MROE	MRO East	1,668.2	0.156	0.026	1,679.3	1.0	1.1	1.3	1,740.1	0.156	0.025	1,750.9	1.0	1.0	1.3	4.49%
MROW	MRO West	1,238.8	0.115	0.020	1,247.4	1.0	1.1	1.4	1,822.0	0.154	0.029	1,834.0	1.6	1.5	2.0	4.49%
NEWE	NPCC New England	558.2	0.090	0.012	563.7	0.4	0.4	0.1	975.1	0.086	0.011	980.5	0.5	0.4	0.2	4.49%
NWPP	WECC Northwest	651.2	0.061	0.009	655.4	0.6	0.7	0.4	1,524.9	0.124	0.020	1,533.8	1.4	1.4	0.8	4.23%
NYCW	NPCC NYC/Westchester	635.8	0.022	0.003	637.1	0.3	0.3	0.0	1,061.7	0.022	0.002	1,062.9	0.5	0.6	0.0	4.49%
NYLI	NPCC Long Island	1,178.3	0.126	0.016	1,186.0	0.9	0.8	0.2	1,338.8	0.036	0.004	1,340.9	0.9	0.9	0.3	4.49%
NYUP	NPCC Upstate NY	294.7	0.021	0.003	295.9	0.3	0.3	0.2	1,018.2	0.061	0.008	1,022.0	0.8	0.8	0.9	4.49%
RFCE	RFC East	758.2	0.050	0.009	762.1	0.6	0.6	0.6	1,434.4	0.079	0.017	1,441.4	1.2	1.1	1.2	4.49%
RFCM	RFC Michigan	1,272.0	0.067	0.018	1,278.9	0.9	0.9	1.7	1,806.1	0.101	0.025	1,816.1	1.3	1.2	2.8	4.49%
RFCW	RFC West	1,243.4	0.108	0.019	1,251.5	0.9	0.9	1.2	1,934.4	0.172	0.029	1,946.9	1.5	1.4	2.2	4.49%
RMPA	WECC Rockies	1,367.8	0.137	0.020	1,376.8	1.0	1.0	0.6	1,688.3	0.147	0.021	1,697.9	1.2	1.2	0.8	4.23%
SPNO	SPP North	1,412.4	0.149	0.022	1,422.2	0.8	0.9	0.5	1,990.8	0.202	0.029	2,004.1	1.4	1.5	1.1	4.49%
SPSO	SPP South	1,248.3	0.095	0.015	1,254.9	0.9	0.9	1.7	1,662.5	0.121	0.019	1,670.9	1.3	1.3	2.4	4.49%
SRMV	SERC Mississippi Valley	838.9	0.050	0.007	842.2	0.8	0.9	0.7	1,186.0	0.071	0.010	1,190.6	1.3	1.4	1.1	4.49%
SRMW	SERC Midwest	1,612.6	0.082	0.026	1,622.5	1.1	1.1	2.4	1,955.2	0.084	0.031	1,966.5	1.3	1.2	3.1	4.49%
SRSO	SERC South	1,089.4	0.087	0.013	1,095.1	0.5	0.5	0.4	1,453.5	0.115	0.017	1,461.1	0.8	0.7	0.6	4.49%
SRTV	SERC Tennessee Valley	1,185.4	0.093	0.017	1,192.6	0.7	0.7	1.0	1,757.4	0.135	0.025	1,767.9	1.1	1.1	1.6	4.49%
SRVC	SERC Virginia/Carolina	805.3	0.067	0.011	810.1	0.5	0.5	0.3	1,422.2	0.111	0.019	1,430.4	0.8	0.8	0.6	4.49%
U.S.		998.4	0.080	0.013	1,004.2	0.7	0.7	0.8	1,501.0	0.111	0.018	1,508.9	1.1	1.0	1.3	4.48%

Budgets & Accruals

Create detailed budgets, accruals, and usage forecasts.

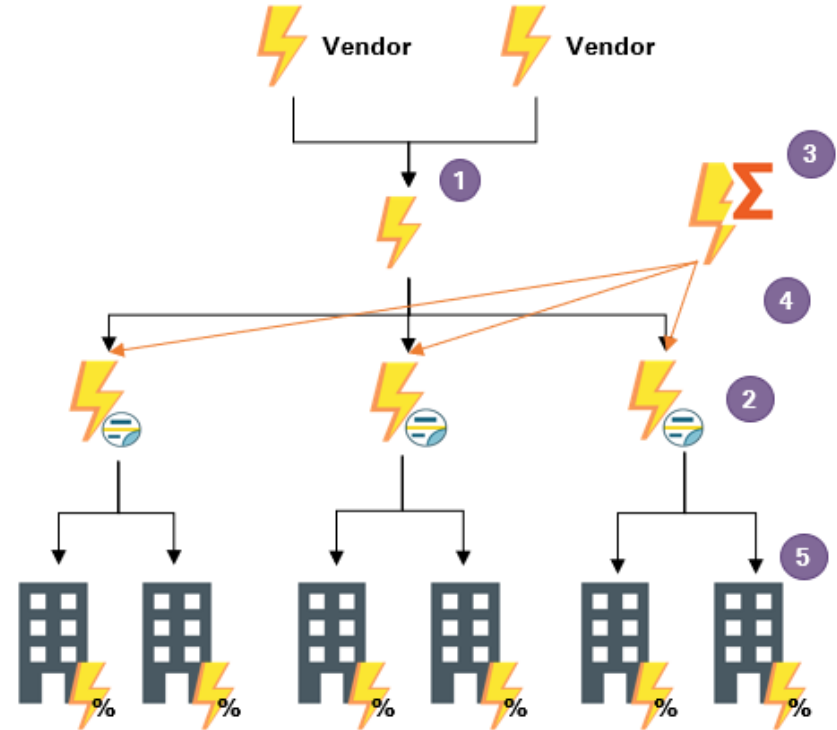


Chargebacks & Campus Distributions

National Leader in Chargebacks:

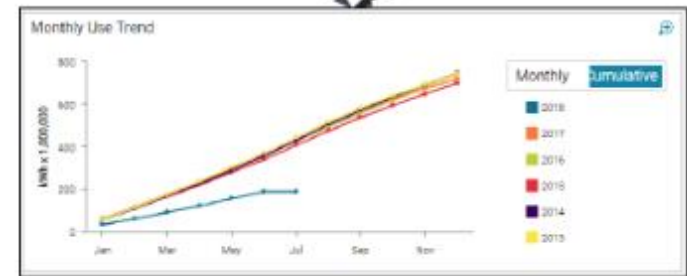
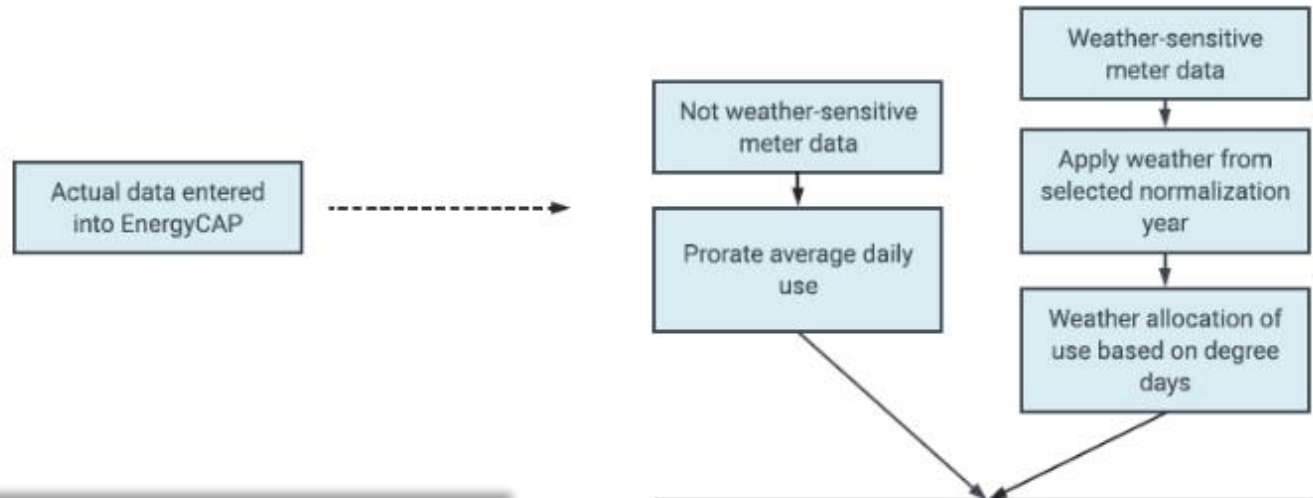
Manage complex and multi-stage chargeback scenarios

- 1 Combine vendor bills
- 2 Calculate submeter bills
- 3 Calculate the difference between vendor bills and submetered bills (loss/remainder)
- 4 Allocate the loss/remainder
- 5 Split the submeter bills to specific facilities



Normalization

Apply the same weather to all utility bills to compare use from year to year.



Degree Day Fundamentals

“**Degree Days**” is a weather analytic that is *only* useful in the context of building energy consumption.

Degree days measure how much the temperature varies from a “balance point temp” at which a building needs no heating or cooling.

Based on dry bulb temperature only

Concept developed in the 1930’s to estimate residential gas demand

BPT: NOAA’s selection of 65F as the “balance point temperature” is a poor choice for modern non-residential buildings. **60F is better.**

Average annual temperature in San Diego is 65F. Average annual temperature in Dallas is 65F. Building energy usage should be about the same, right?

In Dallas, annual A/C usage is 160% more and annual heating use is 350% of San Diego. How can that be?

Dallas has 6x HDD and 1.8x CDD

Location:

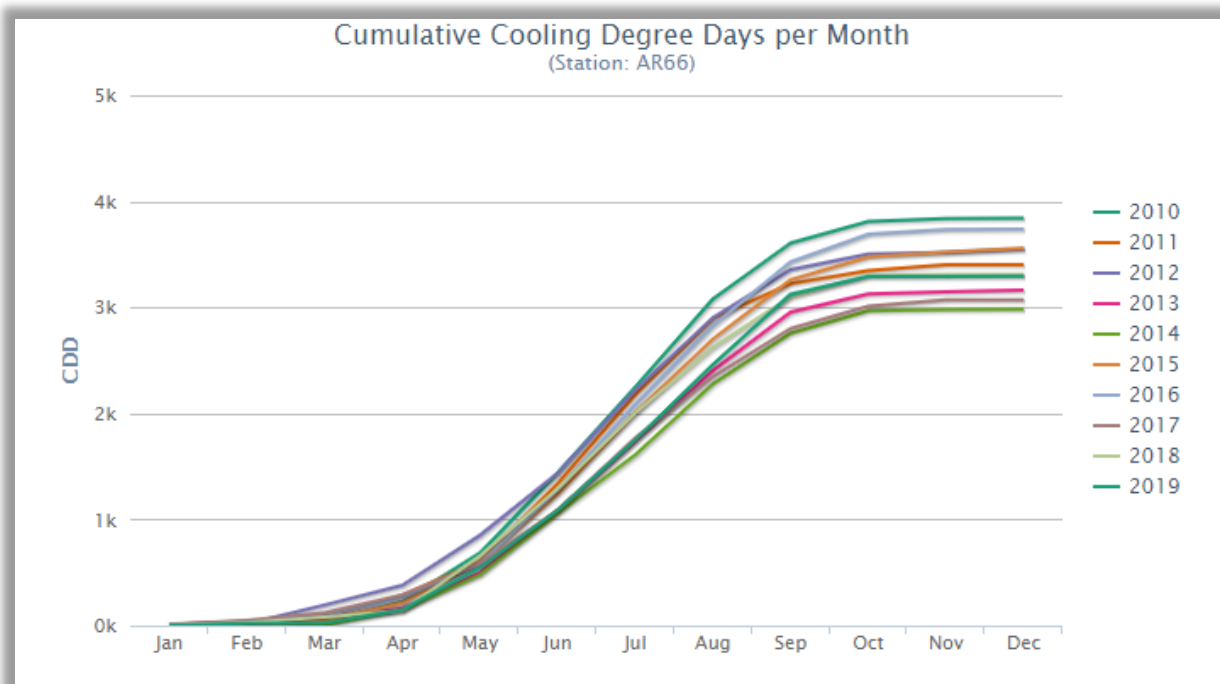
 Balance Point:

Enter Postal Code, Weather Station Code, or City, State

 Base Year:

 Comparison Year:
Monthly Degree Day Comparison (Weather Station: AR66)

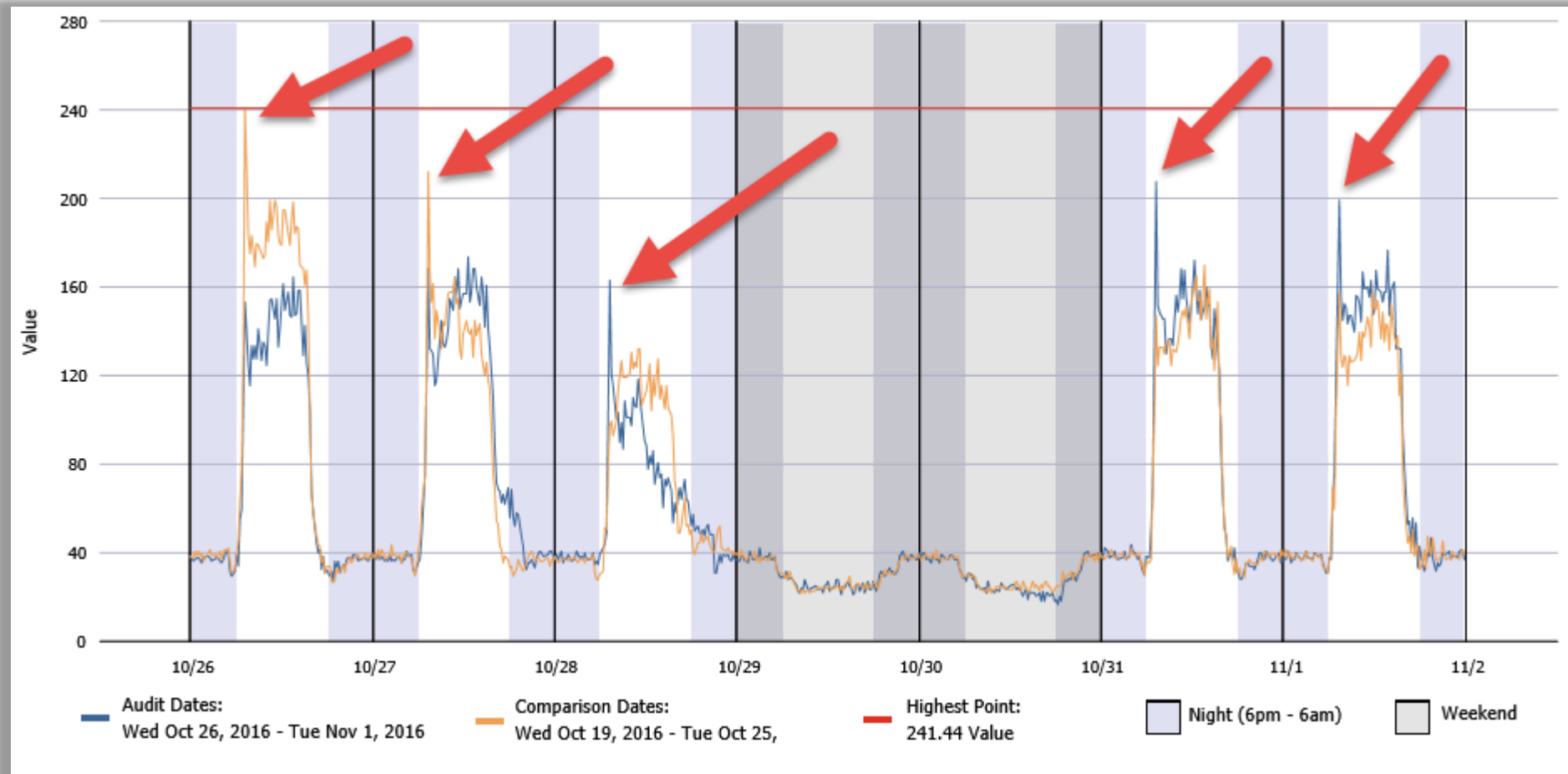
Month	Base Year (2018)			Comparison Year (2019)			Comparison Percentages		
	HDD	CDD	TDD	HDD	CDD	TDD	HDD	CDD	TDD
January	702	3	705	557	0	557	-20%		-20%
February	408	25	433	380	20	400	-6%		-7%
March	171	52	223	303	6	309	77%		38%
April	161	59	220	58	122	180	-63%	106%	-18%
May	0	518	518	3	399	402		-22%	-22%
June	0	632	632	0	539	539		-14%	-14%
July	0	714	714	0	664	664		-7%	-7%
August	0	618	618	0	708	708		14%	14%
September	0	478	478	0	665	665		39%	39%
October	74	203	277	72	167	239	-2%	-17%	-13%
November	383	8	391	356	3	359	-7%		-8%
December	464	1	465	378	3	381	-18%		-18%
Annual Total	2363	3311	5674	2107	3296	5403	-11%	-0%	-5%



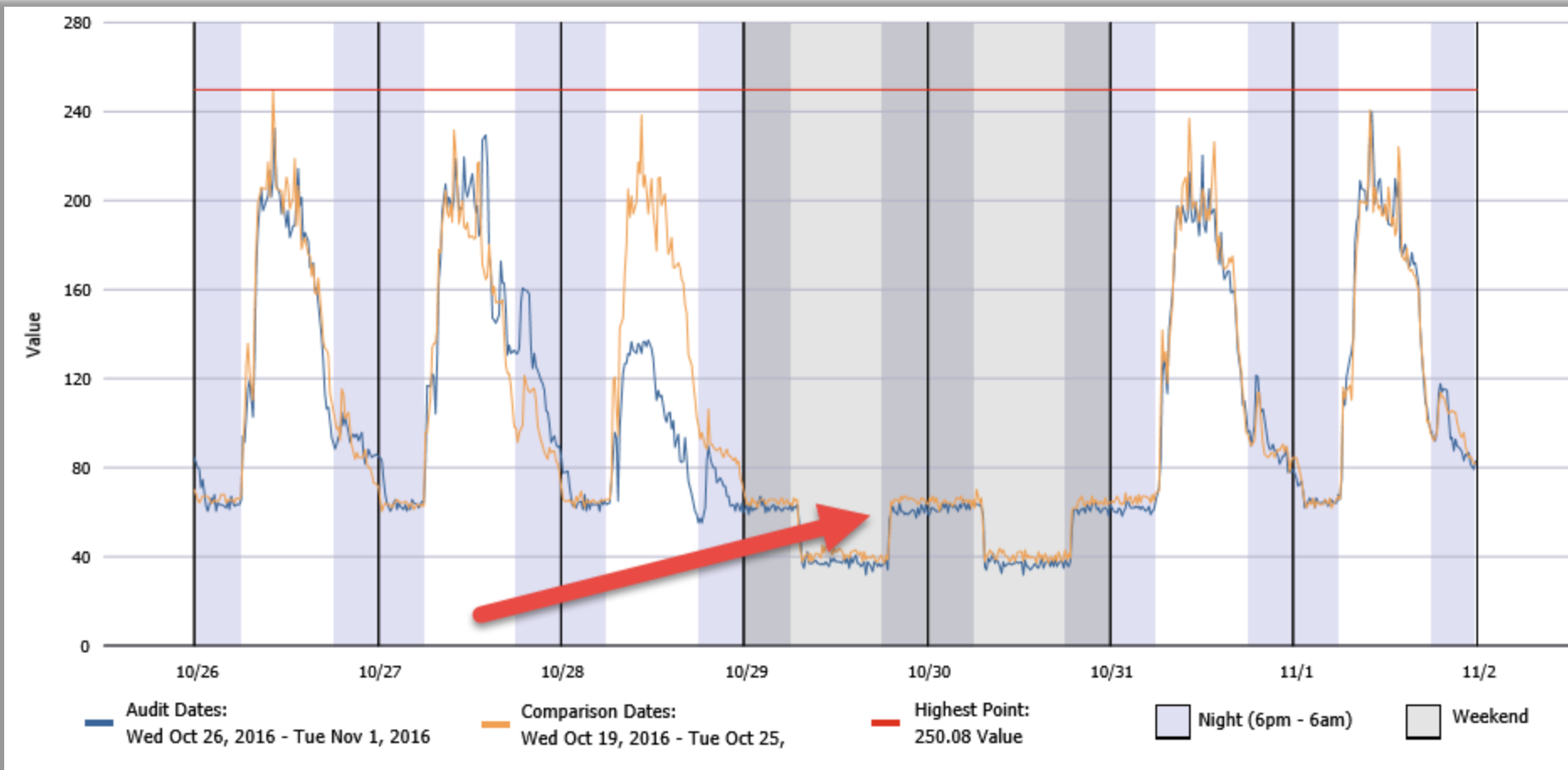
Cumulative Cooling Degree Days (Weather Station: AR66)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	3	3	25	226	683	1437	2250	3079	3607	3811	3839	3844
2011	0	24	78	285	604	1337	2178	2896	3226	3349	3403	3403
2012	2	17	194	379	849	1436	2220	2902	3357	3502	3518	3550
2013	13	40	53	164	497	1090	1738	2402	2956	3126	3147	3162
2014	0	2	3	145	477	1057	1608	2280	2756	2968	2981	2982
2015	0	0	44	215	599	1238	2009	2700	3258	3475	3523	3557
2016	7	31	95	262	588	1278	2085	2827	3428	3690	3733	3740
2017	10	49	120	289	585	1086	1770	2347	2800	3010	3071	3071
2018	3	28	80	139	657	1289	2003	2621	3099	3302	3310	3311
2019	0	20	26	148	547	1086	1750	2458	3123	3290	3293	3296

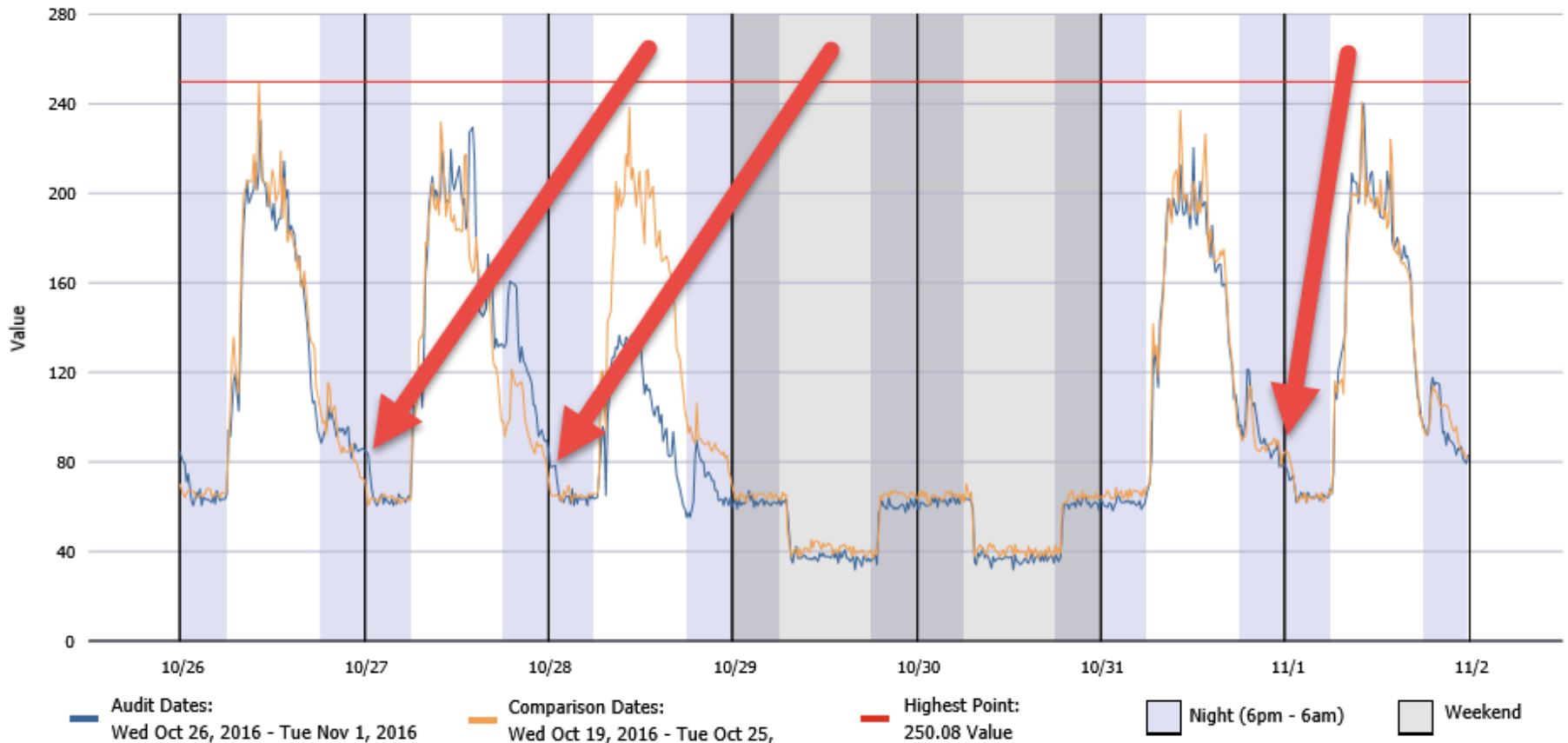
Why a peak at 7am every weekday?



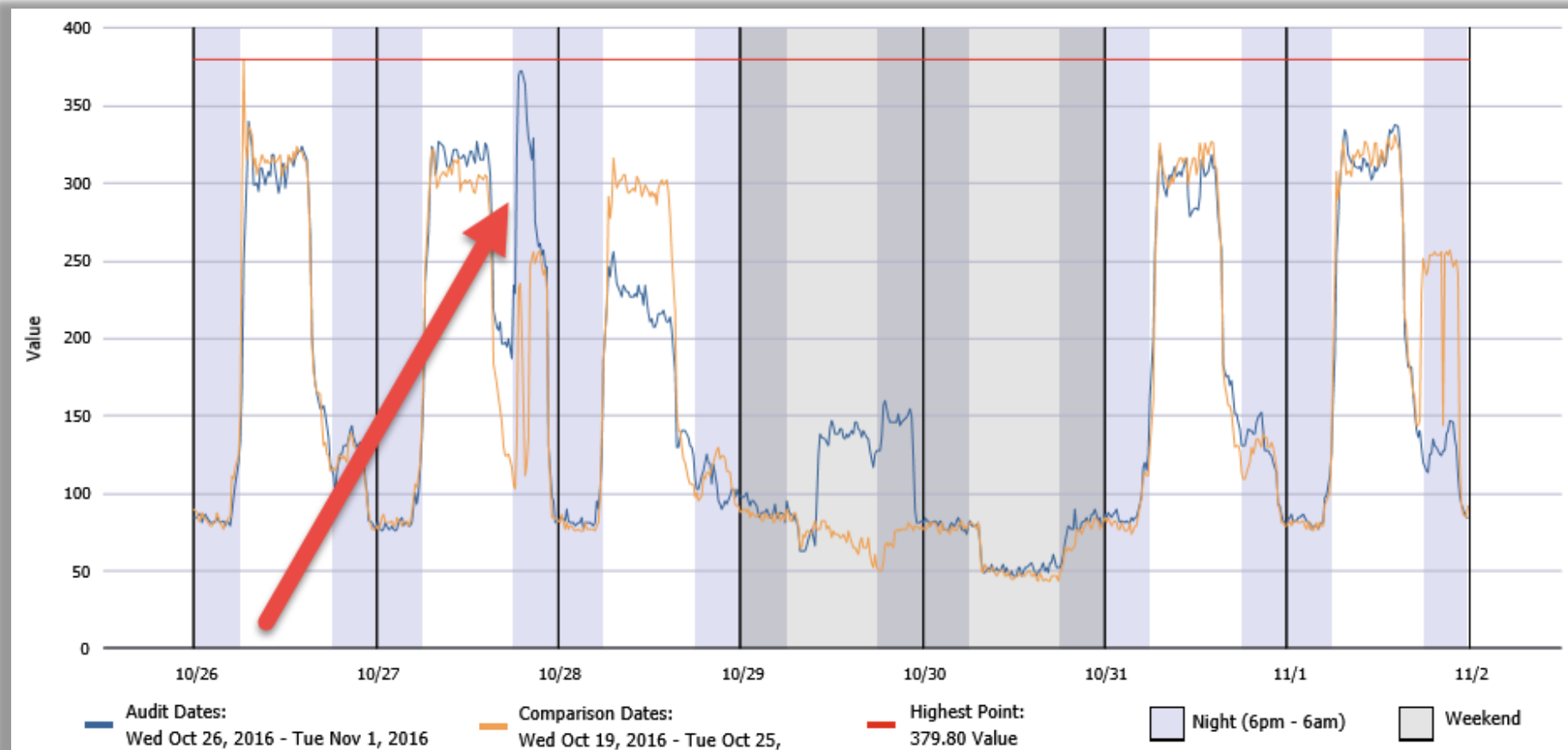
Do we need 30kW of security lights, that stay on until 6:30am on weekends?



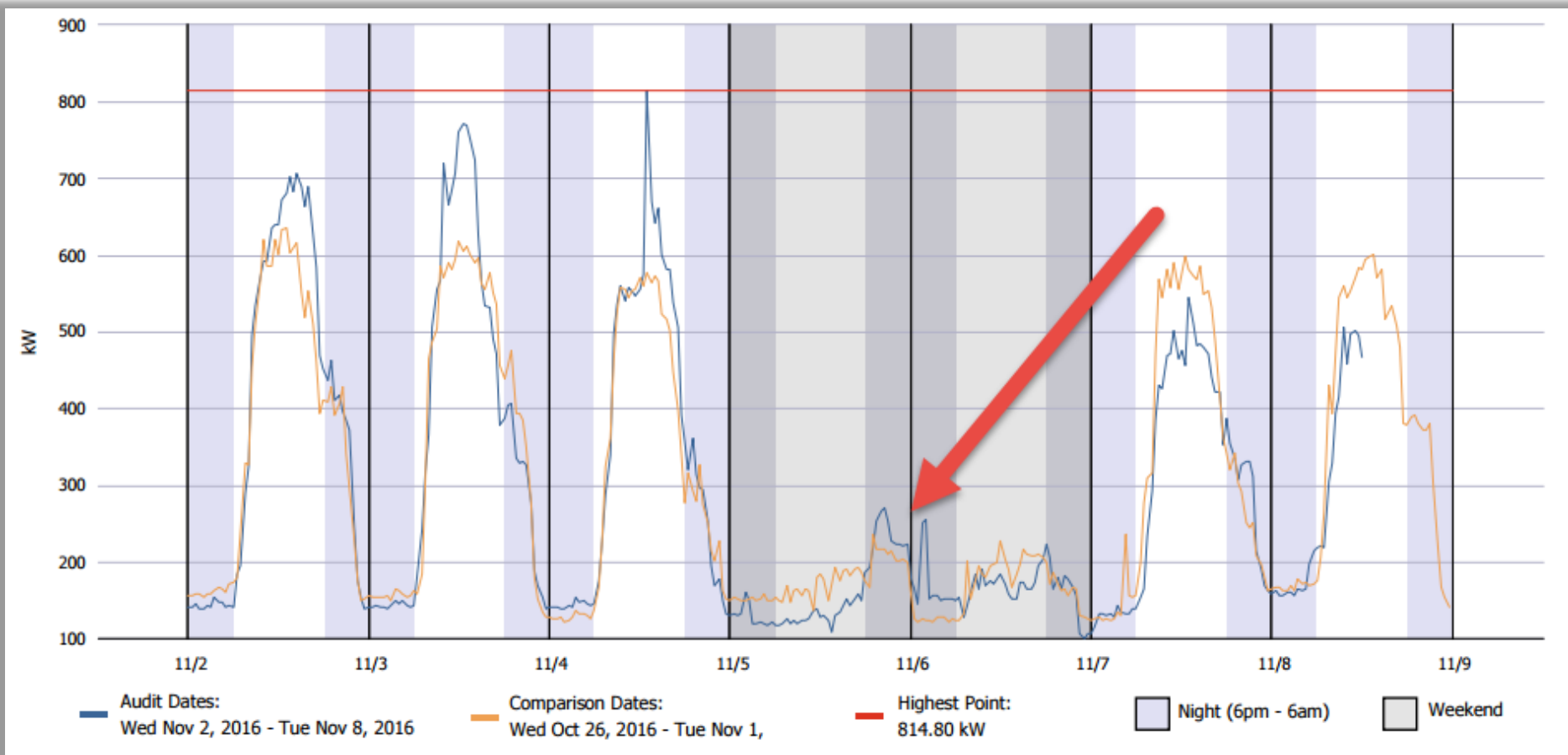
Why don't we get complete nighttime shutdown until 1am weekdays?



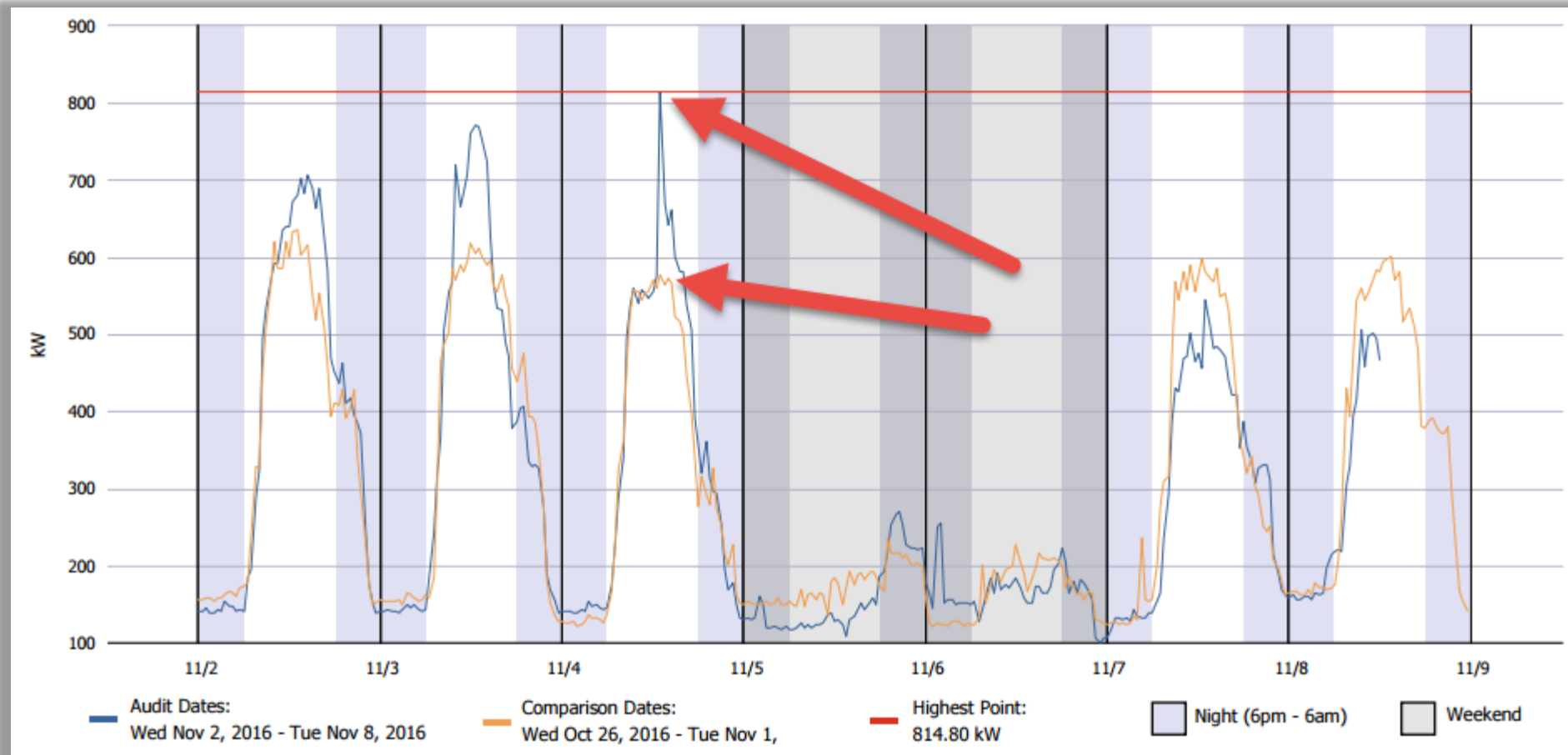
Thursday? Greater kW at 6:30pm than during the school day.



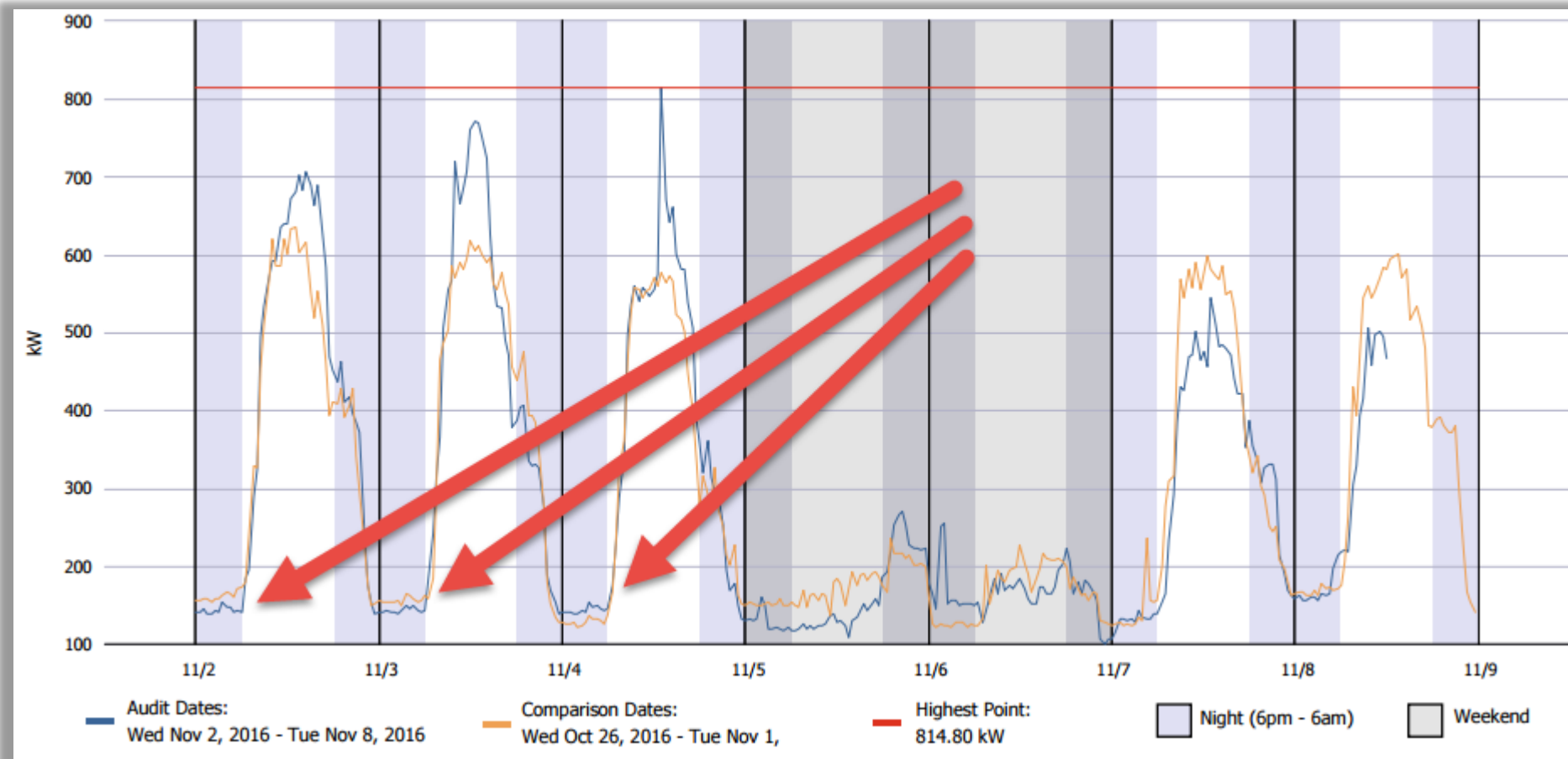
What 125 kW load did we add at 8pm Saturday night?



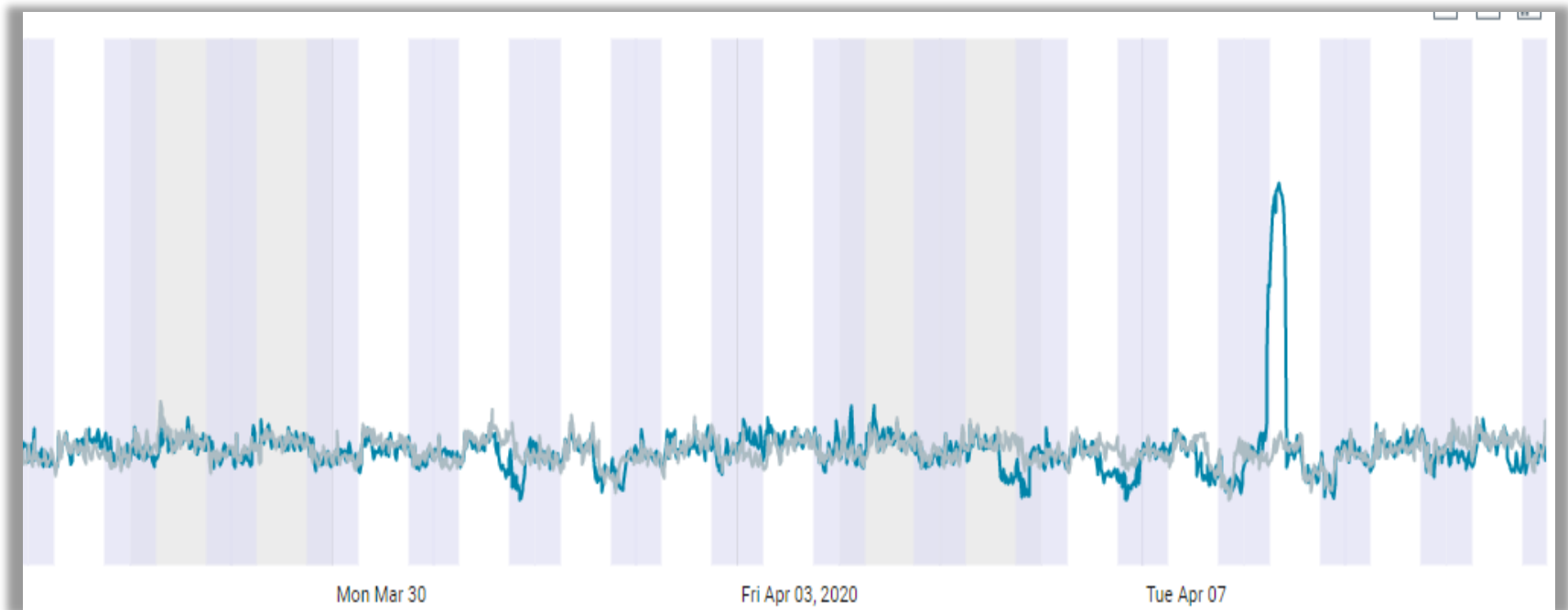
Why did 1pm load increase by 260 kW from last Friday to this Friday?



We're running a steady 150 kW load during nighttime shutdown. Justified?



Oops! Looks like the 3-week COVID-19 EMS shutdown shouldn't have expired on April 8th!



**You all have probably held a 17
million watt device in your hand
recently. What was it?**



By comparison, a blow dryer is about 1,500 watts



An accelerating car is about 100,000 watts



**A Boeing 737 engine is about
17 million watts:**

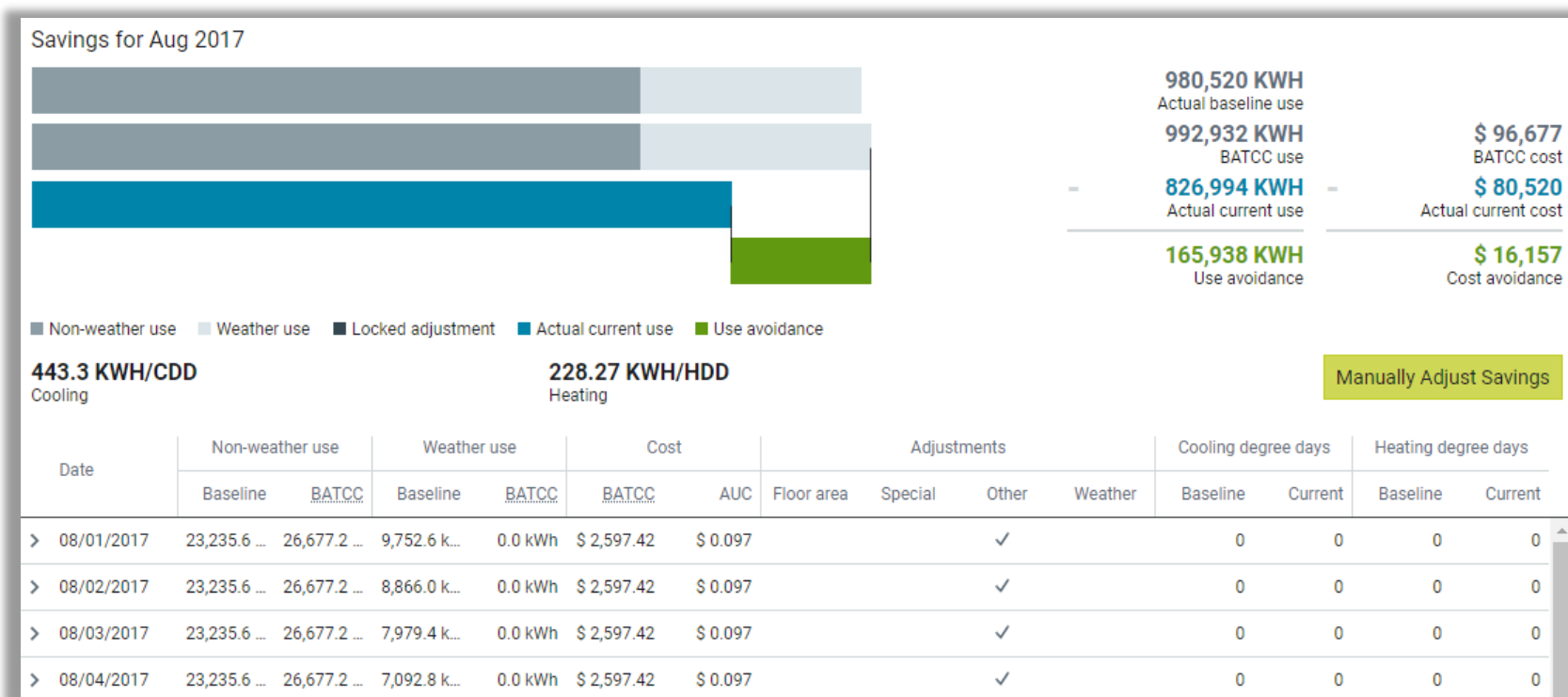


A 17 million watt hand-held device:



Savings

Perform IPMVP-compliant measurement and verification of savings and cost avoidance.



M&V – Measurement & Verification (of savings)

M&V is “Measurement & Verification” of energy and cost savings resulting from an energy efficiency initiative, called an EPIA by ISO (Energy Performance Improvement Action).

“The purpose of M&V is to provide confidence to interested parties that reported results are credible... [including] appropriate accuracy and management of uncertainty” (ISO 50015)

“Measurement and verification” of energy savings is necessary because you can’t simply compare year-to-year out of pocket expenditures. You have to compare what you did spend with how much you would have spent in the absence of energy efficiency, in other words how much you avoided spending.

The U.S. Department of Energy and other impartial agencies funded the development of the IPMVP (The International Performance Measurement and Verification Protocol) beginning in the mid-1990’s.

Today it is managed by an international nonprofit agency called **The Efficiency Valuation Organization**. www.EVO-World.org



Financer
(Owner or third party)



Manufacturer



Contractor
(Installer)

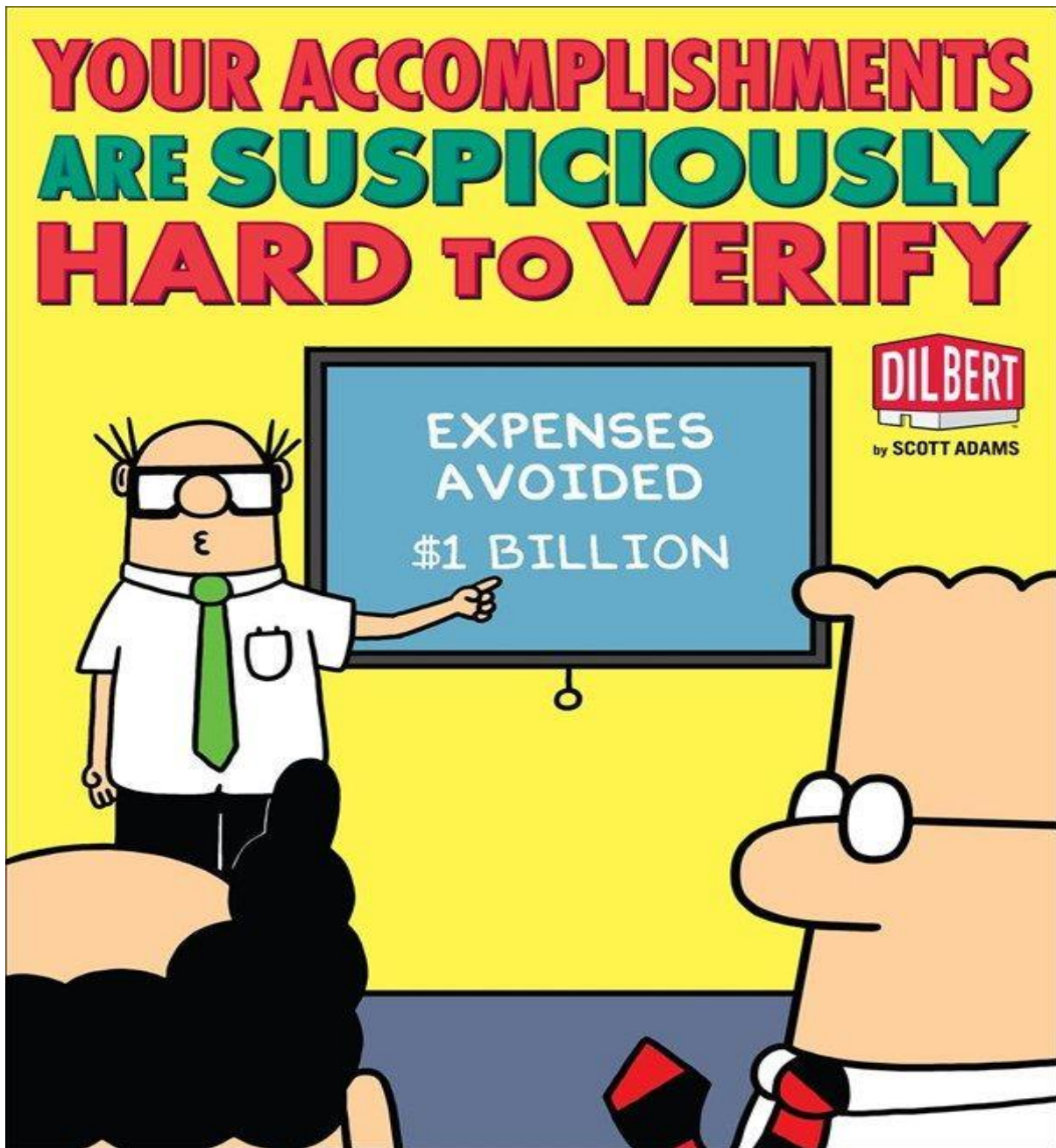
M&V ties it all together!



Building Owner
(Savings beneficiary)



Designer
(Engineer/specifier)



Four IPMVP Options

A. Retrofit isolation. Measure and estimate parameters.

(“Key Parameter Measured, Others Estimated or Calculated”)

EXAMPLE: Lighting retrofit (Measure KW reduction, estimate # of hours)

B. Retrofit isolation. Submeter actual energy use.

(“All Parameter Measurement”)

EXAMPLE: Chiller replacement (All inflows and outflows submetered)

C. Compare before/after utility bills. (“Whole Facility”)

EXAMPLE: Behavior-based program

D. Comprehensive computer modeling. (“Calibrated Simulation”)

EXAMPLE: HVAC controls retrofit

Stipulated Savings – The non-M&V approach

Both parties agree to the savings in advance, as a condition of the contract.

EXAMPLE: The ESCO contract stipulates that savings from this LED retrofit will be
\$25,000/year

Stipulated Savings is not “M&V” because it involves neither measurement nor verification.

It can be a very appropriate way of avoiding the expense of ongoing M&V when key variables are known in advance and all parties are in agreement with the savings calculations.

Example

Cost Avoidance=Adjusted Baseline Cost–Current Cost

Baseline cost: \$1,000

KWH: 10,000

Current cost: \$1,200

KWH: 8,000

Adjusted Baseline cost: \$1,500 (10,000 kWh x \$0.15/kWh)

Cost avoidance: \$300

Limitations of IPMVP Option C

When you have implemented several projects, it's difficult to discern the results of each individually.

The further back the base year, the less reliable the calculations due to many changes in occupancy, equipment, etc.

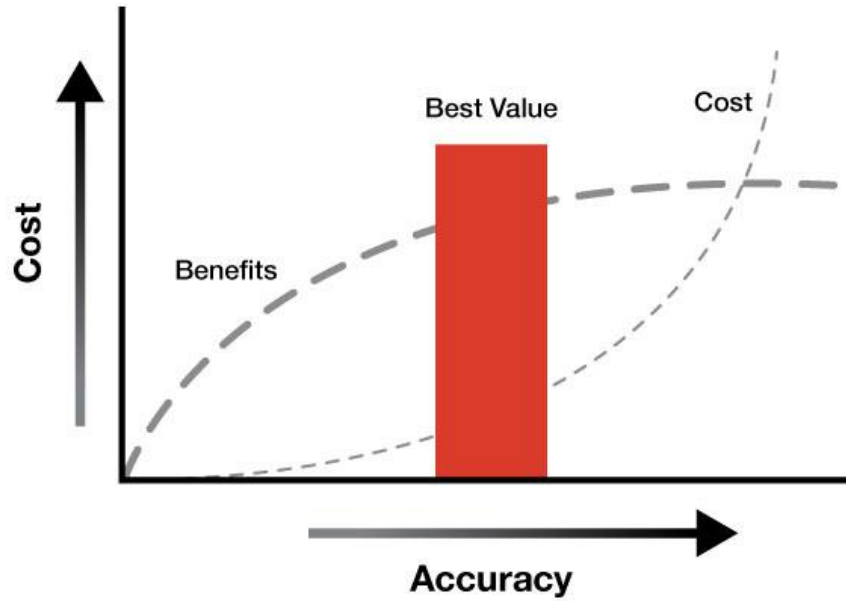
When peak demand charges are a major cost driver, there are valuation complexities.

Non-standard baseline adjustments require engineering analysis, **high skill level and substantial time commitment.**

How much M&V is enough?

The Law of Diminishing Returns

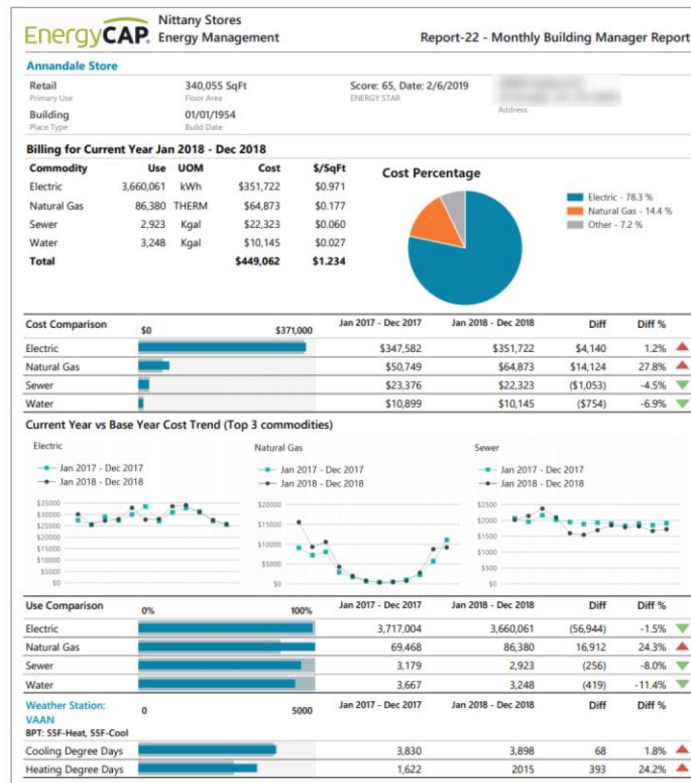
Spend more on M&V for improved accuracy?



Energy Management Report Guide

Energy Management Report Guide

Report-22 Monthly Building Manager Report



Thank you and best wishes for
health and success!



Steve Heinz, PE, CEM, CMVP

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Assoc of Energy Engineers (AEE) Fellow

2013 AEE Int'l Energy Engineer of the Year

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