

We know you wear ten hats. This paper shows how to get the most out of your utility dollar on a mid-size time budget.

- How to decide if your usage is normal or high
- Ways to locate waste using utility data patterns as clues
- Introduction to ghost loads, demand limiting, interval data
- Use of CSU customer portal for data, charts, tools
- Resources for additional ideas on lowering utility cost



Note: Content is tailored to mid-market, although many of the topics apply to all sizes of businesses.

Utility Data as a Tool: Metrics and Visuals Add to Common Sense

Benchmarking Energy Use Intensity values (EUI)

Why? So you know if your usage is normal or abnormal. A good starting spot - a 10,000 foot view.

A common metric is annual energy use per SF per year, compared to similar facilities. The customary units for comparison are Btu/SF-yr and there is a lot of data in these units to compare to.

This can be easily calculated, if you have 12 month total electric (kWh) and gas (ccf) usage data.

Begin with the total yearly amounts of energy product used

Step 1: Total kWh * 3.413 = kBtu of electric energy.

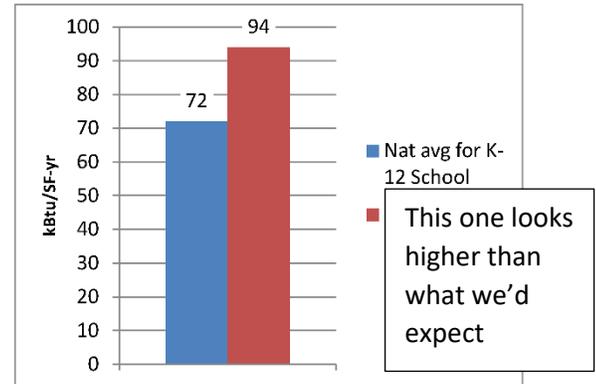
Step 2: Total ccf * 85.0 = kBtu of natural gas energy. The heating value of natural gas delivered to customers varies over time, and by season. This is a typical value as of 2020.

Step 3: Include any additional energy sources used by the building, including electricity generated by solar PV, propane, etc. Convert to kBtu as well.

Step 4: Add the results of Step 1 and Step 2 for total kBtu per year.

Step 5. Divide the total kBtu per year (step 4) by the facility size in square feet.

Compare your results with a trusted source or the national average values at the end of this paper. Decide if your per-SF energy use is high-low-normal based on how it compares to benchmark normal values. Consider your score reasonable if within 5-10%. If numbers are way high or low, check for a math error or a square foot error.



Other metrics

Why? It's optional. Might help if there is a particular item of interest, like energy cost per meal served.

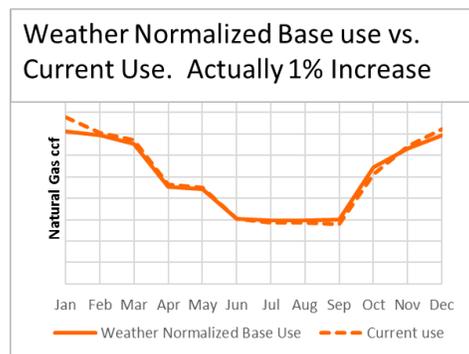
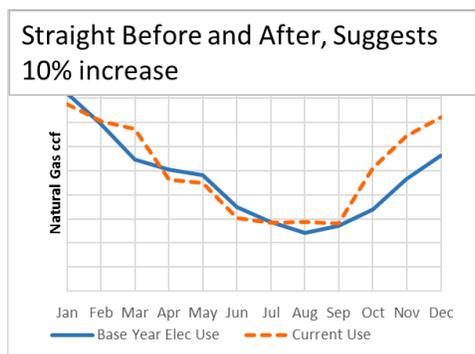
Many other private metrics are possible, so do what makes sense. Even if there is not reliable benchmark data, it is fine to make comparisons to a sister company, a competitor, or the same facility year over year. Custom metrics can also include things like \$ per SF, Btu per gallon of milk, MMBtu per student per year, \$ per meal, etc.

Weather effects and weather normalization

Why? If you want to compare closely the usage between years or verify if savings are as good as advertised for a new heater, etc., weather effects should be removed because results can be skewed.

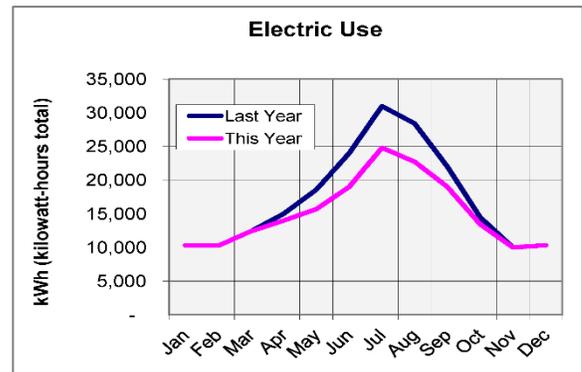
Year-over comparisons can suffer poor conclusions when there is a large weather difference between years. Weather normalization techniques are helpful to remove most of the weather effects. Weather normalization technique is beyond the scope of this paper, but if you are determined, here is an article that explains it in practical terms:

<https://www.abraxasenergy.com/articles/intro-weather-normalization-contractors/>



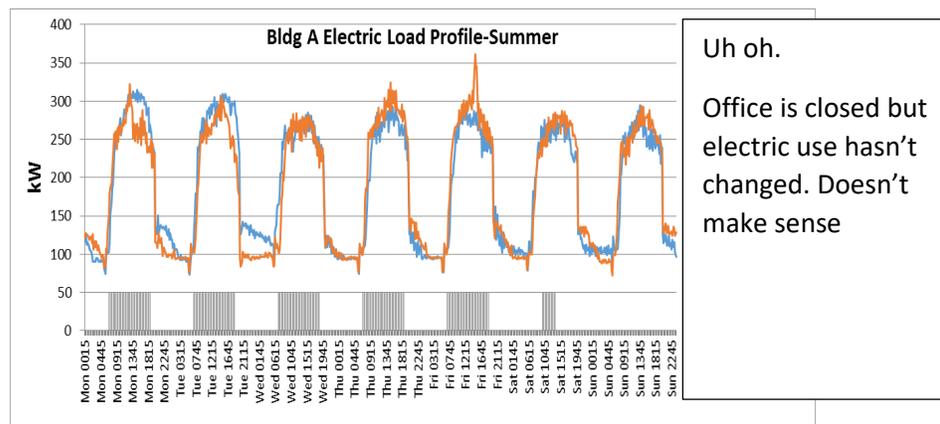
Monthly Usage

Seasonal patterns become visible for weather-related loads like heating and cooling. Base usage also shows up in mild weather. When heating and cooling are minimal or off, any remaining usage is ‘everything else’. For example, if you see gas usage in July, it might be normal if there is a pool, but it might be abnormal if the only thing natural gas serves is a heating boiler. A step in charting monthly data is ‘day normalizing’. This is very easy compared to ‘weather normalizing’. The utility meter reads for a ‘month’ might be 35 days one month and 25 days the next month. Without normalizing the days (use a proportion to get it close), you could be chasing a ghost looking at ‘high’ usage in a month that wasn’t high at all.



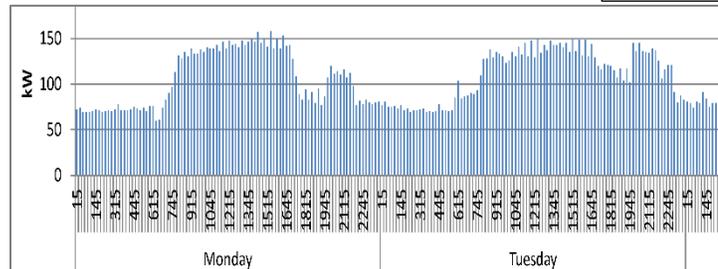
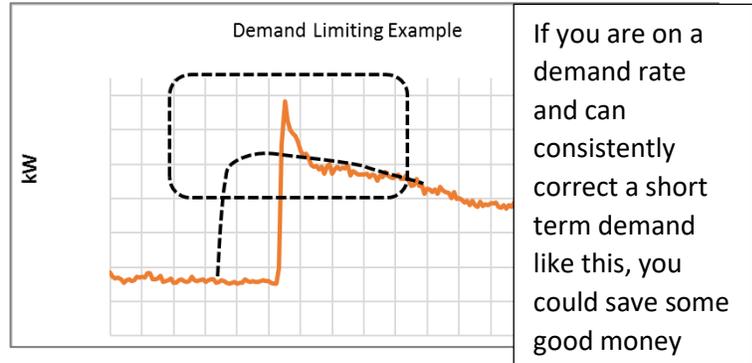
Daily usage

Ah, now we can do some better troubleshooting. Remember that troubleshooting is comparing what you see to what you expect. Let’s say your business is an office and it is closed on weekends. You would expect energy usage to be a lot lower on weekends since lights are off and HVAC is set way back. So once in a while you look at the daily usage on a weekend to see... maybe you find the usage looks almost the same on the weekend...so the review of daily use points to ‘something is wrong’ and you investigate. For example, it could be that the programmable thermostat is taking a vacation.



Hourly use, or even use by the minute.

With this granularity, you would be able to identify the amount of electricity used at night (ghost load), you would notice something that starts and runs in the middle of the night that shouldn't, etc. This 'interval data' is really the pulse of the building. And if your business is on a 'demand rate' where a big part of the bill is 'demand' (power, or high rates of energy use), interval data can be very helpful. For example, if the automatic controls allow a large cooling unit or electric heating unit to run full out at certain expensive times, interval data makes the problem visible so you can then do something about it.



? Is all that usage in the middle of the night necessary?
 Good question! If the expense of it isn't earning your business money, you can find out and maybe turn it off.

Who has time to make charts and study energy use?

We agree, time is precious. It is hard to say in this paper what is the best thing to suit your specific case. What we like to see are tools that make it easy – with pre-made charts, metrics, visual clues, even alerts, so your time is conserved while still having your eye on the utility cost. Newer meters and customer information portals from utilities help a lot with this. Another, more conventional approach, is to invest some time to make a few standard charts in a way that allows the newest chart to require only coping a previous one and dropping in the most recent data. To see where this utility is at as far as customer tools to save time, check out the online portal.

Energy management should not be a ball and chain. Once it where you want it, brief checks should be all that is needed to make sure things are behaving for you.

What to do if you share a building with other tenants?

Yes, the options are less if you are leasing your space. The landlord-tenant arrangement on utility cost is worth a discussion. In fact, your business may be the landlord, but the topics here presume you are the tenant.

- When shopping for a space to lease, ask for utility cost history and compare the combined price of rent and utilities.
- If lease term is long, ask for options to have a separate service (your own meter).
- Learn/ negotiate utility cost term with respect to vacancy. Many lease terms divide the entire facility utility cost among tenants – this can drive up cost if you are in a 50% occupied building.
- If all you have is a dollar charge as each month's utilities are spread out, at least calculate the \$ per SF per year, compared to what you were told to expect.
- Speak up if one tenant's business is more energy intensive or on a different schedule, to know they are paying their fair share.
- Get to know your fellow tenants. If they all have a like mind for being frugal, you will be more likely to try, vs. savings you create being squandered by a neighbor.
- Get to know the shared equipment. Yes, it is the landlord's stuff, but you are a stakeholder with the monthly energy bill. Be polite, but if something looks grossly inefficient, the landlord might make an improvement.

What else can you do?

- Ideas from tip sheets (see **Resources** at the end)
- Ideas from other White Papers, articles, tip sheets, and rebates at [csu.org](https://www.csu.org)
- Energy audit

And Finally:

- Make the most of what is there first. Change equipment last.
- Try anything that raises awareness of energy cost, especially feedback and accountability. You'll know you've been successful when people make energy impact choices at work as if they were paying the bill.
- Look for things that run when they could be off. Parking lot lights on all day? HVAC units running on the weekend when nobody is there? Machinery left idling for long periods of time? And about that gas broiler that warms up in a 'hot second.

- Look for doors that are open or aren't sealed: dock doors left open, walk-in freezer doors propped open, front doors with a large daylight crack under it, oven doors with broken seals, refrigerator gaskets torn.
- Are there a lot of space heaters being used? Sometimes a heated foot mat will do the trick with a fraction of the energy use.
- Maintenance? Some maintenance tasks have a direct effect on energy use (and lack of maintenance goes the other way). Simple things can have nice benefit, like cleaning inside and outside coils once a year so they are clean like new; and making sure the economizers are working to give you free cooling.
- Whenever equipment replacement does come around, ask a lot of questions related to efficiency...some options/features are a big help for controlling cost. Using a rooftop HVAC unit as an example of strategic planning:

Feature to Ask For	How This Saves Money
High EER rating	Lower demand, lower energy use
Air economizer	Free cooling
Easy access for maintainability	Enabler to keep efficiency high long term
Hail guards to protect the outdoor coil	Prevent efficiency loss from bent fins
2 inch tight filter rack and good filters	Prevent efficiency loss from dirty coils
High efficiency fan wheels	Lower demand, lower energy use
Two speed fans with rooftop units	Lower fan energy use
Control: Load-limiting capability	Enabler for demand control
Control: Outside air damper separate signal	If running in unoccupied time, outside air damper stays closed.

Additional Resources

Resources - Commercial

Energy Star – tip sheets

<https://www.energystar.gov/buildings>

- If links do not work, try a search from the [energystar.gov/buildings](https://www.energystar.gov/buildings) page. Use key words from the links in the energy star search box. For the link using 'biz', you would use 'business' and omit the dash marks between words for searching. For example: **'facility owners and managers small business technical resources'** or **'small business technical resources'**

<https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy>

Tip Sheet for generic low cost items

- *Low- and no-cost energy-efficiency measures*

<https://www.energystar.gov/buildings/facility-owners-and-managers/small-biz/tech-resources>

Tip Sheets by business sector

- *Offices*
- *Restaurants*
- *Auto dealers*
- *Lodging*
- *Grocery and convenience stores*
- *Small and Medium Manufacturers*

CBECS table PBA3 - Benchmark values for annual energy use per SF

<https://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/pba3.php>

- If the link does not work, try a search engine with key words **'eia.gov cbece pba3'**

This is the source of benchmark values of kBtu/SF-year national averages in sub-categories. Compare your site to value in the table, for a rough idea if your use is reasonable or high.

Find the column for kBtu/SF-year – on the website it is named **'per SF (thousand Btu)'**. Or the **2012 table pasted on the following page labeled PBA3-2012/CBECS**.

Note this data is updated on ~ 6-year cycles with delays while the data is processed. The 2018 version is due out late 2022 and can be found at the eia.gov site. Use the latest version of PBA3.

To learn what is lumped into main category names, search '**CBECs building type definitions**'

Resources - Industrial

EERE / ITP - Industrial Technologies Program, tip sheets

<https://www.energy.gov/eere/amo/tip-sheets-system>

→ If the link does not work, try a search from energy.gov/eere page. From there, try searching using the eere search box: '**industrial technologies program tip sheets by system**' or '**amo tip sheets**'

Tip Sheets by system

- *Motors, VFDs, synchronous belts*
- *Pumps*
- *Steam and condensate*
- *Compressed air*
- *Combustion and process heating*

Table PBA3. Sum of major fuel consumption totals and gross energy intensities by building activity subcategories, 2012, release date Dec 2016

Q = Data withheld either because the Relative Standard Error (RSE) was greater than 50 percent or fewer than 20 buildings were sampled.

Source: U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Form EIA-871A, C, D, E, and F of the 2012 Commercial

Principal Building Activity (Expanded)	# of bldgs x 1000	kBtu/SF- yr	PBA3-2012 / CBECS
			Sub category, PBA+
Education	389	68.8	
College or university	27	122.9	College or university classroom building
K-12	232	58.4	
Elementary or middle	189	54.9	Elementary or middle school, junior high school, K-12 school
High school	43	65.3	High school classroom building
Preschool or daycare	68	66.4	Preschool or daycare
Other classroom education	62	61.4	Adult education, career or vocational training, religious education, training for disabled, health-related training, art school, tutoring
Food sales	177	209.5	
Convenience store with or without gas station	131	216.3	Convenience stores and convenience stores with gas stations are combined into one category in the building activity subcategory tables
Grocery store or food market	45	205.5	Grocery store, supermarket, meat market, seafoodmarket, produce store
Other food sales	Q	Q	Retail bakery, other food sales
Food service	380	282.7	
Fast food	92	402.9	Fast food restaurant
Restaurant or cafeteria	179	306.3	Restaurant, cafeteria, dining hall
Bar, pub, or lounge	71	155.2	Bar, pub, lounge
Other food service	37	156.4	Catering service, coffee, bagel, or doughnut shop, ice cream or frozen yogurt
Health care	157	172.7	
Inpatient	10	231.1	Inpatient hospital, inpatient rehabilitation center, inpatient psychiatric care
Outpatient	147	94.8	
Office (diagnostic)	60	68.6	Doctor's or dentist's office that reported equipment for medical diagnosis or treatment
Clinic or other outpatient	87	105.3	Clinic, outpatient rehabilitation, veterinarian, cancer center, blood donation center
Lodging	158	96.9	
Hotel	30	100.4	Hotel
Motel or inn	61	71.8	Motel, inn, guest cottage
Dormitory, fraternity, or	25	78.4	Dormitory, fraternity, sorority
Nursing home or assisted	30	120.9	Nursing home, assisted living
Other lodging	13	73.3	Retirement home, convent, monastery, halfway house, shelter, children's home
Mercantile	602	88.9	
Retail (other than mall)	438	66.9	
Retail store	336	66.3	supplies, drugstore, bookstore, building supplies, auto parts, lumber, home improvement, farm equipment, lawn and garden, floral, crafts, gifts, antiques, pawn shop, wholesale club
Vehicle dealership	43	70.7	Dealership or showroom for vehicles or boats
Other retail	59	67.9	Beer, wine, or liquor store; rental center such as for equipment furnishings or movies; studio or gallery; showroom; wholesale supply
Enclosed and strip malls	164	109.3	
Strip shopping center	163	115.9	Strip shopping center buildings contain establishments that are operated independently of each other; strip shopping center buildings are reported at the building level in the CBECS

Principal Building Activity (Expanded)	# of bldgs x 1000	kBtu/SF- yr	Sub category, PBA+
Enclosed mall	1	67.5	Enclosed malls usually contain a few anchor stores, many smaller establishments, and indoor common area
Office	1,012	77.8	
Administrative or professional	558	84.4	Administrative or professional such as consulting, insurance, law, utilities, publishing, or college administration; non-profit or social services; religious office; research and development; sales or leasing office
Bank or other financial	91	85.7	Bank, credit union, home finance
Government	113	73.2	Government office, city hall, city center
Medical (non-diagnostic)	50	57.9	Doctor's or dentist's office that did not report equipment for medical diagnosis or treatment
Mixed-use	125	61.9	Mixed-use office
Other office	74	64.8	Call center; contractor's office such as construction, plumbing, or HVAC
Public assembly	352	86.3	
Library	24	99.5	Library
Entertainment or culture	51	90.7	Museum, theater, cinema, sports arena, casino, night club, aquarium, nature center, visitor's center
Recreation	100	77.6	Gymnasium, health club, bowling alley, ice rink, field house, indoor racquet sports, dance, gymnastics, martial arts
Social or meeting	135	61.1	Community center, lodge, meeting hall, convention center, senior center
Other assembly	41	123.0	Armory, broadcasting studio, exhibition hall, funeral home, student activities center, transportation terminal (airport, bus, or train station)
Public order and safety	84	92.2	
Fire or police station	69	72.4	Fire station, police station, or combination fire and police station
Courthouse or probation	6	94.7	Courthouse or probation office
Other public order	9	115.9	Jail, reformatory, penitentiary, ambulance dispatch
Religious worship	412	38.0	
Service	619	58.7	
Post office or postal center	30	48.7	Post office, postal center, mail processing
Repair shop	84	43.4	Upholstery, furniture restoration, metal shop, shoe repair, clothing alterations
Vehicle service or repair	214	62.9	Vehicle service, vehicle repair, tire center
maintenance	176	48.8	Vehicle storage and maintenance (car barn), boat storage
Other service	114	86.0	Beauty parlor, spa, salon, tanning salon, barber shop, building or grounds maintenance, car wash, copy center or printing service, dry cleaner, laundromat, gas station, kennel, animal shelter, pet grooming, mixed-use service, photo processing, embroidery, frame shop, light industrial
Warehouse and storage	796	32.8	
Nonrefrigerated	787	29.3	Non-refrigerated warehouse or storage
Warehouse	427	32.7	Warehouse
Distribution or shipping	151	30.1	Distribution, fulfillment, shipping center
Self storage units	209	14.9	Self-storage (each separate block of units is considered a building by CBECS definition)
Refrigerated	8	132.5	Refrigerated warehouse or storage
Other	125	142.9	
Laboratory	16	252.0	Laboratory such as biosciences or medical research
Other	109	109.7	Agricultural with some retail, manufacturing or industrial with some retail, airplane hangar, crematorium, data center or server farm, telephone switching facilities, bathhouse for a swimming pool, public restroom, locker-room
Vacant	296	12.7	Vacant (previously used for or intended to be used for commercial purposes)