STRATEGIES FOR TIME-OF-USE and DEMAND ELECTRIC RATES

ARTICLE

Managing electricity cost is different when rates are based on 'time-of-use' and 'demand', and this article is for anyone new to the terms. Understanding the concepts will help lead to ways to manage the cost.

For additional detail and more ideas on how to save, please visit csu.org / business section.

Electricity costs more to provide at certain times

Time-of-use (TOU) rates can be useful to both utilities and customers. Electricity does cost more at certain times, usually because those are times when everyone else is using a lot of electricity…system demand is high. By pricing the electricity higher during the busy times, customers have a financial incentive to use less at expensive times – often using more in the not-so-busy times to make up for it. Where customers can make changes to move usage to 'off peak' they save money; at the same time, the utility load is more even through the day which helps lower cost of the electricity. Win-win!

From Simple to Not Simple

The simplest rates create a bill from a single measurement, usually "per kWh', along with a portion of the bill that is a fixed amount. This works well when a customer group has very similar usage patterns – it also allows simple low-cost metering. Simple is good as long as it works to share costs fairly. When customers use electricity in much different ways than others, there can be different rates, different meters, more complex billing; alas, not simple any more, but more fair by knowing 'how and when' the electricity is used and not just the total energy for the month. This introduces billing terms like 'demand', 'on peak' and 'off peak'. On-peak and off-peak are easy to understand and examples will follow. "Demand' is not very intuitive and deserves a separate explanation. We'll talk about 'demand' first.

Demand

Electricity *demand* is the rate of energy use – if a day's energy use mostly occurs in a few hours, the short term demand is high compared to being spread out over the whole day. Utility equipment and cable sizes are determined by the size of the maximum electric demand – how fast the energy is used. Variable costs like fuel and maintenance go up and down with usage, but 'fixed costs' are the same regardless of usage. Demand charges follow utility demand costs which are fixed costs. There are other fixed costs like buildings, but the large cost of large equipment and cables are the largest portion of the demand charges. Some familiar examples will help.

- One way to view demand is cars: The energy required to drive from point A to point B is determined by distance, hills, the car's condition, and driving habits. Lots of factors. But buying a race car vs. a regular car and making the trip in 1-hour vs. 1-day means the fuel is used in a short amount of time – it also means a bigger engine.
- Another way to think about 'demand' is renting a generator. A customer with a large demand 'rents a bigger generator' than a customer with a small demand. The rental fee for the generator may be monthly or yearly but doesn't change if you use it a lot or a little. Using it a lot would mean adding more fuel, but the rental cost itself doesn't change.
- Back to the bill: On a demand rate, you will see 'per kWh' costs – these are variable costs which you can think of as fuel for the generator. Billing line-items that are 'per kW' are the demand charges – these are for fixed charges which you can think of as the size of generator rented. In cases where the peak demand occurs only for a short time, the 'rented generator' is oversized most of the month. When this happens, customers see demand charges being an unusually large portion of the bill - but what has really happened is the fuel cost is a small portion of the bill.
- Back to what to do about it: Clearly if there is some way to lower that short term demand, the customer could save money by renting a smaller generator. This concept of short term demands aggravating demand charges is useful when looking for ways to reduce demand charges. Oh, and demand charges are also divided into on-and-off-peak times, so a short term large demand in on-peak times is a double-whammy. Demand charges can seem annoying at first but they really do represent the cost of the service provided. Knowing what makes them tick is the first step in finding ways to manage the cost. Some ideas on controlling demand charges are provided at the end of the article.

Time-of-Use

The idea for time-of-use rates is to spread out the load to get the most out of our equipment and cables.

- Let's say it's a hot day in July and the air conditioning is running. Of course, so are a lot of other air conditioners. This is an example of a time-of-use that creates a large demand for the utility…when the cables and equipment are pushed to their maximum output. Compare this to night-time hours when many businesses are closed, and many people are asleep. The electricity use is much lower during these times. An 'on peak' period is a block of time when the utility equipment sees its highest demand and 'off peak' periods are the slower times. The cost to provide electricity is higher for on-peak times – a double whammy: air conditioners use more energy and use it during expensive times.
- Another example that is on its way involves electric cars. Imagine a day when most people have electric cars. Now, imagine us all plugging them in to charge at the same time…our planning

engineers are looking hard at this ‘perfect storm’ scenario of car chargers, worried it could cause an increase in equipment and cable sizes… obviously we would like to see car-charging loads *spread out* and mostly in off-peak hours. In the case of electric car charging, lower priced off-peak power will encourage customers to charge off-peak.

The TOU rates encourage customers to choose lower-cost times which also helps the utility spread out the load. We call these *price signals*. Lower off-peak pricing rewards customers who have the ability to choose when electricity is used. On-peak electricity is priced at the higher on-peak rates.

On-peak times (the expensive hours to avoid if you can) are tuned to the utility peak load. On-peak times can be different seasonally and can change over time.

Managing Electric Costs: Putting the Concepts to Work

Here are some basic things that you can try when your electric rate includes demand or time-of-use, or both. Many will be obvious, akin to the doctor visit joke that says ‘it hurts when I do this…… well then, don’t do that’, and when it seems that obvious it means you have studied the concepts well. Good job.

Sometimes the adjustments are just a habit change, like charging a car at midnight instead of 6pm. Others involve ‘giving something up’ like setting back a thermostat. For businesses the choices made must balance the desire to save with the need to maintain the business or process function. Check out the examples and you’ll probably think of more.

Ways to Save: Time-of-Use Rate

If the electric rate is time-of-use energy (kWh) only (no demand component), then the focus is energy use sub totals for the bill period in the on-peak and off-peak periods.

Unlike demand, if you do ‘energy’ things 29 days in a row and miss the last day, you still see the savings for the 29 days…. no ‘generator rental’ involved.

Examples to illustrate:

<u>Use less to begin with</u>

These all count. Highest per-hour savings will be from measures that reduce energy in the ‘on-peak’ times. Off-peak per-hour savings are lower but off-peak hours are higher.

- Higher efficiency lighting
- Higher efficiency air conditioning equipment
- Higher efficiency air compressor

- Turn things off when not needed including when facility is idle (ghost loads)
- Targeted maintenance such as entry door seals, leaking ductwork, oven door seals, cooler door seals, compressed air leaks
- Flow restrictors for heated water fixtures like hand-washing spouts or showers

Controls to use the electricity when needed vs. all the time.

- Scheduling and setbacks for HVAC
- Motion sensors for office lighting
- Heat lamps during meal hours vs. all the time
- Proximity sensors to blow compressed air on parts only when the parts are there
- Variable speed fans for HVAC and other varying loads, instead of constant steady use
- Control sequences that prevent simultaneous heating and cooling or other overlap

Fuel switching (lower cost energy source)

- HVAC electric heat replaced with gas heat
- Electric cooking equipment or process ovens replaced with gas heat
- Evaporative cooling instead of electric cooling
- Process vacuum pump instead of compressed air eductor

Load shifting (to use lower-cost energy)

- Operate electric- intensive process in off peak periods
- If you have on-site battery storage capability, charge them off-peak and use the energy on-peak

Automatic price-signal following (during peak periods)

- Dim lights slightly, temporarily
- Slow down a fan slightly, temporarily
- Alter a comfort set point slightly, temporarily

Ways to Save: Demand Rates

First, a word about coincidence and persistence.

'Coincidence' is needed for reducing demand charges. To see dollar savings from demand reduction requires being *coincident* with the otherwise-peak time for the bill period. For example if the monthly peak was is set at 3pm, a demand reduction at midnight won't help.

For dollar savings to occur from demand reduction, the measure must *consistently* reduce the otherwise-peak demand. For example, if the peak is normally set at 3pm each day, then demand reduction will occur from a measure that reduces demand at 3pm every time. Miss it once and alas you're still renting the larger generator. The demand charges can be set for the month if using the large demand even for 15 minutes.

Finally, pay attention to on-peak time, since that is where the biggest charges come from.

The on-peak requirement is rooted in the fact that demand charges are almost entirely focused on 'on-peak'. A quick look at one of your bills will confirm this. Consider LED parking lot lighting – almost all of these hours are off-peak and the few that are on-peak don't lower the highest on-peak, so dollar savings for reduced demand for this application would be zero. Dollar savings for LED exterior lights that run only at night are calculated from off-peak energy savings alone. By contrast, LED *interio*r lights that run each day and cover the on peak period *will* achieve on-peak demand dollar savings.

So, coincident and persistent demand reductions on-peak save on demand charges. All three are needed.

Some measures that save energy will not reduce demand charges – for example turning things off at night is a good idea - saves energy, just not demand. LED lighting for a parking lot is another example - the reduction does save energy and the demand of each is less but since the effect is only at night the on-peak demand cost is not reduced.

Some 'catch-all' measures inherently reduce demand charges. These are the least complex since they reduce demand 'all the time' which then incudes the expensive times.

Active measures that that use automatic controls to target demand charges can also be effective when they reduce short term on-peak demands.

In general, anything that allows renting a smaller generator for the month.

Examples to illustrate:

<u>Basic demand reduction</u>

- More efficient interior lights (demand savings all year)
- More efficient air conditioner (demand savings in summer)
- Window shading during periods of direct sunlight, especially west-facing glass in summer

<u>Controls to avoid large, short term demands</u>

- Load limiting on start-up, when starting the next large machine, and other step changes

Fuel switching (demand charge savings only for months that are affected, for example air conditioning benefit does not occur in winter)

- HVAC electric heat replaced with gas heat
- Electric cooking equipment or process ovens replaced with gas heat
- Evaporative cooling instead of electric cooling

Load shifting (to lower on-peak demand)

- Operate electric-intensive process in off-peak periods such as night shift
- If you have on-site battery storage capability, charge them off-peak and discharge on-peak

Load un-stacking (to avoid setting a peak demand)

- If two or more large electric loads exist, operate so they do not run concurrently

Automatic price-signal following (during times of highest on-peak demand)

- Dim lights slightly, temporarily
- Slow down a fan slightly, temporarily
- Alter a comfort set point slightly, temporarily

Visuals

Pictures combined with words can help the concepts sink in and lead to more ideas for savings. At the end of this article are some images we think will help.

Summary

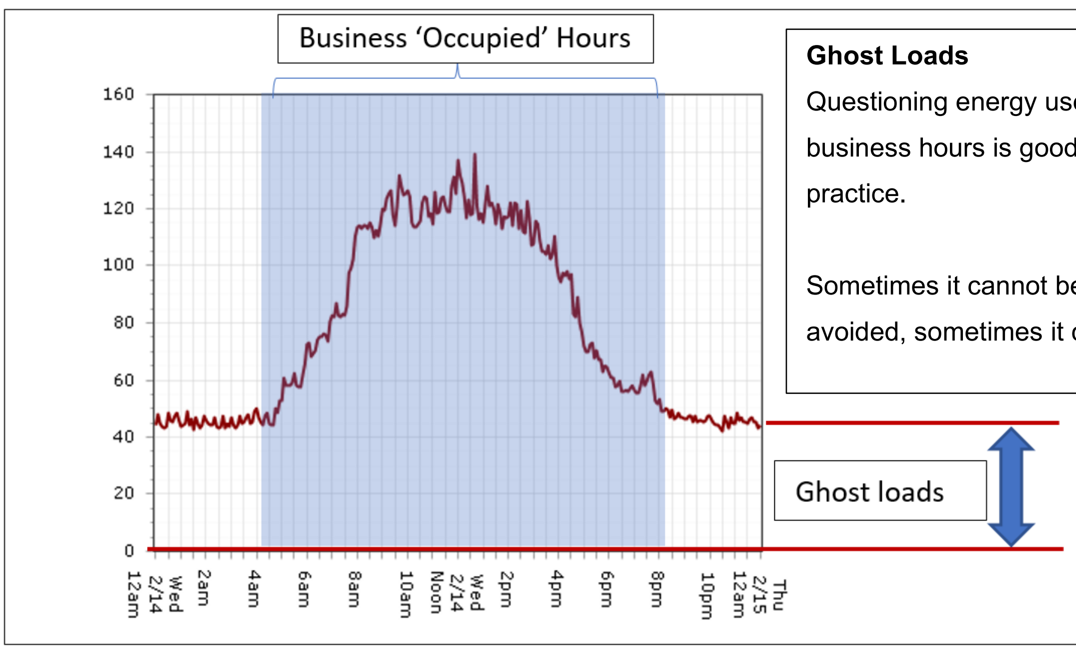
Demand and time-of-use are good indicators of actual utility cost and the extra level of detail allows fair distribution of the utility expense among customers. It does make the bill more complicated though. We hope this paper helps you to better understand the bill and spark some ideas on how to reduce it.

Demand vs. Energy

Both of these cars can drive up to Pikes Peak. One can do it at a nice leisurely pace, and one can do it 'now'. The energy needed to drive there is the same. The ability to do it quicker requires more power. Power is energy per unit of time.

For your electricity meter, kW is power, and kWh is energy (one kW of power for one hour).

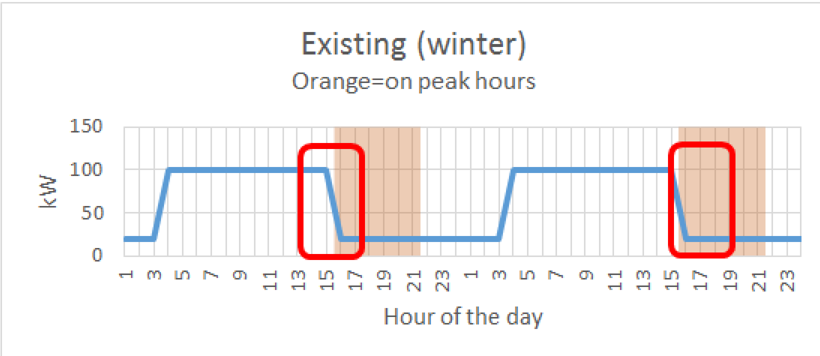
Same concept applies to water and natural gas: If you need a lot of it in a short time, you'll need a big pipe which costs more than a small pipe.

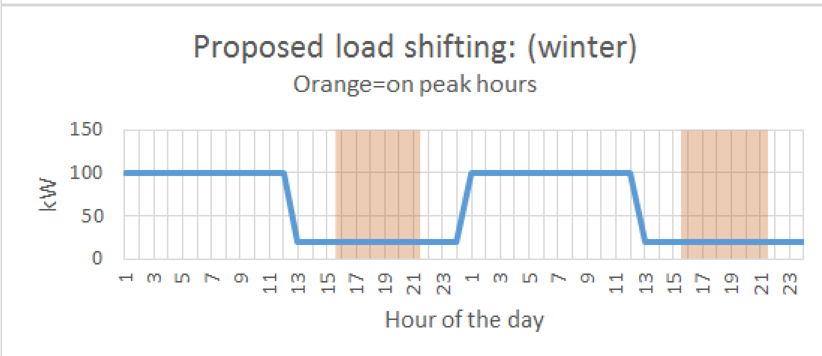


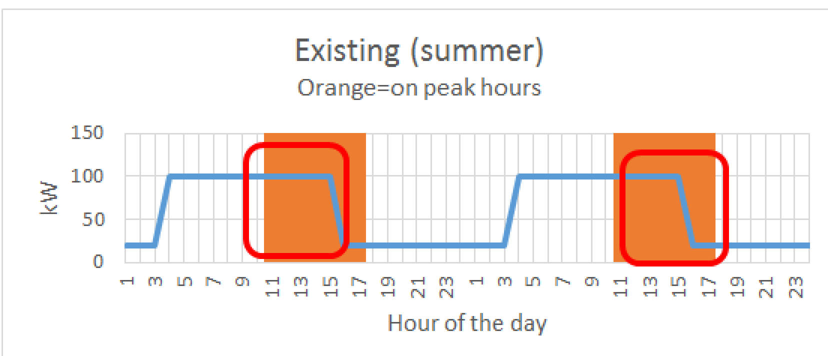
Ghost Loads

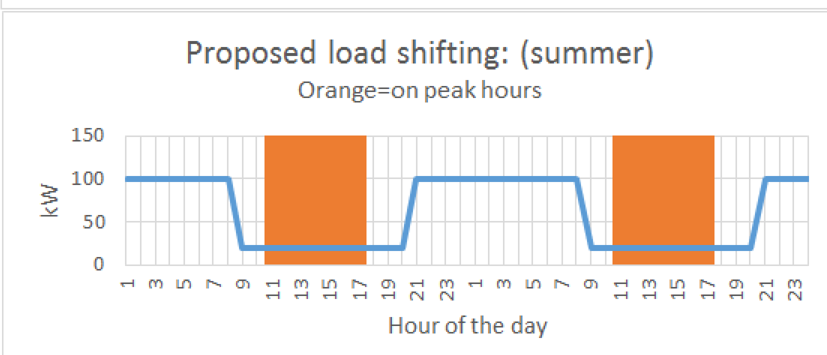
Questioning energy use outside business hours is good practice.

Sometimes it cannot be avoided, sometimes it can.







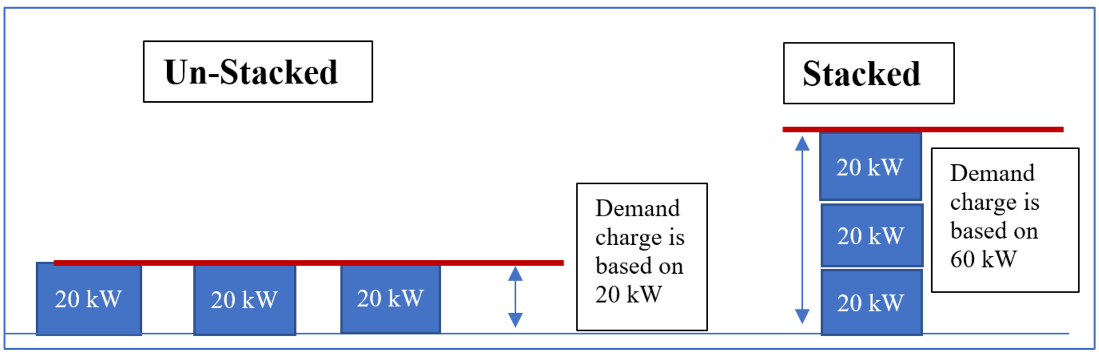


Time-Of-Use Strategies

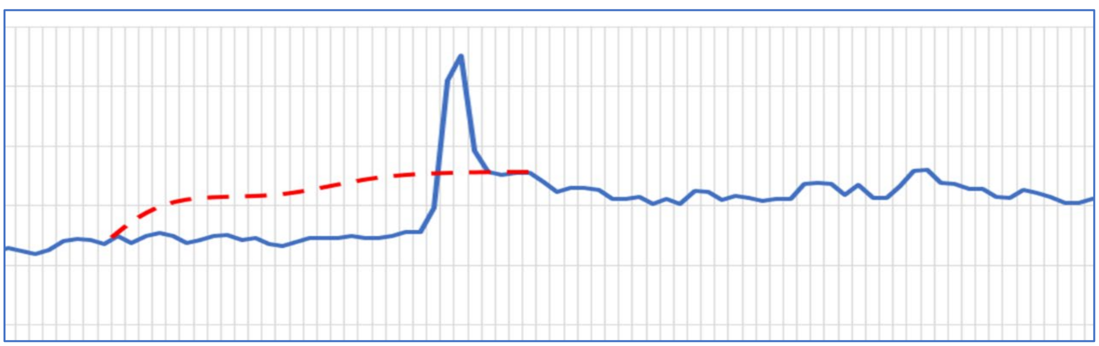
Here is a simplified example of saving money without changing energy use, just moving things around so they occur at different times when the cost is more favorable. The shaded areas are the 'on peak' times when electricity is most expensive. If possible, avoiding those times will save you money.

Demand Charge Strategies

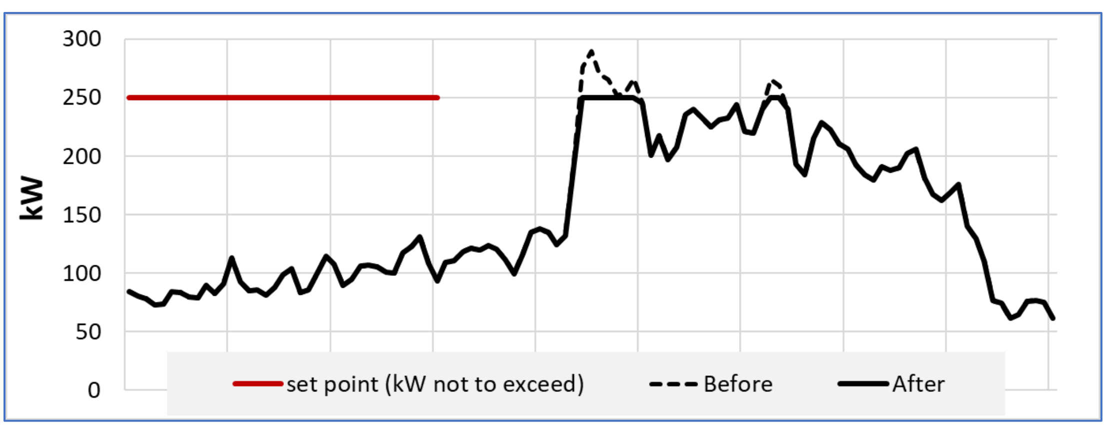
- Top: Load un-stacking. Where things don't run all the time, operating them so they don't all run at the same time will lower the demand. Just be sure to do it consistently to avoid 'renting the generator' for that one time you forgot. Automation is the key.
- Middle: Load-limiting. Here, automatic controls are shown throttling large electric loads on start-up. By doing the same work over a longer time period, short-term demand is reduced.
- Bottom: Peak-shaving. This requires automation to watch the demand and intervene when a peak is approaching. The utility peak is flattened by turning something off or injecting an outside energy source like thermal storage or discharging a battery.



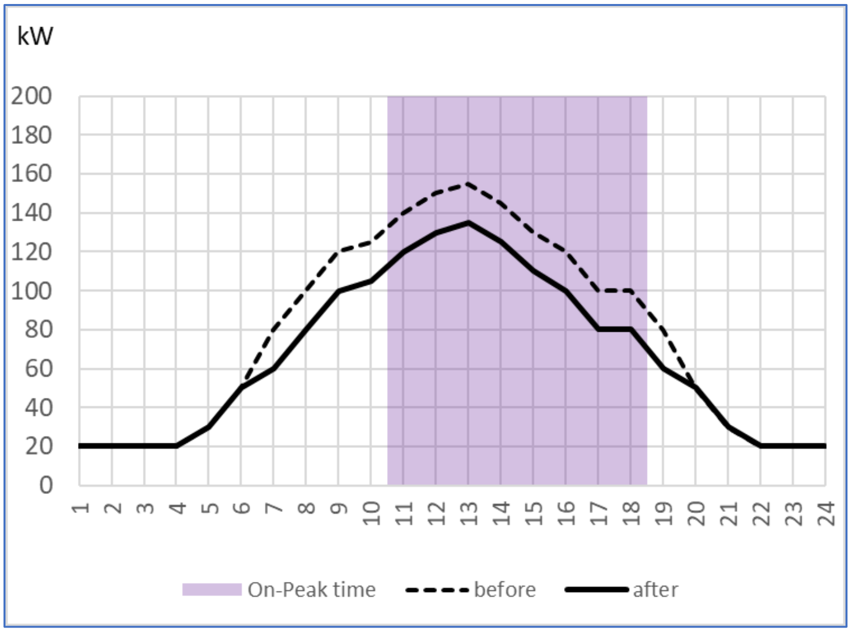
Load Un-Stacking



Load-Limiting



Peak-Shaving



Catch-All

Sometimes we get lucky.

Here, an efficiency measure is applied to a steady daytime load, lowering the whole curve. This catches energy and demand, on-peak and off-peak, all in one bite.

A common example is indoor lighting (more efficient lighting). Other examples can include constant flow HVAC fans (more efficient fans), and compressed air (fixed leaks)

Other efficiency measures that 'use less to begin with' have similar effect but only in their certain times, such as kitchen loads (during meal prep time), air conditioning (in summertime), etc.