What's Load Got To Do With It?

WHAT IS ELECTRIC LOAD / DEMAND

Electricity load / demand (the terms are interchangeable) is the amount of electricity needed (or demanded) at any given instant. Load / Demand is measured in Watts (see "A Watt by Any Other Name..."). The phrase "load on the grid" refers to the amount of electricity demanded from all consumers (residential, commercial, industrial customers, etc.) across the electric grid at a specific moment in time. This load can vary based on time of day, temperature, season or other variables, which is why there are terms such as "peak load" and "seasonal load".

Load/Demand = Generation/Supply

Load/Demand > Generation/Supply

LOAD & RELIABILITY OF THE GRID

The amount of electricity generated at any instant must at least equal the total amount of electricity demanded (load) to ensure grid reliability and integrity. If the difference between the load demanded and the amount generated deviates from this equilibrium then conditions can arise that could result in blackouts, brownouts or even damage to the grid infrastructure. This is why grid operators (ISOs) constantly monitor the demand/load and the amount of electricity available to ensure grid reliability and integrity.

WHAT LOAD ISN'T—CONSUMPTION

The key thing to remember about load / demand is that it is an instantaneous measure. It measures **how much electricity is demanded** at a specific moment in time. What load / demand isn't is consumption, which is the amount of electricity consumed over time and measured in Watt-hours (Wh).

WHY IS LOAD IMPORTANT?

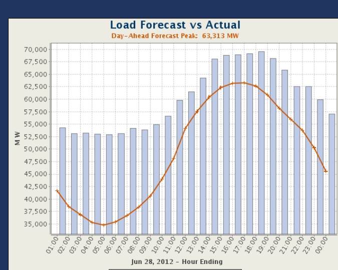
Electricity demand drives the whole energy system, influencing the total amount of energy used; the location of, and types of fuel used in the energy supply system; and the characteristics of the end use technologies that consume energy. It is important to note that, based on estimated demand, generators, transmission and distribution companies must build out reliable infrastructure (poles, wires, etc.) in order to meet customer demand and expectations.

PEAK LOAD

Peak load is the point where load on the system reaches its maximum. It can be measured at the grid level all the way down to the customer level. At the grid level, peak load is used for infrastructure planning purposes to ensure enough generation and T&D capacity are available to ensure grid reliability. At the customer level, it is used to ensure that the distribution infrastructure is sufficient to handle the anticipated load.

LOAD SHAPE

In the electric power sector, load shapes refer to the varying amounts of electricity demand at different points over a given time period (i.e., daily, weekly, seasonally, etc...). Load shapes vary by region, climate, and customer. Each day, balancing authorities—the entities charged with balancing electric supply and demand—forecast hourly electricity demand on their system for the next day. Using these load forecasts, they can develop resource schedules, or plans for the use of available power plants to generate the power needed to meet demand. Load shapes are often used to forecast electricity demand in utility planning.



LOAD IMPACTS

The biggest drivers of electricity demand are population, the weather, economic activity, and daily patterns of human activity. The first two factors affect electricity demand over periods of years or longer. The weather and human activity patterns (e.g., it is warmer in the summer than in the winter, and people tend to move around during the day and sleep at night) influences electricity demand from hour to hour and from day to day.

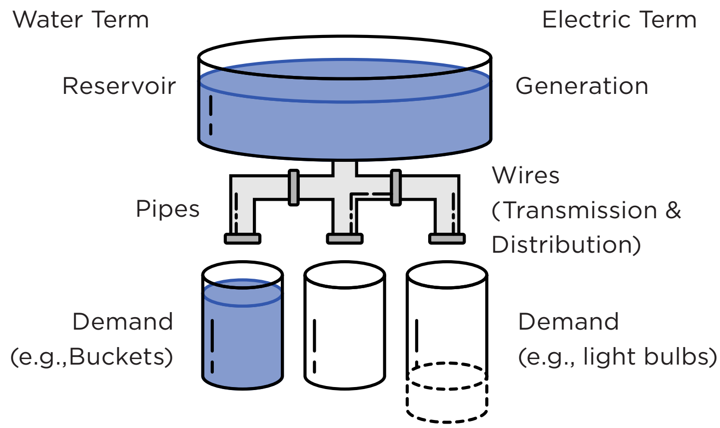
What’s Load Got To Do With It?

Like Water for Electricity

WHAT’S LOAD…

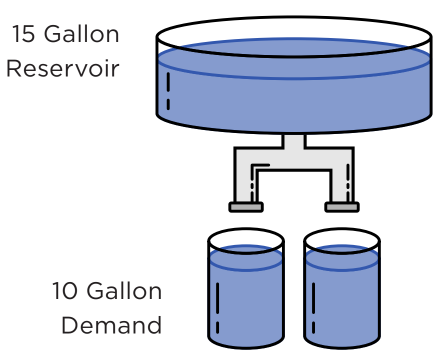
The concepts of instantaneous demand versus consumption of electricity and the impacts to the grid are not easy concepts to grasp. However, if you think of electricity as water instead of electrons it makes a bit more sense…

Imagine a system where we could instantaneously generate up to 15 gallons of water. In that system there were also 3 buckets of 5-gallons each that could instantaneously demand 5-gallons of water. When one bucket “turns on” then it places an instantaneous 5-gallon demand on the system, which our reservoir (generator) is able to meet because we have a 15 gallon capacity (see figure to right). Our pipes are also built to be able to handle the demand as they were built to be able to deliver 15 gallons instantaneously.



However, if we were to expand one of the buckets to 6 gallons without making appropriate changes to generation or infrastructure, it would over power the system. The reservoir wouldn’t have enough water to fill all the bucket and the pipes wouldn’t be big enough to handle the extra water. In this instance the 6 gallon bucket would experience a water shortage.

The same is true in electricity, if the generation and infrastructure aren’t sized to handle the maximum (peak) load/ demand, then you’ll have **brownouts** or even **blackouts**.



…BUT A SNAPSHOT OF CONSUMPTION

In the previous example water was used to demonstrate demand, but what about consumption? If we still assume the same basic structure (15-gallon reservoir and 5-gallon buckets) we can see in the diagram to the left that we have a system that is demanding 10 gallons of water (5 gallon buckets x 2 = 10 gallon demand). Our system can handle this demand because the reservoir can generate up to 15 gallons of water instantaneously. Currently, it only needs to generate 10 gallons to handle the demand so the system is in balance.

However, consider the situation where the buckets immediately start to consume the water poured into them. That would mean we would have to consistently add water to them to keep them filled. You could say that each bucket needs to consume 5 gallon hours (a consistent demand of 5 gallons for a period of 1 hour of time) or say that the system has a total consumption of 10 gallon hours.

This is a scenario very similar to electricity where a 20 Watt CFL bulb (our electric buckets) need to be consistently fed 20W of electric power to stay on. If the light was powered over an hour that would be 20 Watt-hours of electricity. If you had 100 such light bulbs the demand would be 2,000 Watts (20 Watts x 100) or 2 Kilowatts (kW - kilo being prefix for 1,000). If all of those lights were kept on for 1 hour that would be 2 kilowatt hours (2 kWh) of electricity consumed.