ENERGY & UTILITIES

Electricity Metering & Sub-Metering Concepts and Applications

BuildingsOne | April 30, 2018

The measurement of base building systems and tenant-specific equipment electricity consumption, through sub-metering applications, is increasing in importance within the commercial real estate industry. With a continued emphasis in energy initiatives, such as Leadership in Energy & Environmental Design - LEED, "*how much and when we use energy"* is becoming even more important to the real estate manager-operator.

With electricity representing the most widely used building energy resource and often the greatest building operating expense, advancements in metering technology is playing a significant role in how we effectively manage the consumption of electricity in an environmentally prudent and cost effective manner. A significant technological advancement, in web-based electrical metering development, is the ability to measure and monitor electricity on a real-time basis.

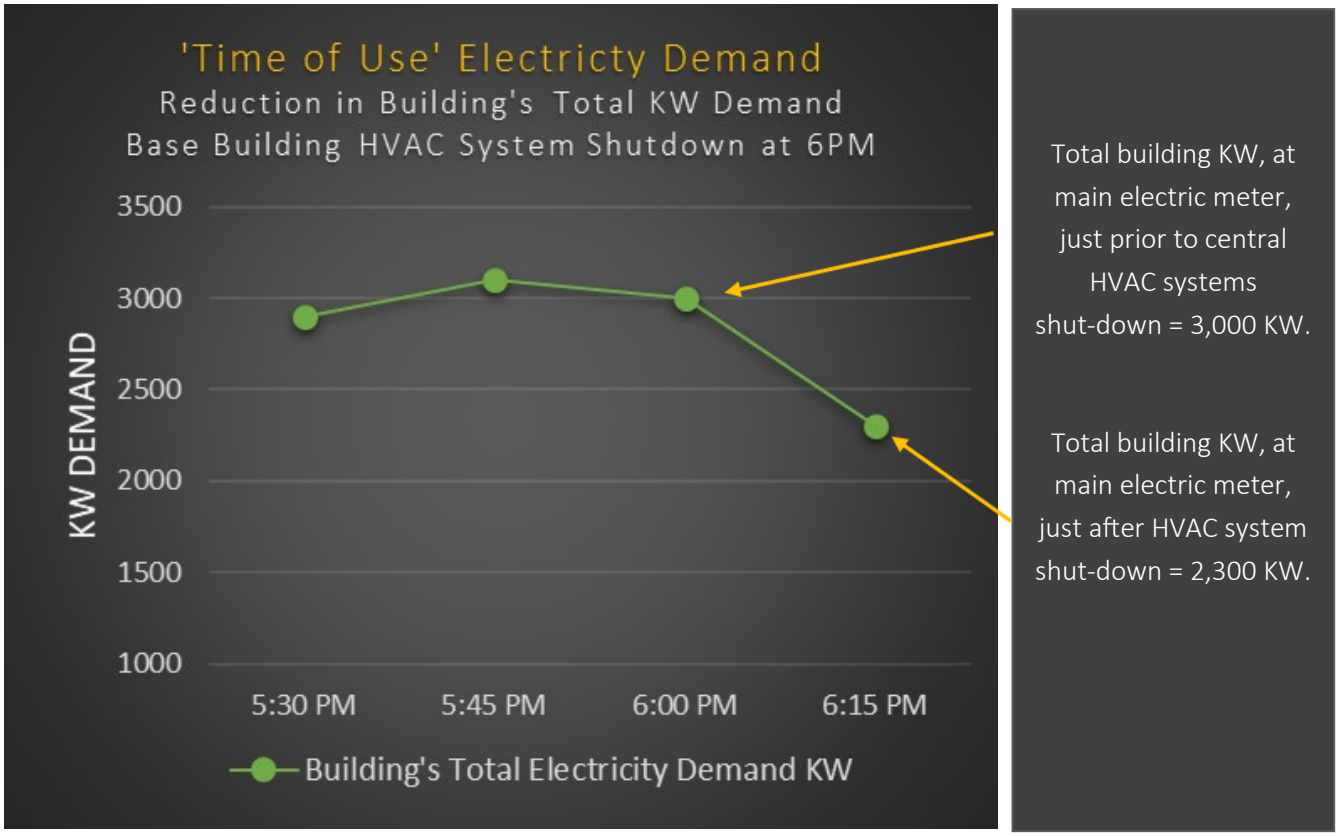
"Computerized metering systems, coupled with internet-based platforms, provide property owners and operators with instantaneous electricity demand consumption information in their office or mobile device".

Because electricity can't be stored on the national electric grid, the actual costs associated with its generation, transmission, and delivery is very much dependent on when the electricity is consumed. In **periods of high demand**, generally weekday business hours particularly during times of extreme warm or cold outside air temperatures, electricity generated by primary power facilities' reserve capacity and alternative power plants' additional capacity is **significantly more costly** than in periods of average and lower demand. Building owners and managers, with opportunities to consume or shift power to lower demand periods, should take advantage of the benefits of metering technology in order to measure and pay for building electricity consumption at relatively lower off-peak rates.

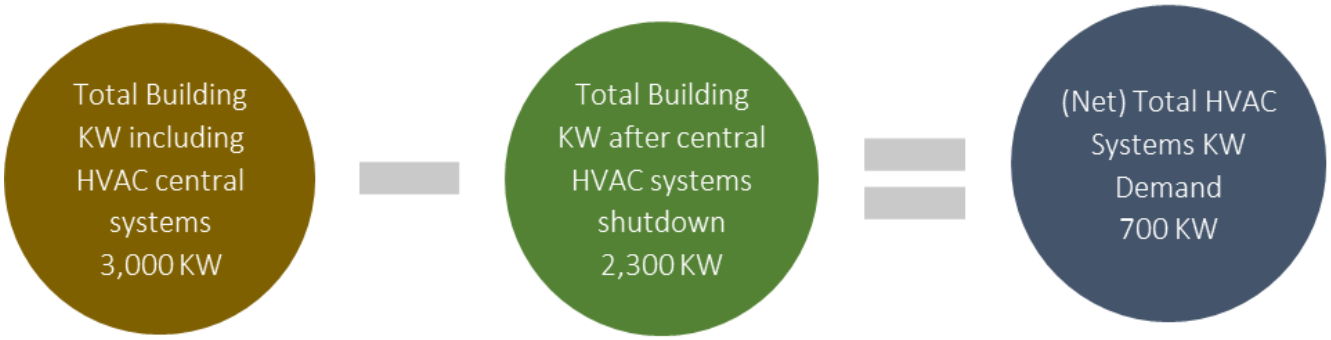
Electricity Metering & Sub-Metering Concepts and Applications

The continuous measurement of electricity consumption technology is referred to as **Time of Use 'TOU' metering**. While the costs associated with implementing time of use metering should be evaluated against the potential cost savings associated with relatively lower (off-peak) electricity rates - *payback analysis* - this technology is often a worthwhile investment when implemented at the building's primary main electric meter. Time of use metering provides many other advantages in addition to the potential benefits associated with off-peak consumption and pricing.

At a typical property, the HVAC system's electricity cost represents a significant portion of building operating expenses. Determining a building's HVAC equipment KW design rating (convert equipment horsepower to KW), then multiplying the utility electricity rate in $ / KWH, is one method of estimating the HVAC system's electricity consumption and cost. For properties monitoring electricity demand at the main electric meter, the graphic below illustrates how the building operator can estimate the building's HVAC system electricity demand (in KW) on a macro analysis basis.



HVAC SYSTEM - ELECTRICITY KW DEMAND (see chart on preceding page)	
KW Demand - Entire building electricity **including base building HVAC systems < 6PM** Common area & tenant lighting, tenant outlets, elevators + HVAC.	3,000 KW
KW Demand - Entire building electricity **not including HVAC systems > 6PM** Common area & tenant lighting, tenant outlets, elevators (with no HVAC)	2,300 KW
Difference = Total Building **HVAC Systems Electricity Demand**	700 KW

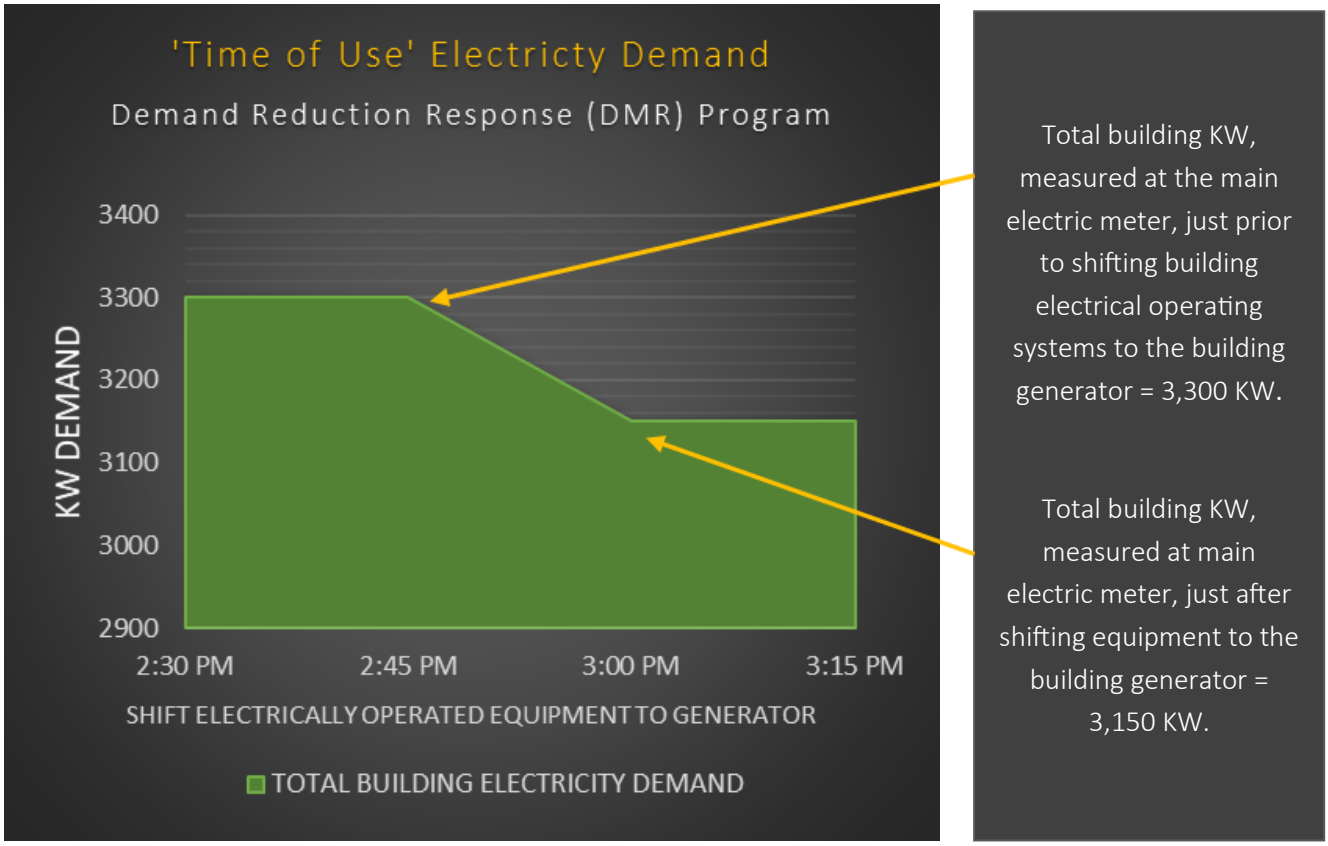


The real estate manager | operator can now calculate the estimated hourly cost of the base building HVAC System = KW Demand X Electricity Rate.

At an electricity rate of $.10 per KWH the cost is 700 KW x $.10/KWH = $70/hour.

Electricity Metering & Sub-Metering Concepts and Applications

The chart below depicts how time of use metering can benefit a building owner participating in an electricity **Demand Reduction Response** (DMR) program. The electric meter measures the instantaneous electricity use, Demand, enabling the building owner | operator to calculate the reduction in electricity, following a *source shift* of electrically operated building systems and equipment from the local power grid to the building's stand-by generator. This reduction in electricity demand would result in the utility provider's incentive payments to the building owner based on the reduction in KW



ELECTRICITY DEMAND RESPONSE REDUCTION PROGRAM (see chart above)	
Building KW demand **prior to** shifting electrical load to the building standby generator	3,300 KW
Building KW demand **after** shifting electrical load to the building standby generator	3,150 KW
Difference = KW load shifted to the generator (KW demand reduction)	150 KW

Sub-Metering of Tenant Electrical Loads

Incorrect metering and measurement of **tenant equipment's**, e.g., supplementary AC units, electricity consumption, is not uncommon in commercial buildings. The majority of problems occur during the initial installation of the electrical sub-meter. The property owner-operator should provide sub-meter program installation policies to the equipment installation project team, closely oversee the process, and inspect and certify the metering process when complete. Routinely encountered electrical sub-meter installation problems include:

Installing the sub-meter on the incorrect electrical circuit

Example: On an air-cooled (split system) AC unit, installing the sub-meter on the evaporator unit only (estimated 20% electricity consumption capture). The compressor-condensing unit is located in a separate location from the evaporator unit and typically consumes an estimated 80% + of the total AC unit electricity.

Sub-meter wires not connected properly to the electrical circuit

For applications with multiple electrical panels and circuits, consider a balanced approach: sub-metering 90% of a tenant's excess electrical load, through installation of one main electric sub-meter, rather than installing 8 small sub-meters. For example, installing one primary electricity sub-meter at the main power feed to a tenant data center in order to sub-meter the data center equipment and the supplementary HVAC unit cooling the data center.

"When sub-metering tenant electrical equipment, aim to sub-meter as much equipment as possible on one meter (consolidate electrical circuits) to lower the cost of metering equipment and installation, while also simplifying the labor and administrative costs associated with monthly meter readings and tenant billings".

Electricity Metering & Sub-Metering Concepts and Applications

In broad terms, the building operator's understanding of

What equipment is being metered? Does the sub-meter charge associated with that equipment make sense?

will provide the best results in ensuring accurate sub-meter installation, meter readings, and tenant billing.

Benchmarking sub-metered electricity consumption, and charges against the system-equipment being metered, is the preferred method. The benchmarking process will provide the manager | operator with a general range of estimated operating costs for common types of electrically-sourced systems and equipment. There are operating variables that will effect actual electricity consumption of sub-metered systems and equipment. For example, a tenant AC unit's consumption will vary based on factors such as the average cooling load and how many hours the unit operates. A tenant conference room AC unit may operate predominately in the warmer summer months resulting in much lower electricity consumption in winter months. Consumption and cost benchmarking is not intended to provide precise comparison information, however, it is a practical and worthwhile process for the property owner-operator team.

Some routinely encountered electrical sub-meter reading and billing administration problems include:

- Incorrect multiplier input on the meter reading sheet
- Inoperable or malfunctioning meter - not noticed, communicated, or reviewed between the engineer-maintenance technician reading the meter and the property manager-administrator conducting the electrical sub-meter administration
- Incorrect meter reading or meter reading workbook (excel) calculations

Recording the correct **meter multiplier** is critical in the accuracy of meter consumption, reading, and billing. A meter multiplier is used in order to correspond with the selection and sizing of a meter's internal measurement components, which is based upon the expected amount of electricity flow. If an electrical sub-meter with a multiplier of 8 is not entered correctly in the meter billing sheet, the result is a sub-meter billing of $100 vs $800 (8X billing error).

HVAC Energy & Operating Expense Calculations Workbook {excel template} is available in BuildingsOne library of documents. This workbook provides practical information and formulas to support the commercial real estate manager | operator in the calculation of utilities and other expenses associated with the operation of base building HVAC systems.