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5.6.2 Managing Utility Costs

Utility bills for large facilities include demand charges that can amount to one-third of monthly electricity costs. Demand, measured in kilowatts, is the average electrical load over a small period of time, usually 15 or 30 minutes. Facilities are billed for the largest peak demand during the billing period. Electrical demand peaks can be lowered in several ways: shedding unneeded loads, rescheduling loads, staging equipment start-up, generating power on-site, or switching to another fuel. Keep in mind that there will be a lot of changes in the coming years as a result of utility deregulation (restructuring). In restructured power markets, some innovative market-based utility partnerships are emerging with large power users. At the same time, however, volatile energy prices are likely to be reflected in prices increases to customers.

Opportunities

Facilities with low load factors or steep load-duration curves are the best candidates for cost-effective peak shedding. Facilities using energy management and control systems may already have most of the hardware and software needed to institute a load-shedding program. As utility restructuring becomes more common, look into innovative load-shedding arrangements with utility companies—e.g., apportioning some load as interruptible and selling to the utility company the right to shed that load during peak-demand periods; such arrangements can be very attractive financially.

Technical Information

Utility tariffs usually encourage demand control and load shifting. Facility managers should understand how their facilities are charged for power and energy (be aware that with utility restructuring, there are likely to be significant changes in the coming years). Here are three utility pricing elements common today:

- **Demand charges** are based on the highest monthly power peak, measured in kilowatts (kW). All but the smallest facilities will be billed for demand. This charge reflects the electric utility's infrastructure cost of power generation and transmission and the more expensive fuels used in peaking plants. Summer-peaking utilities tend to have higher summer demand changes, and winter-peaking utilities (increasingly rare) have higher demand charges during winter months.
- **"Demand ratchets"** are minimum demand bills based on some percentage of the highest peak power metered over the preceding year. Thus, one month's high demand can affect monthly charges for an entire year.
- **Time-of-Use (TOU) tariffs** offer discounted rates for power used at times the utility establishes as off-peak. The difference in energy charges (per kWh) between on-peak and off-peak power can be a factor of two to four.

DEMAND SHEDDING

Demand-shedding or peak-shaving strategies include purchasing smaller, more efficient equipment; altering the on-times of existing equipment; switching fuels during peak periods; and generating power on site. Some popular strategies are as follows:

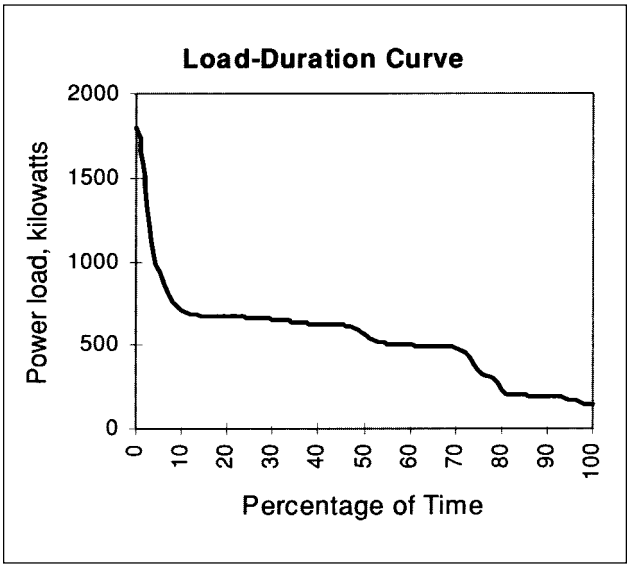
- **Duty-cycling** strategies attempt to limit the operation of equipment to certain times within a utility's demand period. Duty cycling has limited application because of stresses on frequently cycled equipment and the effect on the building or its systems. For instance, duty cycling of cooling tower motors would allow the chilled water temperature to rise. Cycling a ventilation fan might compromise indoor air quality or adversely affect building pressures.
- **Demand limiters** shed loads in a preestablished order when demand targets are about to be exceeded. Two main algorithms are used: simple and predictive (or slope-sensitive). Simple demand limiters can result in undesirably high load-shedding frequencies and cannot control demand closely.
- **Generators** can be used to keep equipment operating while off-grid. If the same generators provide emergency backup power, precautions must be taken to ensure that emergency power is available even during peak periods. If critical loads also contribute to facility peaks, consider shifting these loads to generator power during peak periods.
- **Dual-fuel heating and cooling** equipment can provide a nonelectric means of meeting space-conditioning requirements during times when using electricity would be expensive. For example, hybrid cooling systems, fueled by either natural gas or electricity, can dramatically lower electricity demand by using natural gas at peak hours.

- **Battery storage** generally is not cost-effective for peak reduction unless batteries are in place for other purposes. One situation where battery storage may make sense is for off-peak charging of forklifts that are used during daylight hours.
- **Thermal storage** involves storing thermal capacity generated off-peak for on-peak use. During the peak periods of the day, circulating water is cooled by ice baths or chilled water tanks (instead of chillers) to provide space or process cooling. Precooling a building at night before a predicted hot day so that chillers will not have to work as hard is another form of thermal storage. Water storage is not as common as ice storage because of the extra volumes needed to store thermal energy without phase changes.
- **Dispatchable load shedding** is a direct load-control technique in which the utility controls the times that a customer's equipment is shed under a prearranged agreement. Such arrangements can benefit both parties and justify on-site generation or alternative fuels. In some cases, the utility company may sell that additional power, taking advantage of price spikes in wholesale power markets and sharing a portion of the windfall profits with the facility. With utility restructuring, look for innovative market-based load management arrangements such as this.
- **Cogeneration** of electricity and steam from gas turbines and other power-generation technologies may be cost-effective for large facilities.

Facilities with steep load-duration curves are well suited for applications of peak-shaving technologies. Load-duration curves, such as the one shown in this section, are generated by sorting electrical loads recorded for each hour of the year. Data may be available from the electrical utility or from the facility's energy management system.

Track load factors each month to check utility demand charges. The formula for calculating the load factor is shown below. Load factors greater than 100% are impossible and indicate metering or billing problems. Load factors that suddenly deviate from historical values also indicate problems. If problems are found, recheck the billing information and contact the utility.

$$\text{Load Factor} = \frac{\text{Monthly kWh}}{\text{Monthly peak kW} \times 24 \times \text{No. of days in billing period}}$$



High loads, occurring only a small percentage of the time, can lead to very high demand charges.

If the facility has a high minimum-demand billing, find out if the utility has a "ratchet release" provision to reset the minimum demand to a lower level based on measures implemented by the facility.

☑ **With the use of daylight-linked dimmable lighting ballasts,** both lighting and subsequent chiller loads can be reduced. Allowing temperature and humidity to drift slightly is another effective strategy. According to ASHRAE, one-hour excursions out of the standard comfort envelope will be unnoticeable to most building occupants.

Contacts

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