The Efficient Use of Energy

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1. Introduction

Utility company power bills are usually a large part of the operating expenses of a facility. To reduce the amount of money spent each month on electricity, engineers must understand the billing methods used by the utility. Saving energy is more complicated than simply turning off unnecessary lights. The amount of money that can be saved through a well-planned energy conservation effort is often substantial. Reductions of 20% are not uncommon, depending upon the facility layout and the extent of energy conservation efforts already under way. Regardless of any monetary savings that might be realized from a power-use-reduction program, the items discussed here should be considered for any well-run facility.

The rate structures of utility companies vary widely from one area of the country to another. Some generalizations can be made, however, with respect to the basic rate-determining factors. The four primary parameters used to determine a customer's bill are

- Energy usage
- Peak demand
- Load factor
- Power factor

These items often can be controlled, to some extent, by the customer.

2. Energy Usage

The kilowatt-hour (kWh) usage of a facility can be reduced by turning off loads such as heating and air conditioning systems, lights, and office equipment when they are not needed. The installation of timers, photocells, or sophisticated computer-controlled energy-management systems can make substantial reductions in facility kWh demand each month. Common sense will dictate the conservation measures applicable to a particular situation. Obvious items include reducing the length of time high-power equipment is in operation, setting heating and cooling thermostats to reasonable levels, keeping office equipment turned off during the night, and avoiding excessive amounts of indoor or outdoor lighting.

Although energy conservation measures should be taken in every area of facility operation, the greatest savings generally can be found where the largest energy users are located. Transmitter plants, large machinery, and process drying equipment consume a huge amount of power, so particular attention should be given to such hardware. Consider the following:

- Use the waste heat from equipment at the site for other purposes, if practical. In the case of highpower RF generators or transmitters, room heating can be accomplished with a logic-controlled power amplifier exhaust-air recycling system.
- Have a knowledgeable consultant plan the air-conditioning and heating system at the facility for efficient operation.
- Check thermostat settings on a regular basis, and consider installing time-controlled thermostats.
- Inspect outdoor-lighting photocells regularly for proper operation.
- Examine carefully the efficiency of high-power equipment used at the facility. New designs may offer substantial savings in energy costs.

The efficiency of large power loads, such as mainframe computers, transmitters, or industrial RF heaters, is an item of critical importance to energy conservation efforts. Most systems available today are significantly more efficient than their counterparts of just 10 years ago. Plant management often can find economic justification for updating or replacing an older system on the power savings alone. In virtually any facility, energy conservation can best be accomplished through careful selection of equipment, thoughtful system design, and conscientious maintenance practices.

3. Peak Demand

Conserving energy is a big part of the power bill reduction equation, but it is not the whole story. The *peak demand* of the customer load is an important criterion in the utility company's calculation of rate structures. The peak demand figure is a measure of the maximum load placed on the utility company system by a customer during a predetermined billing cycle. The measured quantities may be kilowatts, kilovolt- amperes, or both. Time intervals used for this measurement range from 15 to 60 min. Billing cycles may be annual or semiannual. (*Figure 1.1*) shows an example of varying peak demand.

If a facility operated at basically the same power consumption level from one hour to the next and One day to the next, the utility company could predict accurately the demand of the load, and then size its equipment (including the allocation of energy reserves) for only the amount of power actually needed.

For the example shown in the figure, however, the utility company must size its equipment (including allocated energy reserves) for the peak demand. The area between the peak demand and the actual usage is the margin of inefficiency that the customer forces upon the utility. The peak demand factor is a method used by utility companies to assess penalties for such operation, thereby encouraging the customer to approach a more efficient state of operation (from the utility's viewpoint).

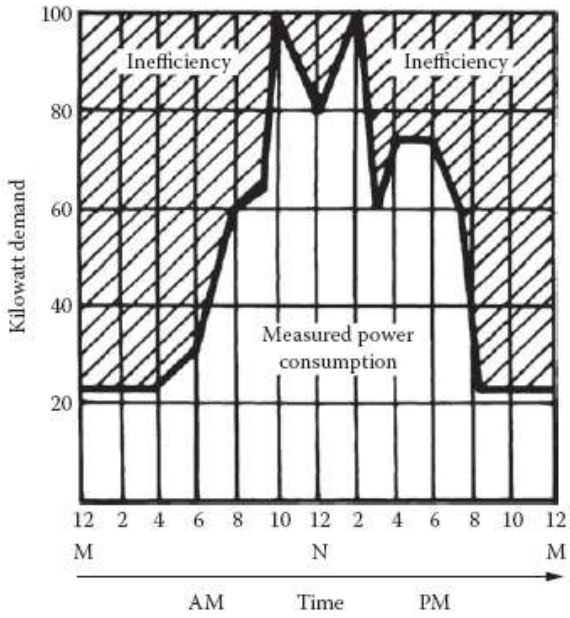

Figure 1.1: The charted power consumption of facility not practicing energy-management techniques. Note the Inefficiency that the utility company must absorb when faced with a load such as this.

Load shedding is a term used to describe the practice of trimming peak power demand to reduce high-demand penalties. The goal of load shedding is to schedule the operation of nonessential equipment so as to provide a uniform power load to the utility company and, thereby, a better kWh rate. Nearly any operation has certain electric loads that can be rescheduled on a permanent basis or deferred as power demand increases during the day. (*Figure 1.2*) illustrates the results of a load-shedding program. This more efficient operation has a lower overall peak demand and a higher average demand.

Peak demand reduction efforts can cover a wide range of possibilities. It would be unwise from an energy standpoint, for example, to test high-power standby equipment on a summer afternoon, when air-conditioning units may be in full operation. Morning or evening hours would be a better choice, when the air-conditioning is off and the demand of office equipment is reduced. Each operation is unique and requires an individual assessment of load-shedding options.

An automated power-demand controller provides an effective method of managing peak demand. A controller can analyze the options available and switch loads as needed to maintain a relatively constant power demand from the utility company. Such systems are programmed to recognize which loads have priority and which loads are nonessential. Power demand then is automatically adjusted by the system, based upon the rate schedule of the utility company.

4. Load Factor

The load factor on an electric utility company bill is a product of the peak demand and energy usage. It usually is calculated and applied to the customer's bill each month. Reducing either the peak

demand or energy usage levels, or both, will decrease this added cost factor. Reducing power factor penalties also will help to reduce load factor charges.

5. Power Factor

Power factor charges are the result of heavy inductive loading of the utility company system. A poor PF will result in excessive losses along utility company feeder lines because more current is required to supply a particular load with a low PF than would be demanded if the load had a PF close to unity. The power factor charge is a penalty that customers pay for the extra current needed to magnetize motors and other inductive loads. This magnetizing current does not show up on the service drop wattmeter. It is, instead, measured separately or prorated as an additional charge to the customer. The power factor penalty sometimes can be reduced through the addition of on-site PF correction capacitors.

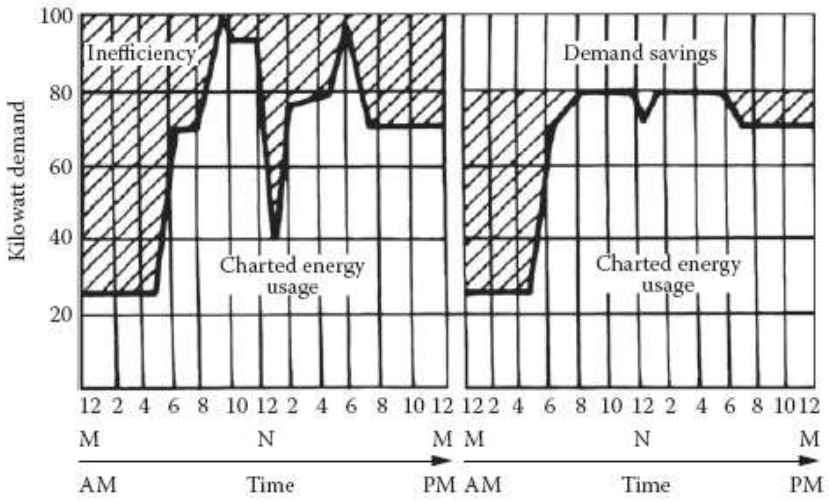

Figure 1.2: An example of the successful application of a load-shedding program. Energy usage has been spread more evenly throughout the day, resulting in reduced demand and, consequently, a better rate from the utility company.

Power factor meters are available for measurement of a given load. It is usually less expensive in the long run, however, to hire a local electrical contractor to conduct a PF survey and recommend correction methods. Possible sources of PF problems include transmitters, blowers, air conditioners, heating equipment, and fluorescent and high-intensity discharge lighting-fixture ballasts.

6. Reference

1. Lawrie, R.H., Practical Guide to Electrical Energy Costs.