3. Understanding Energy Cost Structure

Most utilities offer commercial customers different billing options depending on the level of energy used by the customer as well as the variation in the usage pattern. To determine the best billing method for a specific user, a customer service representative reviews the last 12 months of energy use and considers significant changes, if any, to future usage patterns. A brief explanation of the common factors included in a commercial billing plan follows.

3.1 Electrical Peak Demand Charges

Electrical demand is measured in kilowatts (kW). Peak demand is the highest average kW usage during any one-demand interval (usually a 15- or 30-minute period) of the billing cycle. Utility companies are concerned with peak demand because the size of the equipment they use to generate and transmit electricity must be sufficient to handle the peak demand of its customers. For this reason, a portion of the charges from many utilities is based on peak demand. Billing rates for peak demand vary greatly by billing plan.

Ratchet Clause
Sometimes peak demand charges are based on the highest average peak demand in one demand interval during the past year (or during the summer months). This is known as a "ratchet" clause. In such cases, electric charges will be impacted <u>every</u> month for a single 15-minute period of high demand during the past year (or the last summer month period).

3.2 Managing Peak Demand

Although it may not always be easy, there are ways to manage peak demand. Strategies include:

- sequenced start-up
- staggered or deferred usage
- sheddable loads
- permanent reduction of on-going loads

As the term implies, "sequenced start-up" means starting equipment at different times during the beginning of a shift. This lowers the overall demand for electricity at one time, eliminating (or at least reducing) peak demand charges. In addition, if multiple pieces of equipment require less than full-time operation (i.e. less than eight hours in a single shift or 24 hours in a three-shift operation), it may be feasible to stagger their use. In multiple shift operations, it may be possible to reduce peak demand by performing energy-intensive processes on different shifts. For example, a compressor driven by a large motor might run on a shift opposite a large pump that is also driven by a large motor, therefore reducing peak demand charges and overall energy costs.

Categorizing demand as either essential or non-essential can also result in energy savings. When discontinued for short periods of time, non-essential or "sheddable" loads lower energy usage without reducing productivity or comfort. Some examples include electric heaters, air conditioners, pumps, snow-melting equipment, compressors, and water heaters.[15] It is possible to install monitoring equipment that alerts the energy manager when demand reaches a predetermined range, so that he or she can decide whether or not to begin shedding loads. Shutting down or restricting the sheddable loads once a certain demand in kW is reached can significantly reduce peak demand charges.

Any ongoing load that is reduced or eliminated during the peak will cut total usage and also reduce the peak. A good example is switching from traditional overhead lighting to newer cost-effective, energy-efficient lighting.

3.3 Electrical Energy (Usage) Charges

The kilowatt-hour (kWh) is the basic unit of electrical power usage/consumption. Most utilities offer industrial customers a lower price per kilowatt hour (kWh) as consumption increases. The price typically changes at fixed levels of usage, so that there are two or more usage tiers. For example, in a three-tier system, the first 250 kWh may be billed at a one rate, the next 750 kWh at a somewhat lower rate, and any usage in excess of 1000 kWh is billed at an even lower rate.

Usage tiers may change depending on the time of year. In the summer there may be only one tier while the winter months may have multiple tiers. The cost of energy in each tier is also likely to change depending on the time of year. There may also be a change in costs depending on the time of day the energy is used. For example, a kWh consumed during “on peak” hours may have a higher charge than a kWh consumed during “off peak” hours.

One method of billing actually combines peak demand with energy usage. In this method, the number of hours in each tier is multiplied by the peak demand to determine the number of kilowatt hours charged at the rate for that tier. Since this type of billing also contains a separate demand charge, reducing peak demand can significantly reduce the total cost of electricity.

3.4 Reactive Demand Charges

Commercial customers like chemical manufacturers use a lot of equipment (induction motors, transformers, florescent lights, induction heating devices, etc.) that requires magnetizing current, which is measured in “kilovolt-amperes reactive” (kVAR). Kilowatts (kW) are a measure of the work-producing current in the circuit. Total current, which is impacted by the combination of magnetizing current and work-producing current, is measured in kilovolt-amperes (kVA). The power factor is the ratio of kW to kVA. When the magnetizing current is zero, kW is equal to kVA and the power factor is 1.0. This is good for the utility and no additional charges accrue during a period where the power factor is 1.0.

In circuits that use magnetizing current the total current rises and the power factor drops below 1.0. A low power factor, 0.6 for example, means that the utility has provided a large quantity of reactive current (kVAR) that would not be covered by a charge for only the kilowatts (kW) delivered. For this reason, utilities often include some sort of reactive demand charge on the

[15] *Handbook of Energy Engineering, Fifth Edition*, Thumann and Hehta, The Fairmont Press, Inc. 2001.

electric bill. These charges can be very significant if the power factor is very low; however, this is typically not the case in Iowa.

The good news is that reactive demand charges can always be dramatically reduced, and often even eliminated. Capacitors can be installed that will provide the needed reactive current, thereby bringing the power factor close to 1.0. Review of at least one year's data on the maximum demand, power factor, typical energy usage, and reactive demand charges will help users calculate the amount of capacitance that must be installed to raise the power factor to an acceptable level. For help, consult with the electric utility or the Iowa State Industrial Assessment Center.[16]

3.5 Incentives and Rebates

A variety of incentives and rebates on energy-efficient equipment are offered to commercial customers. Complete and updated lists of incentives and rebates are available from most utilities companies. A partial list of some of the most popular areas that have incentives and rebates is given below:

- fluorescent T-8 and T-5 lighting
- reduced wattage metal halide lamps
- chillers
- ground source heat pumps
- high efficiency natural gas boilers
- motors and variable speed drives
- compressed air system equipment

In addition, customized or special projects that save energy may also be considered for incentives or rebates.

The state of Iowa exempts a certain amount of electricity costs for industrial production loads from sales tax. A certificate of verification is required and must be renewed every three years. Once certified, commercial customers who have not previously been exempted may apply for a refund of overpaid taxes from previous years.

[16] The Industrial Assessment Center, funded by the US Department of Energy that serves Iowa is located at Iowa State University. Their website is http://www.me.iastate.edu/iac/, or call (515) 294-3080.