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Electric Tariffs

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1.0 Tariffs - General

The term "tariff" can have two meanings. One definition states that it designates a tax imposed on imported goods. Another definition is the rate structure charged by a party for services or goods. This second definition is used by many electric utilities to identify their rates for their electrical service. Every utility will have a rate structure that it charges for its electrical service but not every utility will necessarily identify that rate structure as a "tariff." The term "rate" is also commonly used by electric utilities when referring to their schedule of charges.

Tariffs for electricity vary greatly from one service area to another. A large number of factors determine the cost of electricity in any particular region. The two major expenses that determine the cost of a customer's electricity are a utility's cost of energy and its cost of capital.

Fuel costs are a large part of a utility's operating expense. If the cost of that fuel rises, the utility must, in turn, raise its fees to compensate for its greater expense. Some sources of electrical energy as hydro, solar and wind are free. There is no energy expense associated with these sources, but there is a capital expense that must be reimbursed. The cost of capital equipment is the other large expense that utilities must address.

In the USA utilities are investor-owned, independent firms but elsewhere many utilities are government- owned. Firms in the USA are free to design their tariff structures although in regulated states the net remuneration is set by a state agency. Some utilities are state-regulated and some are deregulated. More and more the regulating bodies of the states have been enacting deregulation programs to move the pricing of electricity from regulated to deregulated.

The intention of deregulation is to encourage competition between energy suppliers with the hope that lower energy prices will result. In deregulated states, consumers are allowed to choose their energy provider. Deregulation has led to the rise of independent power producers (IPP's), namely non-utility firms that generate and sell electrical power into the grid. These IPP's of course compete with the traditional power-generating utilities. Regardless of

the selected energy provider, utilities must deliver energy to customers within their jurisdiction. Accordingly a billing for electricity within a deregulated area will necessarily include a charge for delivery and service of the distribution lines.

Every user of electrical power would be well advised to thoroughly understand the tariff structure of the utility that delivers its power. This generalization is applicable to residential users, commercial users and industrial users alike. Engineers can often play a significant role in assisting owners to reduce the monthly costs of an electrical service. In some instances savings may be realized by mere changes in usage practices. In other cases changes in electrical gear, or the installation of new gear, may be warranted. It is the responsibility of the engineer, if so engaged, to study the various possible courses of action and to make specific recommendations. To do so, an engineer must first understand electrical tariffs as well as the possible changes that may be taken.

2.0 Residential Tariffs

Residential users have limited options available that may be taken to reduce the monthly billing for electricity. These tariffs are mostly based on energy consumption although a residential bill will often have added fees of a wide variety. Time of use (TOU) has become one option that has been offered to many residential customers. By reducing electrical energy consumption during peak periods a home owner with a TOU option can reduce the cost of the electrical bill. The increasing use of TOU options is in part due to the increasing use of smart meters which can easily measure and transmit energy use during different times of day.

Some utilities offer a variation of a TOU program whereby a home owner can agree in advance to allow the periodic interruption, initiated by the utility, of the operation of certain appliances during peak usage periods. Items that are often considered for periodic interruption are: air conditioning units, clothes driers, water heaters and pool water pumps. As needed, the utility remotely interrupts operation of the designated devices to shed load during peak times.

In recent years a number of home owners have installed solar panels or wind turbines to offset the monthly electrical bills. Generated power is fed back into the electrical lines and is sold to the utility. This practice offers an alternate means of offsetting the expense of energy consumption.

Typically, a residential energy charge will be based on the energy usage throughout a period of time - usually a period of approximately 30 days. If TOU is applicable there will be a rate for off-peak usage and another, higher rate for usage during peak times. A typical rate schedule will provide better insight to the TOU programs. Following is an actual rate schedule of a Mid-western utility.

TOU Energy Charge for Residential Usage
Interstate Power and Light - Iowa

Summer Period: June 16 - September 15
On-peak hours 7 a.m. to 8 p.m. CST all weekdays
On-peak hours 8 a.m. to 9 p.m. CST (Daylight Savings Time) all weekdays
Off-peak: All other hours including weekends

Rate 100, 150, 400	On Peak Winter ¢/kWh	On Peak Summer ¢/kWh	Off Peak Winter ¢/kWh	Off Peak Summer ¢/kWh
First 16.438 kWh/Day or first 500 kWh/Mo	11.297	13.625	4.035	4.866
Next 23.014 kWh/Day or next 700 kWh/Mo	8.252	13.625	2.947	4.866
Over 39.452 kWh/Day or over 1,200 kWh/Mo	3.112	13.625	1.112	4.866

An examination of the above rate schedule of Interstate Power and Light will indicate that there is an attractive incentive for a homeowner to shift energy usage to an off-peak period.

3.0 Commercial and Industrial Tariffs

Commercial and industrial customers usually have a three phase electrical service and the tariff structure for that service will be very different from the typical residential tariff. Customers of three phase electricity are generally classified into one of several possible tariff categories. Some utilities have a variety of tariffs. Some California utilities have dozens of tariff schedules.

The billing sent to most three phase customers will have a number of components to it. For this reason, there are several options that can be considered in an effort to reduce costs. Often a three phase customer can easily make a few minor, and sometimes inexpensive, changes to significantly reduce the cost of purchased electricity.

In most areas, the cost of a three phase service in any tariff category will have several components to it. The most common categories are:

- Energy (kWh) – peak
- Energy (kWh) – off peak
- Demand (kW, current or VA)
- Power factor penalty

3.1 Energy Charges

Commercial and industrial customers of a three phase service very often can reduce the charge for energy by one or more methods. (The common unit for electrical energy is kilowatt-hour which is often abbreviated as "kWh.") With the more frequent appearance of the smart meters the number of options is generally increasing. In those area where TOU is offered, energy consumption can often be shifted to off-peak times thereby reducing the electric bill. On the other hand, many three phase customers find it impractical to shift electrical usage as other considerations take preference. Sometimes, potential savings can more easily be found in other charges appearing on the monthly electrical bill.

While many utilities offer TOU incentives to commercial and industrial customers, these options are not necessarily made available to all categories of customers. Below is a partial listing of a non-TOU tariff structure that is offered by Westar Energy for medium general service in northern Kansas. The listing here shows only the charges for an active meter ("customer service"), demand and energy. (A bill for service may include additional charges as transmission, environmental costs, taxes, etc.)

Westar Energy - Medium General Service

The Medium General Service – commercial and industrial customers with electrical demand greater than 200 kW are eligible to be served under this tariff.

Customer Charge..... $100.00

Demand Charge

$12.506021 per kW

Energy Charge For the months of June through September:

$0.019261 per kWh

For the months of October through May:

$0.014627 per kWh

(Note: The tariff schedule shown here by Westar Energy is one of the more simple tariffs and it includes no allowance for TOU. To be certain, most utilities offer a variety of TOU plans to commercial and industrial customers. However, it is not possible to generalize on the structures of these greatly varied plans. Some are very complicated and described in detail only by means of long documents.)

Example 1.1

A sample calculation is shown here for only energy charges for a typical Westar Energy customer assuming the above tariff schedule. Assume an energy consumption of 80,000 kWh in a winter month.

80,000 kWh X $0.014627 per kWh = $1,746.88

3.2 Demand Charges

Many larger customers of a three phase service are billed for electrical "demand." The term "demand" may appear on the monthly billing although the charge may appear under a different title. "Billing capacity" is one such term sometimes used in lieu of "demand." Typically demand charges are a measure of the power (kW), current or VA consumption integrated over a predetermined time period of time. The rates for demand vary greatly from one utility to another. Many demand rates are typically in the range of $0 to $20/kW.

One large electric utility explains demand as,

> "Demand is the amount of electricity you require at a given time. For example, if you turn on ten 100-watt bulbs at the same time, your demand at that moment would be 1,000 watts, or 1 kilowatt. Because you pay for electricity demand as well as electricity use (kWh), you can save money by reducing demand. Even if you don't change the amount of electricity you use."

The general need, and justification for demand charges, is succinctly explained by the National Grid (which serves parts of Massachusetts, New York and Rhode Island) in its position on demand charges for its New York commercial customers:

> "What Is This Thing Called Demand. The price we pay for anything we buy contains the cost of the product plus profit, plus the cost of making the product available for sale, or overhead. In seeking to understand

> demand, we might equate it to this type of overhead expense. This is in contrast to charges National Grid customers pay for the electricity itself, or the 'cost of product,' largely made up of fuel costs incurred in the actual generation of energy. Both consumption and demand charges are part of every electricity consumer's service bill. Residential customers pay one rate of charges for electricity service, covering both consumption of electricity and demand. This simple, combined charge is possible because there is relatively little variation in electricity use from home to home. This is not the case among commercial and industrial energy users, whose electricity use–both consumption and demand–vary greatly. Some need large amounts of electricity once in a while–others, almost constantly. Complicating this is the fact that electricity cannot be stored. It must be generated and supplied to each customer as it is called for–instantly, day or night, in extremely variable quantities. Meeting these customers' needs requires keeping a vast array of expensive equipment – transformers, wires, substations and even generating stations–on constant standby. The amount and size of this equipment must be large enough to meet peak consumption periods, i.e. when the need for electricity is highest."

Other utilities may explain demand charges differently. Nevertheless, the reasons for demand charges by any utility the world over remain essentially the same and generally would echo the position stated by the National Grid.

Following are some specific examples of demand charges,

NorthWestern Energy, Montana and North Dakota

> The utility uses a 15 minute period for measuring demand. Customers are cautioned that operating a motor for a short period during a billing period will result in a demand charge that is a high percentage of the billing. It is stated in the way of example that if a customer runs an irrigation pump for only five hours during a billing period the demand charge would be 98% of a $301 billing. On the other hand, if the pump were operated for the entire billing period the demand charge would be only 24% of a $1243 billing.

The above examples of billing practices related to demand illustrate how a customer of electricity could be severely taxed for a limited operation of electrical equipment. If that operation occurs within a billing period when electrical energy consumption might be on only a few, brief occasions that demand charge could be especially hurtful. Owners of irrigation pumps and

air conditioning chillers are two categories of electric customers who are frequently surprised with a high demand charge on a billing that shows up near the beginning or end of a season of generally heavy use.

For many years demand was measured by an electromechanical demand meter that determined the demand charge for a billing period. Demand meters usually measure power (or current or VA) throughout a period of time that traditionally has been 15 or 30 minutes in length. The meter dial will begin travel along a scale. The rate of travel is proportional to the measured parameter. If, for example, the measured parameter was 20 kW and constant for, say, a 15 minute period then at the end of the 15 minute sampling period the pointer would point to 20 kW. On the other hand if 20 kW existed for only 7.5 minutes, the pointer would be advanced only to the 10 kW position at the end of the 15 minute period. (Note: the pointer is not automatically reset at the end of the measurement period. Rather, it will rest at the position determined by the highest demand within the reading period. When the meter reader logs the demand value for the period he will manually reset the pointer to the "zero" position.) The older, electromechanical demand meters had only one method of measuring demand regardless of the time of day or time of year. Today's smart meters simulate the sampling method of the older meters but offer the added capability of measuring demand during peak or off-peak periods.

Example 1.2

In above Section 3.1, Energy Charges, parts of the tariff schedule of Westar Energy is shown. In that schedule both the demand charges are shown (applicable for any time of the year) and it is stated as $12.506021 per kW. In Example 1.1 a sample calculation is performed for an assumed monthly billing of 80,000 kWh. Assume that during that same period the demand was determined to be 250 kW. Calculate the demand charge for the month.

250 kW X $12.506021 per kW = $3,126.51

In this particular instance the demand charge is drastically larger than the energy charge for the selected month.

3.3 Power Factor Penalty

Most customers of three phase electrical power have electrical gear that is inclined to cause a lagging power factor. Motors, which are predominantly of

the induction type, are the major cause of a lagging power factor. Transformers and some lighting ballasts can also be a cause. Most, but not all, utilities charge a penalty for a low power factor. Billing practices used by utilities who charge a penalty vary greatly. So, generalizations could be misleading.

Following is an example of a penalty charged by a utility for a low power factor. (Note that billing practices followed by utilities often change from year to year.)

Clark Public Utilities, Vancouver, WA:

> **"Adjustment of Demand for Power Factor:** Demands will be adjusted to correct for average power factors lower than 95%. Such adjustments will be made by increasing the measured demand 1% for each 1% or major fraction thereof by which the average power factor is less than 95% lagging.

Example 1.3

Assume the energy consumption of Example 1.1 (80,000 kWh) and the demand value of Example 1.2 (250kW). Use the criteria of Clark Public Utilities (stated above) for determining low power factor penalty and the nominal Clark Public Utilities demand rate of $6.77 per kW. Consider a power factor of 0.90. Determine the applicable demand rate for the selected month.

Answer: The power factor is 5% below the utility's criteria of a 95%. Accordingly the demand rate is adjusted upward by 5%. The applicable demand rate for the selected month becomes:

$6.77 per kW X 1.05 = $7.10 per kW

To reduce or eliminate power factor penalties, capacitor banks may be installed by a user. The costs of installation and maintenance are the owner's responsibility. Capacitor banks and their use are treated in a number of PDH Online courses.

3.4 Miscellaneous Charges

A bill for an electrical service may contain a listing of a number of miscellaneous charges, most of which are fixed by the utility and nonnegotiable. In addition to the charges for energy, demand and low power

factor, all of which are treated above, the following are separate line items often found on electrical bills:

Meter charge – This is a charge for having an active electrical service to a facility. The charge is also sometimes included as a "customer charge," an "active meter" or a "minimum billing."

Transmission charge – A charge for the transmission of electrical power. (This charge usually appears on the bills received from utilities within deregulated areas, but not necessarily on the bills in regulated areas.)

Nuclear decommissioning – A fund set-aside for the eventual (and potentially very expensive) decommissioning of a utility's nuclear plant.

Customer charge – A charge to help pay for overhead expenses as mail, maintenance, line service, reading meters.

Environmental charge – A fee to pay for equipment specifically mandated by regulators to protect the environment.

Fuel charge – A separate identification of fuel costs which often vary from one month to the next.

Taxes – A remuneration for taxes that a utility must pay to governmental taxing agencies.

4.0 Summary

All residential, commercial and industrial electric bills will include a charge for energy. Commercial and industrial billing will also generally include charges for demand and low power factor. For many users of an electric service, changes can often be made to reduce the costs of these components of a bill.

User of three phase electrical power would generally be well advised to have an experienced professional review the monthly electric bills to consider changes that might be pursued to reduce monthly billing charges.

Engineers engaged to consider options for reducing electric service charges should consider:

1. Possibly shifting energy use off-peak where TOU options are available.

2. Possible changes to usage practices with the aim of reducing demand charges.

3. A review of power factor penalties to determine if the installation of power factor correction equipment is warranted.