

# Peak Demand Energy Charges In Agriculture

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## UNDERSTANDING ELECTRIC DEMAND CHARGES

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In 1925, an estimated 3.2% of the 6.3 million U.S. farms had electric service (Beall, 1940). To provide electricity to American farmers, the Rural Electrification Administration was established in 1935. It provided funding for extending electric distribution infrastructure into rural areas. As a result, “between 1930 and 1940, the rural farm electrification rate in the United States increased by 230 percent” (Kitchens and Fishback, 2015). As agricultural operations have become more sophisticated and automated, the electrical demands of many farms have increased, requiring enhanced needs for high quality electric to power equipment. In 2014, the agricultural sector consumed 1,714 trillion BTU of energy, with electricity representing 17 percent of the total energy consumed in agriculture. Energy inputs are important to agriculture, as electricity costs average 1-6 percent of total expenses for farm businesses. In 2011 about three-fourths of U.S. farms had a profit margin of less than 10 percent, including roughly 61 percent with a negative operating profit margin (USDA ERS, 2014). Higher energy expenses increase production costs, raise prices of agricultural products, and reduce farm income.

Farmers are constantly managing costs to increase profitability. This Technical Report is designed to help farmers better understand how their electric bills are calculated, and identify strategies to lower monthly energy costs.

## Review Your Electric Bill and Rate Tariff



While most farms are interested in lowering their electric bills, very few have taken the time to thoroughly evaluate their electric rate tariff (schedule) which determines how their electric bills are calculated. Before investing in energy savings strategies, you must first understand how you are charged for electric and identify the greatest potential for savings. There are more than 3,200 electric utilities in the United States using slightly different terminology on their bills. While the layout of each electric bill is unique, common charges included in commercial rate tariffs include a customer charge, transmission charge, distribution charge, and generation charges (Image 1).

- **Customer Charge** - The customer charge is sometimes referred to as a service fee, convenience fee, or basic charge. A customer charge is a fixed monthly fee, typically associated with administrative costs for billing, meter reading, equipment, and infrastructure maintenance.
- **Transmission Charge** – The transmission charge is the charge for transporting electricity across high voltage transmission lines from the generation plant to the distribution lines of a local electric utility. The Federal Energy Regulatory Commission (FERC) regulates the interstate transmission and wholesale sales of electricity within the United States.
- **Distribution Charge** - The distribution charge is the charge for moving electricity over local distribution lines and delivering the electricity to your location.
- **Generation Charge** - The generation charge, sometimes referred to as a supplier charge, is the charge that covers the cost of producing electricity. Generation charges are typically calculated based on

a cost per kilowatt hour (kWh). Some rate tariffs will include a tiered pricing structure with various costs based on how many kWh you use and/or time of use charges that change depending on the time of day or year that you use the electricity.

- **Cost Adjustments** - Many utilities have multiple cost adjustments charges commonly referred to as riders, surcharges, cost trackers, and cost recovery. These adjustments allow the utility to modify approved rates to reflect specific cost changes that occur in-between general rate proceedings. Cost adjustments appear as an additional itemized charge on the utility bill in addition to the transmission, distribution, customer, and generation charges.

To review specific details for your electric rate tariff, contact your utility provider to request a copy or visit your electric utility providers' website and search for "rates."

### Image 1: Sample Electric Bill

Transmission Service	\$	504.32
Distribution Service		1,086.55
Customer Charge		22.79
Retail Stability Rider		315.83
Deferred Asset Phase-In Rider		39.85
Phase-In Recovery Rider		241.80
Power Purchase Agreement Rider		2.91
<b>Current Electric Charges</b>	<b>\$</b>	<b>2,214.05*</b>
<hr/>		
43560 kWh @ \$0.0705600	\$	3,073.59
<b>Current Supplier Balance Due</b>	<b>\$</b>	<b>3,073.59*</b>
<hr/>		
<b>Total Balance Due</b>	<b>\$</b>	<b>5,287.64</b>
*Charges make up the "Total Balance Due"		
Pay \$5,331.92 after 09/14/2018		



## Demand Charges

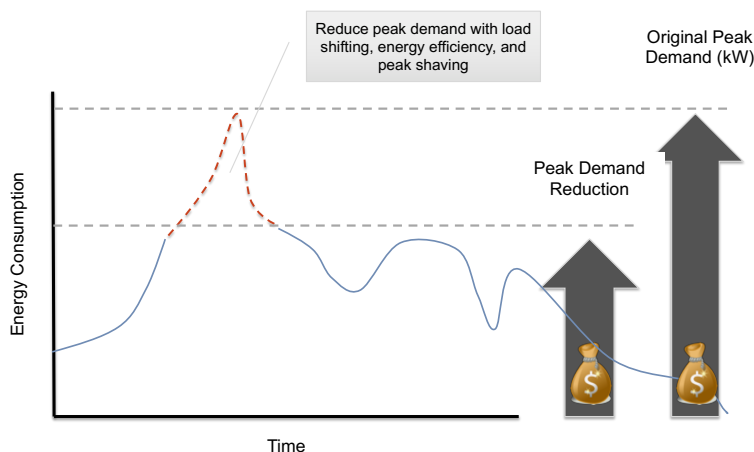
Most consumers are familiar with energy consumption, which is the total amount of energy measured in kilowatt hours (kWh) that you use over a period of time, or billing period. However, fewer consumers are familiar with energy demand charges, which are based on the maximum amount of electricity drawn from an electric power system at a single point in time, generally measured in megawatts (MW) or kilowatts (kW). Some demand charges are clearly labeled on your bill, while sometimes it is difficult to determine which portions of your bill are impacted by your monthly demand. Monthly billing demand is often used to calculate distribution charges, transmission charges, and some cost adjustment riders.

Demand charges cover the electric utilities' costs of delivering a maximum level of energy to their customers. Utilities must maintain enough electrical generation and distribution infrastructure (including substations, transformers, and wires) to satisfy the highest spike in demand, even if it occurs over a short period of time. Maintaining infrastructure to satisfy this peak demand is extremely expensive. Demand charges help offset these costs. In addition, assessing demand charges helps to allocate the associated cost to consumers that contribute to causing the inconsistent spike in usage and encourages users to reduce demand spikes in their load profile (Image 2). If you have demand charges on your rate tariff, it is extremely important to understand how they are calculated. In addition, it is important to analyze your load profile or usage patterns to understand when your facility is setting its peak demand and what equipment is causing the spike in usage. In many cases, demand charges can represent 30 to 70 percent of commercial customers' electric bills (Dieziger, 2000). Once the problem is

better defined, demand management strategies and equipment can be used to reduce the use of electricity or shift specific electric loads away from periods of high electrical demand.

While it is important to understand your peak demand spike for a specific billing period, it is equally important to consider seasonal demand spikes at your facility. Some utilities have rate tariffs that include specific language for calculating the monthly billing demand that considers seasonal spikes. Often referred to as a "ratchet" demand, a percentage of the highest monthly demand occurrence for the year will determine your minimum demand charge for the next year. For example, a rate tariff often includes a section that explains how the minimum monthly billing demand is determined. While each utility has unique language describing this process, it is common to find a clause that reads, "the minimum billing demand shall be the greatest of the following: (a) the maximum 15-minute integrated kW demand measured during the month, or (b) 75% of the highest kW demand similarly determined for any of the eleven (11) preceding months." In general terms this means 75% of the highest monthly demand will set your minimum monthly demand for the next 11 months. Demand tariffs that include a "ratchet" provide opportunities for consumers to save money by better managing their usage patterns.

### Image 2: Flattening Daily Peak Demand Load





## Power Factor

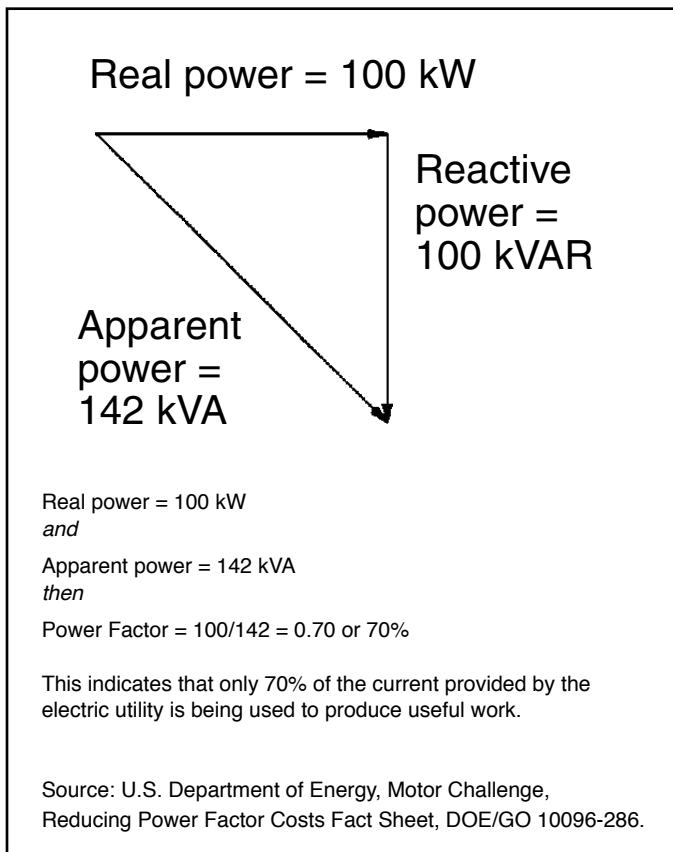
Another variable that can influence your billing demand is the power factor. To understand how power factor is calculated, it is important to first understand the difference between apparent power, reactive power, and real power. First, apparent power, measured in volt-amperes (kVA) is the total amount of power delivered by the utility, which includes both real power and reactive power. Next, reactive power is measured in kilovolt-amperes reactive (kVAR), which is the portion of electricity that is used to establish and sustain the electric and magnetic fields of induction loads. Inductive loads such as electric motors, transformers, and lighting ballasts require current to create a magnetic field, causing current to be out of sync (e.g. lagging or leading) with the voltage. Finally, real power, measured in kilowatts (kW), is the portion



of electric power that actually performs work (USDOE/EIA, 2018). As illustrated in Image 3, power factor is the ratio of the real power transmitted to the apparent power (Power Factor = Real Power / Apparent Power) that could have been transmitted if the same current were in phase and undistorted (Washington State University Cooperative Extension Energy Program and the Northwest Energy Efficiency Alliance, 2003).

Many utility providers consider the power factor of your facility in calculating your monthly billing demand charges. In some cases, this can have a significant impact on your overall demand charges. Not all utilities will show the power factor on your bill, however if you see both peak kW and peak kVA stated on your bill, it is likely that power factor is considered in determining your billing demand (Executive Office of Energy and Environmental Affairs, Commonwealth of Massachusetts, n.d.).

### Image 3: Power Triangle



## Load Factor

A useful metric in evaluating your facilities energy usage is the load factor. The load factor is the ratio of a facility's average demand, compared to the measured peak demand. This factor is used to indicate if a system's electric use over a period of time is reasonably stable, or if it has extreme peaks and valleys (Public Utilities Commission of Ohio, 2018). A load factor of "one" is good and indicates a perfectly consistent use of electricity over the billing period, while a lower factor suggests greater variation in consumption patterns. To calculate a monthly load factor, simply divide your total monthly energy consumption (kWh), by the maximum measured month's demand (kW) times 720 hours in the month (Frazier, 2014).



## Example: Calculating Demand Charges and Power Factor

Demand charges for commercial accounts vary greatly based on your utility provider and the specific rate tariff on your account. For example, demand charges in Ohio range from as little as \$2.00 per kW to more than \$12.00 per kW. While demand charges are based on your peak usage in a specific period in time, it is not necessarily an instantaneous peak. Instead, most utilities will measure a peak demand as a rolling average over a specific time interval, typically 15 or 30 minute intervals. A simple formula to calculate demand is:

- **Power (kW) = Energy (kWh) / Time**

However, it is important to apply this formula based on the demand interval on your rate tariff. For example, a dairy farm with 300 milking cows is on a commercial rate with a demand measured on 15 minute intervals. The farm's maximum monthly energy consumption in over a 15 minute interval (.25 hour) was 25.82 kWh, when most critical operations were running at the same time.

You calculate the farm's measured peak demand as:

- **25.82 kWh / .25 h = 103.28 kW (Measured Demand)**

The dairy farm uses numerous electric motors for applications such as milk recovery, milk cooling, ventilation, water pumping, silo feed controls, and manure pumping. The induction loads from multiple electric motors causes current to be out of sync with the voltage, contributing to poor power factor. Most utilities assess a penalty for low power factor. In this example, the dairy farm had an average power factor of 72.5 % for the month. Based on the rate tariff, the utility requires the farm maintains a power factor above 90% and if the power factor is below this benchmark, the billing demand may be adjusted using the formula (Billing Demand = Metered kW Demand X 90% /Actual Power Factor).

You calculate the farm's billing peak demand adjusted for power factor as:

- **(103.28 kW x .90) / .725 = 128.2 kVA (Billing Demand)**

Unfortunately, there is not a standardized process for how utilities design their billing structures. In some examples, utilities will assess separate itemized demand charges for distribution demand, transmission demand, and excess kVA for poor power factor. However, other utilities will combine these charges into one simplified demand charge fee. In this example, the dairy farm is assessed one demand charge of \$10.43 per monthly billing demand which is calculated as the maximum kilowatt demand established in a 15 minute interval and adjusted for power factor as described above.

You calculate the demand charge component of the farm's monthly bill as:

- **128.2 kVA Billing Demand x \$10.43 = \$1,337.26 (demand cost without power factor correction)**

As demonstrated in this example, poor power factor can significantly increase your billing demand, ultimately inflating your monthly electric bill. Fortunately, power factor correction equipment such as capacitors can be added to the circuitry or individual motors to increase the power factor above the utility's minimum benchmark (90% in this example). In many cases, power factor correction is simple a process that yields ongoing cost savings. In the dairy farm example, we now assume power factor correction equipment was installed to improve the 72.5% power factor above the required 90% benchmark by the utility.

You calculate the demand charge component of the farm's monthly bill with power factor correction as:

- **103.28 kW Billing Demand x \$10.43 = \$1,077.21 (demand cost with power factor correction)**

While each situation should be independently evaluated, various strategies such as properly sizing electric motors, shutting down idling motors, and installing capacitors can be implemented to improve a low power factor.

As you can see in the example, by simply addressing the poor power factor and installing correction equipment the farm reduced their monthly bill by \$260.05 in a single month.

## Summary



Reducing energy costs can be beneficial to any farm operation. However, before making investments in energy efficiency and renewable energy equipment, it is important to understand how you are charged for electricity. Some farms are still on residential electric rate tariffs and their bills are relatively easy to understand. However, because farms are using more electric, many farms are now on commercial electric rate tariffs that are more complex. Taking the time to investigate your rate tariff and analyze your consumption patterns will help you prioritize potential energy savings solutions providing you the greatest return on your investment.

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