DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

Agriculture and Natural Resources

FSA1101

Making Sense of Your Electric Utility Bills with Demand Charges

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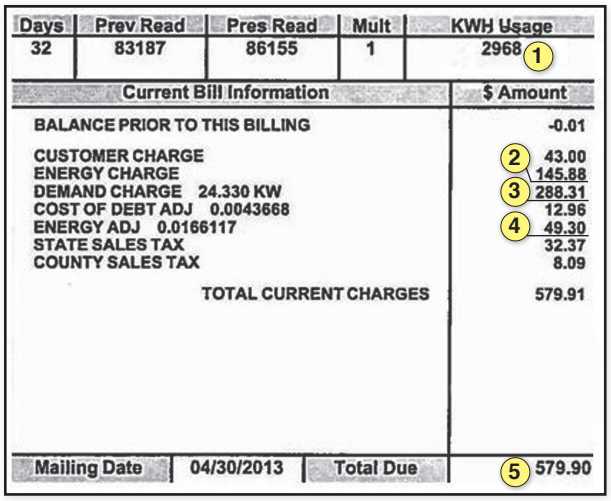
Understanding the energy use on your farm is the first step to becoming more energy efficient. A great place to start is by looking at your utility bills and using the details to identify potential opportunities for energy and money savings.

There are about 24 electric cooperatives and investor-owned utility providers serving 75 counties in the state of Arkansas, with different rate structures. Poultry farms are typically categorized as "small commercial" ratepayers, with some having demand charges.

This article will explain what consumption (kWh, or kilowatt-hours) and demand (kW) mean on your electric bills (figure 1), as well as different types of rate schedules that your electric companies may charge you. Understanding them may help to lower costs by either improving energy efficiency or adjusting energy usage patterns. If you are considering an on-site renewable energy generation, such as solar panels, this publication will help in understanding which portion of the electrical expenses can be offset by the renewable energy generation.



Days	Prev Read	Pres Read	Mult	KWH Usage
32	83187	86155	1	2968 (1)

Current Bill Information	$ Amount
BALANCE PRIOR TO THIS BILLING	-0.01
CUSTOMER CHARGE	(2) 43.00
ENERGY CHARGE	145.88
DEMAND CHARGE 24.330 KW	(3) 288.31
COST OF DEBT ADJ 0.0043668	12.96
ENERGY ADJ 0.0166117	(4) 49.30
STATE SALES TAX	32.37
COUNTY SALES TAX	8.09
TOTAL CURRENT CHARGES	579.91

Mailing Date	04/30/2013	Total Due	(5) 579.90

Figure 1. Sample electric bill

1. **Total Usage:** Total amount of electricity used (kWh), calculated by taking the difference between the two meter readings at the beginning and end of the billing period.
2. **Energy Charge:** Total charge of electricity used during the billing period.
3. **Demand Charge:** The peak demand used to calculate the demand charge was 24.33 kW, and the utility provider charged $11.840 per kW as the demand charge.
4. **Cost Adjustment:** The cost of debt, energy adjustment.
5. **Total Cost:** The summation of all charges and costs.

Energy Charges

Usage on electric bills is the amount of energy (kilowatt-hours, kWh) used during the billing period, multiplied by the relevant price of energy ($/kWh). Table 1 shows the typical electric equipment in a broiler house, such as light bulbs and fans of different sizes and numbers in a commercial broiler house, as well as their nominal ratings. The approximate electric usage per day is based on the hypothetical number of hours in operation and power inputs based on the assumed power factors of each piece of equipment. The demand of each equipment group is also computed based on the assumed power factors. Of course these values will vary for different sizes of houses and environmental control design.

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Table 1. Examples of wattage (W) and energy usage (kWh) for equipment used in a broiler house of 40 × 400 ft dimension.

Equipment	Rating Wattage (W)	Number in Use	Usage per day Kilowatt-hour (kWh)	Demand kW
LIGHT BULBS				
Incandescent bulb	60	42	60.5 (24 hours)	2.5
LED bulb	10	42	10.1 (24 hours)	0.42
FANS				
Stir fans (1/3 HP)	250	6	17 (8 hours)	2
36" fans (0.5 HP)	375	4	9 (4 hours)	2.5
48" fans (1.0 HP)	750	9	240 (24 hours)	10
FEED MOTORS (0.5 HP)	375	6	4 (2 hours)	2

Electricity charges and rates can be complicated. The most common **rate structures** are "fixed rate" and "tiered rate" for most small commercial customers. Large commercial and industrial customers have the option of "time of use" rates.

Fixed Rate

For the fixed rate approach, the supplier charges a fixed amount of money per kWh of electricity used.

Tiered Rate

For the Tiered Rate approach the amount of electricity used is compared to two or more usage ranges (or tiers). As each tier will typically have different charge rates, the amount of energy used will affect the total energy charges on the electric bill. As a result, change in electricity usage that results in crossing a usage threshold may have a significant impact on the amount of the electric bill. At a tiered rate, the electricity supplier charges a higher or lower rate once a particular threshold of energy use is exceeded.

Each month, your bill includes a service availability charge, which is a fixed fee that recovers a portion of the cost required to deliver power to your home or business. Additionally, other cost adjustments, such as fuel adjustment charge, cost of debt adjustment, etc., is calculated using a formula found in the utility tariffs for each utility (http://www.apscservices.info/tariff_results.asp?IndustryType=elec) and can vary monthly. These types of adjustments help the cooperatives to avoid large, permanent rate adjustments.

Demand Charges

Demand charges are additional charges on top of regular usage charges. They are based on the maximum (or peak) amount of power used at a single point in time, measured in kilowatts (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 monthly peak demand as a rolling average over a specific time interval, typically 15 or 30-minute intervals. The utility provider checks which 15-minute interval had the highest power usage over the past billing period and uses that to determine your demand charges.

BASE, INTERMEDIATE AND PEAK LOAD

Base-load electricity is provided by extremely reliable, inexpensive, and efficient power plants, which run continuously during the year. Such plants – including nuclear, hydroelectric, geothermal, and coal power plants – often take a long time to start up and are designed to work at their nominal capacity with a small degree of variability.

Intermediate power plants are operated between 20% and 70% of the time, with the objective of following the fluctuations of the load and curtailing their output in periods of low demand, such as during the night. These plants are typically coal-or gas-fired, including high-efficiency gas turbine combined cycles. Wind and solar power plants are typically considered intermediate power plants, since their operations are limited by the availability of the renewable resources exploited. As a result, there is no guarantee they can supply the required power when peak demand occurs.

Peak power plants run only when there is a high (peak) demand for electricity, typically for less than 20% of the hours in a calendar year. Peak plants are generally smaller, can be started up quickly, and are flexible enough to match rapid fluctuations in the demand.

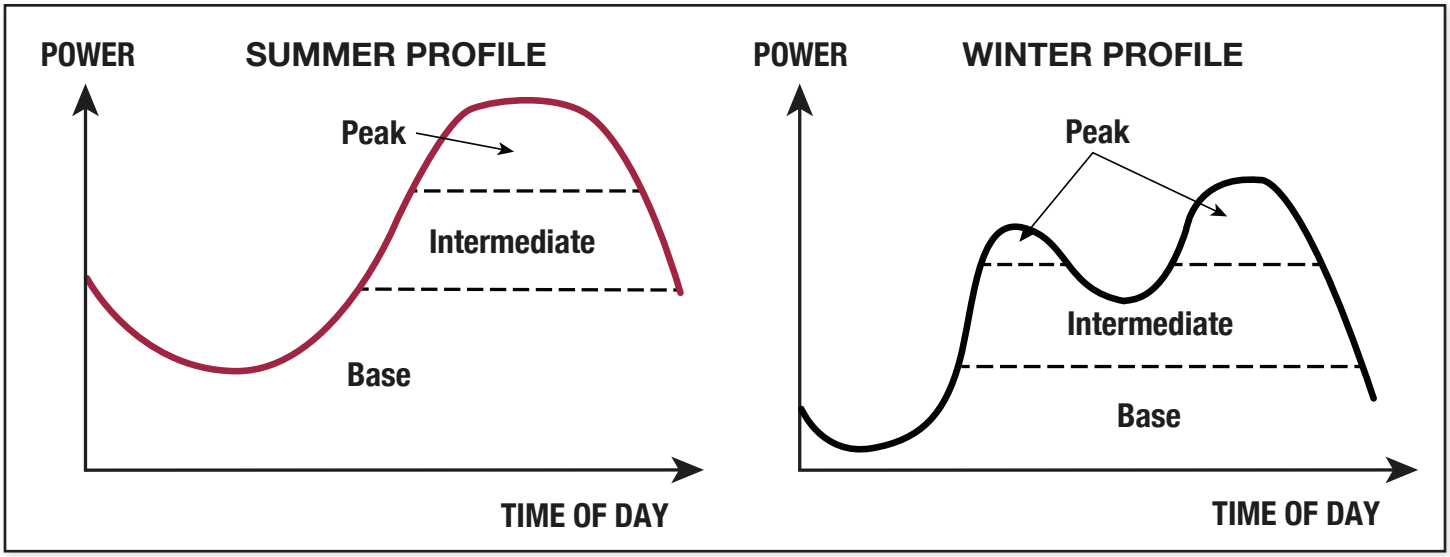

Figure 2. Typical daily electric load (demand) profile in a transmission region (Muratori & Rizzoni, 2014). See the sidebar for explanation of peak, intermediate and base loads.

Figure 2 presents typical summer and winter electricity demand curves—showing base, intermediate, and peak load. The peak load period requires the utility provider to maintain operational capacity to meet high demand, which is often expensive and underutilized (operating only a few hours per year). Such curves might vary depending on geographical location, but the daily and seasonal variation in the demand peaks remains a common issue for electric power generation.

Utilities have different types of rate schedules for different types of customers. While the exact billing approach varies by utility, some include multiple types of demand charges, with higher charges during hours of peak demand, and lower charges during intermediate (or "partial-peak") or base ("off-peak") hours.

One simple demand charge that's applied to small commercial operations is the fixed charges per kW. Most utility rates specify the maximum power demand that a customer is allowed to have (i.e. 25 kW or 50 kW). Exceeding the maximum power demand for consecutive months can result in being moved to a different rate with higher demand charges.

In broiler production, electricity is mostly consumed by lights and ventilation fans, with feed motors and pumps, etc. using a much smaller portion. During brooding, lights are on at full intensity and minimum ventilation fans operate intermittently. During periods with near-marketage chickens, lights are generally dimmed with less power demand, but most if not all fans are on continuously to remove heat released by chickens from the houses in warm weather.

Utilities use demand charges to incentivize customers to spread their energy usage over time and minimize peak loads. In principle, energy could be used at uniform rates to avoid the added expense resulting from demand charges. However, the equipment on poultry farms such as light bulbs and ventilation fans do not have much flexibility in the timing of their operation to reduce demand charges. Hence it is important to understand that any effort to improve energy efficiency of the electric equipment not only lowers energy usage, but also potentially reduces demand charges. For example, the replacement of 60W incandescent lights with 10W LED lights of equivalent illuminance will reduce the demand during brooding period five-fold (from 2.5 kW to a fraction of kW, Table 1). An energy efficient fan will be able to deliver the same amount of air with lower demand and less energy consumption.

Not all poultry farms are billed with demand charges. When they are, one should pay attention on how much of a monthly bill is from energy usage and how much is from demand charges.

In order to understand the impact of demand charges on overall electricity expenses on farm businesses, actual electricity bills from a two-house electric meter on a broiler farm were analyzed. Low demands of 6 -10kW occurred in January, March and April, while high demand of 25kW occurred from June to October due to the operation of tunnel fans (figure 3). Overall, the demand charge was more than half of the total annual electricity expenses for this farm. In fact, demand charge was greater than usage charges for 11 out of 14 months.

How Does Solar PV Affect Demand Charges?

The impact of solar power on consumption charges is relatively straightforward. By producing electricity from a solar power installation, a business owner can reduce the amount of energy they buy from the utility and therefore reduce utility costs.

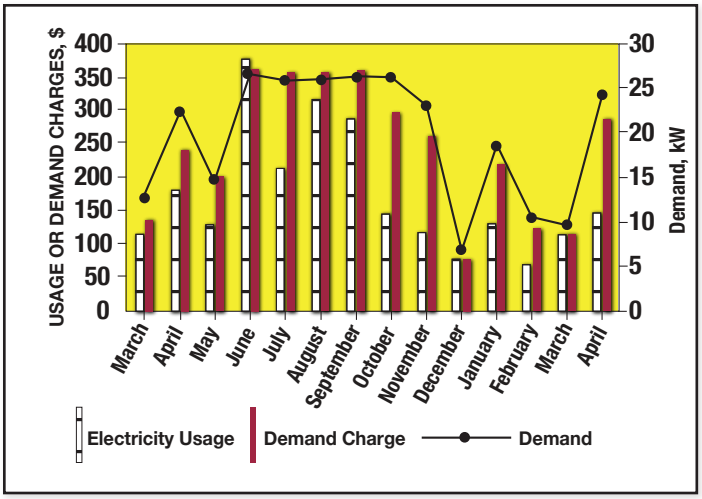

Figure 3. An example of the proportion of monthly energy and demand charges, as well as the demand of a two-house electric meter on a broiler farm.

Unfortunately, when it comes to demand charges, solar power does not provide consistent cost savings. Because solar energy production varies based on weather conditions and time of day, periods of high solar power will not always coincide with the times when a building has its highest power demand. This means that solar customers cannot count on their solar systems to reduce demand charges. A rainstorm at a time when the farm happens to use energy at its highest rate during the month, or when warm summer nights keep all stages of tunnels fans powered on, would result in a demand charge as high as it would have been before installing solar power.

In summary, understanding electrical bills can help reduce energy consumption and total farm expenses by wisely implementing energy efficient technologies. For farms that do have demand charges, these charges can comprise a significant proportion of the bills. Solar PV can save money by reducing the energy charges (including the fuel cost adjustment), but will not consistently reduce demand charges. As a result, solar power may be more attractive for non-demand charge farms than those with demand charges. Reviewing and understanding a farm's electric utility bills is the best way to weigh the considerations regarding electrical use and charges.

References

Muratori, M. & Rizzoni, G. 2014. Role of residential demand response in modern electric markets. Renewable and Sustainable Energy Reviews. 33: 546-553.

Printed by University of Arkansas Cooperative Extension Service Printing Services.

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FSA1101-PD-2-2022R