Saving Energy on Electric, Lighting and Water Systems

Proper installation and maintenance of all electronic systems can lead to significant savings in monthly overhead.

- John W. Bartok, Jr.

If you talk to a grower, one of the most costly problems mentioned is the high electric bill. For most greenhouse operations, the electric bill is about 5-10 percent of the total energy cost and covers such items as the power to run motors, lights, heating elements and controls. A typical bill for a 1-acre greenhouse can exceed $1,000 per month.

The demand for electricity has been increasing rapidly over the last few years due to greater use of electronic devices and machinery. In many sections of the country, electric utilities are operating at maximum output. The new plants now coming on-line are usually peaking facilities that are meant to pick up the slack during times of high demand. While cheaper and easier to build, they do not provide baseload power.

Deregulation, in the states that have it, has not done much to control electricity costs. There is not much incentive to build new plants when companies are being forced to sell their generating capacity. Companies that purchase these plants can sell the electricity for whatever the market can bear.

Conservation may be the only way that growers have to offset the rise in energy costs. Proper installation and maintenance are two ways to achieve significant savings.

Electrical Service

Your electrical service must be of adequate size to handle the load. Adding greenhouse space frequently overloads the system and causes circuit breakers to trip.

In calculating load, it is necessary to make a complete list of electrical equipment, giving full-load amperes and operating voltage. Next, identify the equipment that will be operating simultaneously. This has a demand factor of 100 percent. The next 60 amps of all other loads are assigned a demand factor of 50 percent, with the remainder assigned at 35 percent. An additional amount, usually 25 percent, should be added for future expansion or for additional equipment.

To avoid multiple base charges, all the greenhouses and accessory buildings should be served by one electrical service. It is usually less expensive if a farm rate can be obtained rather than a commercial rate that has an associated demand charge.

Wiring

To meet the National Electric Code, the wire type should have insulation to fit the application: wet, dry or high-temperature. In many greenhouse locations, especially where moisture and dust are present, the code Á requires that the wiring be placed in conduit. Polyvinyl chloride (PVC) conduit is a good choice as it is corrosion-resistant, watertight and easy to install. Watertight electrical boxes and receptacles should also be included in the system to keep out moisture and dust.

One problem common in greenhouse operations is using wire that is too small for the size of the load. This is a frequent cause of fan and furnace motors overheating and failing. It also uses extra electricity that is converted to heat in the wires. An electrician can provide information on the correct wire size. The size is based on the amount of amperage, length of wire and type of insulation.

Motors

Electric motors power most of the greenhouse equipment we use, and given minimum care, they will provide many years of service.

The following service operations should be provided at least once per year and more often if the motor operates under severe heat, cold or dust conditions.

• Keep motors free of dust and dirt, which can restrict airflow across the windings. Vacuum them at least once a year.

• Follow the manufacturer’s recommendations for lubrication and proper cleaning to maintain the equipment that the motor is powering. Sealed bearings do not need lubrication.

• Check wiring and replace worn or frayed wires.

• Clean switch contacts using electrical contact cleaner.

• Check pulleys and belts. Replace belts that are worn and adjust tension so that there is a two-inch deflection halfway between the pulleys. Be sure that the pulleys are secure on the shaft and aligned.

Motor Replacement

When a motor fails, determine the cause. An overloaded motor runs hot, slow and draws more than the nameplate amperage. It may give off an odor of burning varnish or trip the thermal overload switch. You cannot tell by touch if a motor is running hot, as the normal operating temperature is generally 90-120º F above the air temperature – enough to burn your hand.

A common cause of motor overheating in a greenhouse is low voltage. This can be from a wire size that is too small for the distance from the electric source or from too many motors or electrical

devices connected to one line. Use a volt/amp meter to check the voltage and current when the motor is operating.

A defective motor should be replaced with one of the same horsepower rating and voltage. Today, consideration should be given to installing a high-efficiency model. These motors use more electrically conductive materials than comparable standard motors and convert more electrical energy input into mechanical, load-driving output.

For example, a 1-horsepower, capacitor-start motor operating on 115 volts draws 13.6 amps, whereas a similar, high-efficiency motor will draw only 9.2 amps, a 32 percent saving. High-efficiency motors cost slightly more initially, but this cost is quickly recovered. Check with your electric company to see if there is a rebate program for the replacement of inefficient motors.

Lighting

Selecting the right light source can save money on the electric bill. With an average of 16 lumens per watt and 1,000 hours average life, incandescent lamps should not be used anywhere in your operation. Fluorescent lamps in 4- or 8-foot lengths, or the newer compact design, will give about 75 lumens per watt and operate for 12,000 hours. Although the initial cost is greater, the savings in electricity will pay this back quickly. Cool white fluorescent bulbs also give a light spectrum close to sunlight.

For areas that are lighted for long periods of time, high-intensity discharge lighting may be a better choice. These produce light when an electric current is passed through a gas or vapor under pressure. Efficiency is about the same as fluorescent, but the life of the bulb can be up to 20,000 hours. Metal halide gives a white light and is good for work areas. High-pressure sodium provides a yellow light and is slightly more efficient with about 110 lumens per watt.

Lighting should be installed to provide adequate but not excessive light for the task that is being done. For potting, transplanting and office areas, 20-25 foot-candles (ft-c) are needed. For storage areas, 10 ft-c are enough. Use an inexpensive light meter to check the level.

Supplemental plant lighting in a greenhouse may be required at levels of 500-1,500 ft-c. To save on energy, a computer system should be installed that integrates the daily sunlight with enough hours of supplemental light to provide for the needs of the plants, but not an excessive amount.

For all tasks, a uniform pattern of light should project over the work or plant area. This requires careful selection and spacing of the fixtures. Most lighting equipment suppliers have computer programs that will give the best placement.

Security lighting in parking lots and around buildings consumes considerable electricity because Á the lights operate for 12 hours a day or longer. Installing motion detectors to control the light can produce significant savings; it has been found that trespassing and break-ins occur less frequently if the lights are not on all the time.

Watering Systems

At an electric rate of 12 cents per kilowatt-hour, most nonmunicipal pump systems will supply about 50 gallons of water per one cent. Making good use of the water helps reduce the electric bill.

For each pound of fresh matter produced, as many as 2.5 gallons of water move through the plant. With many irrigation systems to choose from, it is important to select one that will provide adequate water without wasting it. Traditional overhead systems apply water in a circular pattern and irrigate both the plants and the area in between. As much as 80 percent of the water may not reach the root system of a crop of potted plants.

Trickle systems place the water near the root system where it is needed. Moisture is supplied to the root zone through drip tubes or emitters, which can save up to 75 percent in water costs. The foliage also remains dry, an advantage in reducing disease problems.

A boom irrigator can achieve much more even watering than with hand watering or a conventional overhead system. The most flexible systems use programmable controllers or micro-computers that allow speed changes, skipping of empty bench areas, selection of boom section to activate and multiple passes over the same area. The watering uniformity needed for plants grown in plugs or cell trays can be obtained only with a boom irrigator.

Ebb-and-flood systems recycle excess water and nutrients and prevent potential groundwater pollution. A tank large enough to store all the solution contains a pump that supplies watertight benches, floor beds or troughs. A controller programs the length of time the water is available to the plants. Every pot or flat gets the same amount of nutrient solution. Energy is reduced as less water is needed.

Other Measures

Friction loss is created when water flows through pipes, valves, fittings and sprinklers or emitters. Supply lines and laterals should be sized to carry the flow needed without excess friction loss. Because friction loss is cumulative between the source and the nozzle, allowances have to be made to ensure that each nozzle has adequate pressure. Check pipe size pressure-loss tables when designing a water system.

Water heaters should be enclosed with an insulation jacket to reduce heat loss. For most applications, maintain water temperature at 140º F or less to save energy.

Hot water pipes should be insulated to conserve energy. One-inch-thick fiberglass or foam insulation Á will save up to $2.00 per linear foot of pipe per year, and the payback is usually less than one year.

With the many pipe fittings and connections in a greenhouse, drips are inevitable. A faucet dripping at 60 drops per minute will waste 113 gallons per month. If this water is heated with

electricity at $0.11 per kilowatt-hour, it will cost $3.50 per month.

Power Generation in the Future

The future of power generation and distribution is being researched. Photovoltaics, the direct conversion of sunlight to electricity, has been under development for many years. Solar panels are presently expensive and economically feasible only in areas where power lines are expensive to install. Future greenhouses may have solar panels built into the roof that will power equipment and lights, with excess power fed into the utility company power grid.

Fuel cell technology, where hydrogen from natural gas, methane or gasoline is mixed with oxygen from the air to produce electricity, is also in the greenhouse industry's future. This technology increases efficiency and reduces pollution, compared to existing methods. Several large industrial companies are testing units, and Northeast Utilities has been interested in installing a unit in Connecticut that would provide heat and electricity for a greenhouse operation.

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