Cutting Costs & Improving Energy Efficiency

in the Greenhouse

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The efficient use of energy can help businesses cut costs and save those hard-earned dollars. In recent years, with advances in greenhouse design, construction, and operation, energy efficiency makes more financial sense than ever. Incorporating energy-saving measures into new greenhouses or additions can provide dramatic energy savings with typical paybacks of three to five years. Energy-efficient retrofits can also deliver solid savings that will mount if energy costs continue to rise. An efficient retrofit is the installation of roof vents for natural ventilation in place of large cooling fans and cooling pad systems that are expensive to operate and maintain. The use of energy-efficient designs, materials, and equipment can even benefit greenhouse owners by appealing to consumers who prefer to support environmentally sensitive companies and products.

If you operate one or several greenhouses, it is worth considering energy-efficient heating and cooling alternatives including natural ventilation, shade and energy curtains, rigid coverings, heating equipment, environmental controls, and partition walls. Here's how some of the latest advances in energy efficiency can help you save money and earn some go-green points.

Ventilation

Maintaining correct temperatures is critical for productive plant growth, but it is equally important to employees and customers inside the greenhouse. More greenhouse owners are reaching out to new and returning customers by extending their sales seasons and expanding into the "destination" garden center market. For those owners, controlling temperatures for their customers' comfort and maintaining a stable and dependable environment for plant products are critical.

There are several roof designs that enable natural ventilation, greenhouse cooling, and dehumidification while lowering energy costs.

Open-roof structures employ vents that hinge on the roof purlins and gutters and open outward and then make a tight seal when the vents are pulled together. When open, these vents allow the same unobstructed path for heat to escape as a chimney would. There are several types of open-roof vents. A single atrium peak vent running the full length of a greenhouse span can allow a minimum of 25 percent opening in the roof covering. Conversely, a twin-vented dual atrium roof system allows for an opening of approximately 50 percent. The dual atrium has fewer gutters and only half the motors and rack and pinion mechanisms needed for a full, open-roof mini-peak system, even though it creates an almost-identical environment. The initial investment costs, maintenance, and energy consumption are less than on a full open roof. The full open roof opens 100 percent of the roof area and is as close as possible to the great outdoors. The three roof designs have their place.

Side and end vents are always recommended for larger and multiple greenhouses. The interior guillotine vent is rack-and-pinion-driven with a typical 4-5-foot length and lifts up to open from the inside with vertical rack and pinions, you do not have to deal with rack arms sticking into the house or posts and external rack arms. The interior guillotine vent offers an appealing, clean look.

Alternatively, the exterior drop-down guillotine (EDDG) vent is easily customizable. They operate similarly to the typical double-hung window. Both types can provide inlet air without the obstruction of a vent door hanging over the vent opening.

Another great retrofit idea is for the Quonset-style greenhouse that uses mechanical cooling. Many of these greenhouses can be retrofitted with truss adaptors and vents to allow for natural ventilation.

Shade and Energy Curtains

A shade/energy curtain that is correctly designed and installed can slash energy consumption for heating by as much as 35 percent by creating insulated air space above the curtain and shrinking the area that requires heating. Curtain efficiency depends on its fabric, greenhouse style, the curtain location, roof design (sloped, flat, truss to truss, or gutter to gutter), outside temperatures, and type of environmental controls installed in the house. Depending on these factors and the number of required motor drives, costs for a curtain can range from $1.25 to $4 per square foot. Given the potential energy savings, a typical curtain is estimated to provide a return on investment within two to three years. Beyond the impact on energy costs, the curtain also cools and shades plants, slowing their transpiration and additional watering needs.

Many energy-efficient tools are used in the dynamic open-roof green houses at Lucas Greenhouses, Monroeville, N.J.

Interior retractable shading is commonly used with natural ventilation. When the roof vent opens, the retractable shade closes or partially closes, allowing for even shading and ventilation through the shade. Dual interior retractable shading systems give growers greater flexibility in controlling the available light levels for different growing requirements. The dual system uses two curtain systems, each with different cloth characteristics. A shade cloth is typically used during summer to cool, minimize plant stress, and reduce water consumption. The second cloth can be a blackout cloth that can be used to adjust day length and heat retention at night. Another popular option is clearer cloth that is used to cover the crop during colder days for heat retention; yet it still allows maximum light for maximizing growing conditions.

An exterior shade system is installed outside the structure using a cloth designed to breathe. Both air and rain pass between the shading. The shade reduces light and heat gain in the greenhouse. Although highly effective in many areas of the country, it is not suitable in regions with significant snow loads.

Most modern steel or aluminum greenhouses can be adapted for curtain systems, making retractable energy/shade awnings an energy-saving option for new construction and retrofits. In addition to providing growers with a relatively short payback, they offer added flexibility in creating optimum growing conditions for a variety of plants.

Heating

Whether powered by traditional or nontraditional fuel sources, boilers drive the heating process. Nontraditional fuels such as wood chips, wood pellets, and grasses are slowly joining traditional fuels such as oil, propane, and natural gas to give growers a full array of fuel choices to control energy costs. Biofuel-powered boilers, which are used by a small but growing percentage of growers, may have special requirements for a secondary fuel source. A wood burner, for example, should always have a dual-fuel option in the event the biofuel pricing skyrockets in price or becomes unavailable. Redundancy of heat source is critical.

Naturally ventilated open-roof greenhouses that incorporate shade and energy curtains can slash energy consumption.

Traditional heating systems include atmospheric boilers, which pull air from the room in which the boiler is located and operate at an efficiency of approximately 80-82 percent, pressurized combustion boilers, with an efficiency of about 85-87 percent, and unit heaters, which can be hydronic (using hot water or steam) or flame-fired (using natural gas, fuel oil, or propane.) Unit heaters cost approximately $0.85 to $1.10 per square foot to heat the typical 20,000-square-foot greenhouse. Although they are easy to install and a traditional favorite, atmospheric unit heater efficiency is only 80-83 percent. Their relative inefficiency has made many growers seek alternative heating technologies or fuel sources. Fresh-air-pressurized unit heaters are also available.

Radiant floors are one heating option. A steady flow of hot water is pumped through tubing in the floor of the greenhouse, going directly to where it is needed — at plant level — instead of into the air. Depending on the grower's crop locations (floor or bench) and temperature requirements, the cost of a radiant floor system would run between $2.50 and $3.50 per square foot for a typical 20,000-square-foot greenhouse. Radiant flood heating typically supplies only 40-50 percent of the total heat load required by the greenhouses in northern climates, but studies show that it can save as much as 30 percent or more in energy costs. It is usually augmented by a unit heater designed to fill the heating gap during cold days.

One-hundred-percent hot water heating offers the greatest efficiency, which is why more growers are going this route. Often, one element of a 100 percent hot-water heating system is radiant floor heating, with additional heat provided from a fin or 51-millimeter pipe placed along the perimeter or overhead of the greenhouse. Any 100-percent hot water system should have more than one source of heat for protection against catastrophic failure of the primary system.

Additional Controls

Energy efficiency is always a work in progress. Heaters, curtains, and roof systems all play their roles in achieving greater efficiencies and reducing energy costs, but there are additional tools that can be brought to bear. Environmental control systems, for example, are invaluable for controlling irrigation, temperature, light levels, humidity, and specific conditions in a multizone greenhouse. Many controllers have weather stations, which monitor conditions outside the

greenhouse and report back to the controller that responds by closing or opening vents, reducing or raising temperatures, operating curtain systems, or irrigating.

Greenhouse design and construction have a profound impact on the energy efficiency of a greenhouse. Particularly important is the use of appropriate coverings. Factors to consider include house size, the use of insulated knee wall panels, the shade percentage and light reflectivity of coverings, and the materials used to build the greenhouse. If plants are grown on the ground, growers may want to avoid shade on the plants by insulating a knee wall only two feet from the ground. In other locations, the typically cold northern wall could be fitted with an aluminum-insulated (white for reflection) knee wall panel all the way to the peak for maximum efficiency. Partition walls enable independent heating, irrigation, and covering of individual zones within the greenhouse. After all, you typically would not fill or empty a larger greenhouse in one period of time, so if this takes a few weeks or months, you could keep certain zones shut down for efficiency.

The biggest sign of changing attitudes and technologies may be in the use of alternative and renewable power sources. Growers around the world, most notably in Europe, are experimenting with power systems based on solar, wind, geothermal, and biofuel technologies. While many growers remain skeptical about alternative power sources, that skepticism is being softened by advances in technology, ongoing research, pilot operations, and a host of financial incentives offered by federal, state, and local agencies, utility providers, and even manufacturers.

Energy efficiency is a way for growers to address escalating energy costs. It may also be a competitive edge for growers in serving new customers who are showing preference for green companies and products. What could be greener than an energy-efficient greenhouse?

Jeff Warschauer has been with Nexus Greenhouse Corporation for over 23 years and has acted as vice president of sales for 14 of those years. Jeff began as the regional sales manager in the Midwest, growing his knowledge and love of the industry. Jeff is without a doubt the most well-known and knowledgeable retail and commercial structure expert in the industry. He is a frequent lecturer and writer on industry-related issues. He and his wife Sharon live in Henryville, Pa.