BUSINESS PROGRAMS

Ten Easy Ways to Cut Energy Costs in Existing Greenhouse Spaces

FACT SHEET

For more information
call 800.762.7077 or
visit focusonenergy.com

Energy can easily be one of the most costly expenses for greenhouse operations. Maintenance and proper materials can reduce energy use.

Soaring natural gas and propane prices have made fuel conservation a top priority for businesses of all types, and as a greenhouse owner you're probably feeling the pinch more than most. You need to maintain plant-friendly temperatures regardless of outside conditions, which means that energy costs, especially heating, are one of your highest expenses—typically second only to labor. Here are ten tips to help you create the environment you need in the most cost and energy efficient way possible.

HEAT LOSS

1. Infrared (IR) plus anti-condensation treated films

Many greenhouses use a double-layer of polyethylene to reduce heat loss. This solution helps to retain heat but it's far from perfect. Standard polyethylene film allows infrared or long wave radiation to be transmitted to the outside, especially on clear nights, and can cause condensation to form on the inside surface. Interestingly enough, condensation actually helps to reduce thermal radiation loss by as much as 50 percent, but also reduces light and solar radiation levels by 15 percent to 25 percent and can compromise plant health. Instead, opt for a combination IR/anti-condensation-treated film. IR film should be installed to the inside of the greenhouse with a standard film on the outside. This duo reduces space heating energy use by 10 percent to 20 percent without condensation problems, and the costs are quite low—typically as little as an additional 2.0 cents per square foot or about $80 for a 30 foot by 96 foot greenhouse. This puts payback at less than one heating season in the Wisconsin climate, even if you only heat your greenhouse for a few months of the year.

2. Insulated side walls

Use a bench system? With a bench system, energy savings can be achieved by insulating side walls, end walls and perimeter with one inch or two inch foam insulation board. Insulation should be dug in 12 inches to 24 inches deep and can extend up to plant height. The foam should have a protective cover such as aluminum foil to prevent UV deterioration and reduce fire hazards. Spray-on foam on framed walls are another good option, but also need to be protected. If foam is placed on the inside of the greenhouse, make sure it's topped with a reflective coating aimed toward the inside. This will reflect direct solar radiation back to the crop canopy and aid in plant growth. Energy savings can be substantial: just two inches of foam insulation around the knee wall of a 28 foot by 100 foot greenhouse will save about 400 gallons of fuel oil, 610 gallons of propane or 558 therms of natural gas annually if your greenhouse is heated throughout the year.

Moveable insulated curtains can reduce heat loss from 20 percent to 70 percent depending on curtain material.

3. Night curtains

While many businesses have their highest energy usage during the day, greenhouses tend to peak during the night: research indicates that a greenhouse uses 80 percent or more of its heating energy after dark. Consequently, greenhouse owners should focus on limiting nighttime heat loss whenever possible, and one excellent way is with a movable insulated curtain. There are several types of curtain materials: porous curtains cut heat loss by about 20 percent to 30 percent when closed, can be used for shade in the summer, and allow water to drain through. Non-porous aluminized materials provide shading in summer and heat retention in winter by up to 70 percent, but hold water which can cause the curtain system to fail from the water weight. Semi-porous aluminized materials do the best job of cutting heat loss—up to 65 percent when closed—provide summer shade and drainage of condensation.

INFILTRATION LOSSES

Infiltration refers to air movement into and out of a greenhouse through small cracks and openings in the building's shell. The following ideas can help to limit these types of losses.

4. Close the gaps

Any hole or crack—no matter how small—can result in unwanted air movement. Eliminate these with weather stripping or caulk and replace any worn out gaskets. Pay particular attention around doors and windows and any point where the greenhouse cover or glazing attaches to the foundation, side walls and end walls, and seals around vents. A 36 inch entrance door with an 1/8 inch wide crack around it will allow about 500 cubic feet per minute of infiltration requiring about 25,000 Btu per hour of additional heat. At $2.00 per gallon of propane, the cost is about $0.55 per hour.

5. Poly film coverings on glass houses

Glass greenhouses tend to have more infiltration because they have a large number of joints. A single or double layer of poly film—installed permanently or only during the winter months—can reduce infiltration and heat loss, but be aware of potential problems. Reducing infiltration can lead to increased humidity levels and faster depletion of carbon dioxide. A double poly cover can reduce heat losses by up to 50 percent, but can also reduce light levels by as much as 18 percent, and might require mechanical ventilation to control humidity and replace carbon dioxide. Weigh the trade-offs and determine which options make the most sense for your greenhouse.

6. Wind breaks

Wind velocity has a direct effect on the infiltration rate. If your greenhouse is located in an open, windy area, a wind break in the path of the prevailing winter wind will help to reduce infiltration losses. A permanent wind break can be created with four or five rows of deciduous and evergreen trees planted four-to-six mature tree heights upwind of the greenhouse. Plant a mix of tree species to guard against losing the entire windbreak from

disease or insects. Proper fertilization and irrigation can accelerate tree growth, and with care and a little luck from Mother Nature, your windbreak will provide some protection in about five years. Need protection now? Make a temporary wind break. You can protect the typical 11 foot to 14 foot high greenhouse with a 10 foot to 12 foot high snow fence placed 40 feet to 60 feet away from the greenhouse.

HEATING SYSTEMS

A consistent, thorough maintenance schedule will help to keep your heating systems in energy efficient running order.

7. Thermostats

Clean thermostats regularly—a dirty thermostat will not read temperature correctly—and calibrate them annually to ensure accuracy. If you purchase a new thermostat or controller, use electronic models with 1°F differentials. Consider a low-cost solid state controller to ensure optimum efficiency; most models offer multiple control options.

Control systems can optimize the efficiency of your greenhouse.

8. Furnace checkup

Furnaces and unit heaters should be serviced and tested yearly by a professional. This helps to ensure furnace safety and energy efficiency, and the increased efficiency will easily pay for the cost of the inspection and tune-up. A two percent increase in efficiency will save an estimated 179 gallons of fuel oil, 259 gallons of propane or 250 therms of natural gas per year for a 30 foot by 96 foot greenhouse that is used year round. Replace older deteriorating unit heaters or gravity-vented unit heaters with power-vented unit heaters or with 90 percent efficiency condensing type unit heaters. The power-vented unit heater will pay for itself in 36 days versus purchasing a gravity-vented unit heater, while a high efficiency condensing unit heater could provide a simple payback of approximately two years.

Gas Burners – The flame should burn as blue as possible; a yellow flame indicates insufficient air. Check gas supply line pressures and check all fittings for leaks.

Oil Burners – All parts replacement/maintenance should be completed as per the furnace manufacturer's specifications, but here are some general pointers. Replace the nozzle annually and change oil filters twice a year. Check pump output pressure: this will typically be between 100 to 120 psi; low pressure causes incomplete combustion. Check the spark jump between igniter contacts and install new 14,000 volt electronic igniters; clean igniter contacts and ignition sensors. At temperatures below 20°F, oil viscosity increases, water droplets freeze and paraffin precipitates out. To reduce the possibility of these problems, move the oil storage tank inside, add fuel treatments and raise pump pressures.

Chimneys – These should be air-tight, have the same diameter as the furnace connection, and be at least eight feet high and at least two feet above the greenhouse peak. A chimney cap is also a good idea: it will help to reduce backdrafts and keep rain out.

Infloor heat can reduce energy costs, produce faster plant growth and eliminate wet floors pictured here.

9. Central heating systems

Each uninsulated linear foot of two-inch heating supply pipe will lose an estimated $6 worth of heat this winter (at $2.00/gallon of propane). Eliminate this waste and expense by properly insulating the heating pipes and air ducts in headhouses and boiler rooms. Insulation is simple to install and usually has a payback of less than two years.

It's also important to have the heating system serviced regularly. This includes changing fuel filters, cleaning nozzles, checking valves and controls, checking and aligning belts, lubricating bearings, testing combustion efficiency and removing soot from inside the firebox. Soot removal is especially critical. Improper air to fuel ratios or plugged nozzles can cause soot to build up in fire tubes and it takes very little soot to compromise fuel efficiency: just 1/8 of an inch of soot can increase fuel consumption by 10 percent or more.

10. Bottom heating

The location of your heating system can improve your energy efficiency. Move heating pipes and air distribution systems from overhead to either under bench, on floor or in floor, and you can save 20 percent to 25 percent in heating costs and have the added bonus of faster plant growth. One study reported a seven percent average yield increase from greenhouse tomato production, largely due to a 7°F higher root medium temperature. If you have a gutter-connected greenhouse, heating pipe will still be needed under the gutters to speed up snow melt.

Want to learn more about energy savings measures for greenhouses? Contact Focus on Energy at 800.762.7077 and ask to speak with an Energy Advisor from the Agriculture and Rural Business Team. Or visit our Web site at focusonenergy.com.

FOR ADDITIONAL INFORMATION SEE THE FOLLOWING:

- Energy Conservation for Commercial Greenhouses, J.W. Bartok Jr, NRAES, Ithaca, NY, 2001.
- Greenhouse Engineering, Aldrich, R.A, J.W. Bartok Jr, NRAES-33, NRAES, Ithaca, NY, 1994.
- "Grower 101: Heating Systems – Maintenance Pays," J.W. Bartok Jr, Greenhouse Product News, September 2003, Vol 13, No. 9.