



By Milt Geiger

There are two seasons for many Wyoming greenhouse owners – winter or getting ready for winter.

Whether using a greenhouse to extend the growing season in spring or fall or using it year-round, energy management is paramount in the operation of a cost-effective, productive structure. More than 75 percent of all energy used in a greenhouse is to heat the structure, so the best bang for your buck generally addresses heat loss.

Different crops need varying amounts of nutrients, water, light, and heat. However much heat the crops need, the tips below will help increase the profitability and sustainability of your greenhouse. Although each greenhouse will have unique levels of energy use and opportunities for efficiency improvements, the following tips are often cost-effective.

Reduce Air Leaks

Airflow in a greenhouse should be controlled by vents and not by uncontrolled airflow through gaps in the structure. Weather-stripping, foam, and caulk are the best tools for controlling air infiltration. Look around doors and fans for gaps and take steps to fill any found. The foundation is another likely weak area, especially in plastic-covered structures, so be sure to fill all the cracks and gaps with caulking or soil. Ensure louvers on ventilation fans shut tightly.

Double Covering

Allow one less chance for heat to escape by adding another cover to the structure. The inside sidewalls and end walls can be lined with polyethylene or bubble wrap to create energy-efficiency benefits similar to a double-pane window. An additional layer to older glass or soft-covered structures can reduce infiltration and heat loss by up to 50 percent.

Energy Conserving Curtain

Just as on a chilly camping trip, more blankets are better. Reduce nighttime heat loss with installation of a thermal curtain, which can cut heat loss by 20-50 percent. The curtain simply covers the greenhouse (inside or outside) and prevents heat loss through the night. During the day, the cover is removed, typically through an automated system. Be sure to have tight closures where curtains meet sidewalls, framing, or gutters.

Foundation and Sidewall Insulation

Heat leaves a greenhouse in all directions through conduction and radiation. Insulate below grade, typically using 1-2 inches rigid polyurethane or polystyrene sheets. Insulating 18 inches below ground increases soil temperature inside a structure by as much as 10 degrees during winter. Depending upon the structure's



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design, the sidewalls also should be insulated to a height of 3 feet.

Site Location

Choose wisely, or at least make the best of what you've got. Wyoming winds can wreak havoc on greenhouses, especially those with lots of air leaks, so the use of windbreaks is advised. Siting the structure in a protected area, for example the lee side of a barn, is an excellent energy savings decision. If planting a windbreak or living snowfence, plant them on the north and west sides of the structure. Be careful to site the windbreak correctly to avoid burying the greenhouse in a snowdrift! For advice on proper placement of a windbreak to avoid snow being deposited where it's not wanted, contact your local conservation district office. (See "Take a break from the wind! Windbreak/living snow fence benefits, planning, and planting" in *Barnyards and Backyards' Wyoming Rural Living Resources* guide for more information on how windbreaks deposit snow.)

Heating System Enhancements

Ensure that heat ends up where you want it. First, buying the most efficient heating system possible, be it propane, natural gas, or an alternative fuel, is generally a sound investment. With existing systems, consider the use of in-floor or under-bench radiators. This is shown to increase the temperature around the plants by 5 to 10 degrees. Install programmable thermostats to accurately control temperature during the day and reduce it at night. Finally, just like in a home, regular maintenance, such as checking filters or dusting radiation surfaces, can improve the efficiency of the system. Just having the system "work" does not mean it is working as well as it should!

Space Utilization

A greenhouse full of plants is an efficient greenhouse. Making the most of the heat put into the greenhouse is one of the best energy management strategies. For example, you could have a full, old plastic greenhouse that looks like Swiss cheese – or a super-tight passive solar structure that is only 10 percent full – and the old greenhouse is actually more efficient per unit of production. Plan the planting intelligently, such as the use of peninsular or movable benches. Other ideas include installing multi-level racks for crops that do not require high light levels. Depending upon the strength of the greenhouse frame, you can grow a crop in hanging baskets on overhead rails or truss-mounted conveyor system. A roll-out bench system can double growing space. Top-level plants are simply moved outside during the day.

Management Techniques

Management techniques are critical to energy efficiency. Although specific plant requirements vary, many crops tolerate, even prefer, lower nighttime temperatures, so simply lowering the thermostat a bit at night can reduce energy use without negatively affecting production.

Generally, fuel consumption is reduced 3 percent each degree temperature is lowered. To delay the start of the greenhouse operation season, build a germination/growth chamber to start seedlings. This will also help you obtain a full greenhouse as soon as possible, which, as mentioned previously, is an efficient greenhouse.

By implementing some of these tips, your greenhouse can operate more cost-effectively while reducing the environmental footprint of your premium, locally raised produce. If you have any questions on energy management in your greenhouse, be sure to contact your local UW Extension office.

(This article is adapted from the work of John Bartok, Jr., agricultural engineer at the University of Connecticut. He shared the information on the eXtension Farm Energy group under the title Greenhouse Energy Conservation Checklist. It is available directly from <http://bit.ly/greenhouseefficiency>.)



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