

Greenhouses Energy Savings Guide

The greenhouse industry is an important contributor to Oregon's economy that accounts for more than \$100 million in gross sales in a typical year. In a competitive market, Oregon greenhouse growers must continuously look for ways to reduce costs, while improving yields. Even with Oregon's moderate climate and ample rainfall, greenhouses require significant energy input. And as energy costs rise, energy efficiency improvements offer an expanding opportunity to trim greenhouse operating costs.

Energy Trust of Oregon is dedicated to helping you identify options for continuous energy improvement. We'll show you how energy is used in a typical greenhouse and can help you understand where to focus your efforts. We've also compiled a list of "next steps" for your review. Talk with your vendor or Energy Trust about which of these steps could have the biggest impact on your energy savings.



GREENHOUSE SHELL

Would improving your greenhouse shell deliver robust

savings? Heating accounts for about 75 percent of greenhouse energy costs. Upgrades to the shell can maximize greenhouse productivity and significantly reduce heating costs.

- Retrofit hoop houses that have a single layer of polyethylene to an inflated double-polyethylene covering to reduce heat loss by about 50 percent.
- Upgrade a hoop house that has a double-polyethylene cover to a double-layered infrared (IR) inhibiting polyethylene to further decrease heat loss by up to 20 percent. Typical simple payback of one month to two years.
- Replace corrugated fiberglass on the end walls of hoop houses with double-wall polycarbonate material, which reduces heat loss and provides a flat surface that may enable a better seal against air infiltration. Typical simple payback of one to seven years.
- □ Upgrade glazing on rigid-framed greenhouses from fiberglass or corrugated polyethylene to double- or triple-polycarbonate to reduce heat loss by as much as 40 percent.
- Seal cracks and holes in the greenhouse shell against air infiltration.

THERMAL CURTAINS

Could thermal energy curtains further reduce heat loss from your greenhouse? Thermal curtains make it easier to maintain greenhouse temperatures at night or when it's cold outside. The performance of thermal curtains varies between manufacturers and models. Your vendor can help you determine which model fits your needs.

- Install thermal curtains to reduce heat loss. Typical simple payback from six months to five years.
- Add controls to automatically open or close thermal curtains according to ambient temperature or time of day.

BOILERS

Is it time to upgrade your boiler and related heating systems?

Making improvements to how you heat your greenhouse and benches can significantly reduce operating costs and make it easier to maintain optimal growing temperatures.

- Tune-up boilers to boost combustion efficiency by up to 10 percent while improving performance.
- Insulate pipes that deliver heated water or steam to prevent heat loss.
- Upgrade to a high-efficiency condensing boiler, which provides more heat from a given volume of natural gas and decreases waste heat exhausted from the boiler. Typical simple payback ranges from three to eight years.
- ❑ Install underbench heating to bring heat directly to plant roots. By delivering heat where it's needed, you can lower the greenhouse ambient temperature several degrees, reducing unit heater costs by 20 to 25 percent. Typical simple payback of one to five years.
- Install radiant floor heating to efficiently deliver boiler water at plant level. Similar to underbench heating, radiant floor heating reduces wasted heat by allowing you to lower the temperature in upper areas of the greenhouse.

UNIT HEATERS

Would upgrading unit heaters to high-efficiency condensing units capture significant energy savings? Today's unit heaters offer better performance and efficiencies than models installed just a few years ago. Return on investment for high-efficiency unit heaters can be as little as one year, and a typical simple payback period for an upgrade to a new unit heater is one and a half to four years.

- Install high-efficiency condensing unit heaters. Today's condensing unit heaters can have efficiencies higher than 90 percent—considerably better than the 80-percent-efficiency models installed just a few years ago.
- Upgrade existing gravity-vented unit heaters to power-vented unit heaters or to separated-combustion unit heaters to take advantage of higher seasonal efficiencies.

CONTROLS

Could new greenhouse controls improve the efficiency of your operation? Modern digital control systems automate greenhouse processes and reduce energy waste by better coordinating energy-using systems. For example, controls can ensure heating systems don't run while vents are open, which results in heated air being exhausted outdoors.

- Replace dial thermostats that control heating systems with programmable digital thermostats to improve coordination of heating and ventilation processes.
- Install digital control systems to regulate temperature, humidity, ventilation, lighting and irrigation using a weather station interface, sensor feedback or digital timers. Additional capabilities, such as data logging and energy use optimization, also may be included in the control system. Typical simple payback of one to five years.
- Program digital control systems for a nighttime setback to slightly reduce heating while still maintaining adequate temperatures.
- Calibrate sensors that work with control systems to ensure accurate assessment of the conditioned space and proper system adjustments.

VENTILATION

Consider taking steps to reduce greenhouse fan energy through natural ventilation or by upgrading fan technology. Fan systems that ventilate greenhouse spaces could be evaluated to determine if higher efficiency options are available, reducing the electrical load.

- □ Change from a powered ventilation regimen to partial or full natural greenhouse ventilation to lower operating costs while maintaining or improving air-change rates.
- □ Replace low-efficiency fan systems with high-efficiency models.
- Install controls that reduce fan run time during periods when constant operation of the fan is not necessary.

ENERGY TRUST INCENTIVES MAY REDUCE PAYBACK PERIODS LISTED IN THIS GUIDE BY AS MUCH AS 50 PERCENT ON CAPITAL UPGRADES.

LIGHTING

Are there opportunities to upgrade lighting systems in greenhouse support structures? Lighting upgrades could reduce electricity use while improving the quality of light available in support structures.

- Replace HID lighting, such as metal halide and sodium vapor, with linear fluorescent options, such as T5 high-bay or T8 task lighting. Linear fluorescents reduce energy use by 50 percent and enable instant-start/restart, allowing you to turn off and restart lamps without any warm-up time.
- Change incandescent lighting to compact fluorescent lighting, which provides similar light levels while reducing energy use 75 percent or more.
- Install occupancy sensors to further reduce energy use in intermittently used spaces. Where installed, occupancy sensors can reduce lighting energy use by up to 25 percent.
- Consider installing LED lighting, which has become a popular energy-efficient replacement for other technologies.
 LED lighting combines ultra-high efficiency with excellent performance in an increasingly affordable package. LEDs have an extremely long life of up to 50,000 hours, saving significantly on time and money associated with lamp replacement.

IRRIGATION

Could irrigation systems be optimized to save energy? Pumping systems that support greenhouse spaces can be optimized to use the smallest amount of electricity while providing proper support of greenhouse irrigation.

- Optimize irrigation pumps for the particular application.
 Oversized pumps that run at constant volume can be replaced or adjusted with an impeller trim.
- □ Install variable frequency drives, VFDs, on existing pumps that serve areas not requiring constant flows. A VFD adjusts the speed of the pump motor to the system need in real-time.

ENERGY USE PROFILE FOR A TYPICAL GREENHOUSE



ENERGY PLAYS A CENTRAL ROLE IN GREENHOUSE INDUSTRY

Energy Trust can help you take control of your energy costs and reduce the cost impacts of energy on your bottom line.

Energy Trust provides cash incentives and technical services to help your operation improve energy efficiency and reduce operating costs. Our Program Delivery Contractors, PDCs, are highly skilled industrial energy experts who understand different types of greenhouse systems, what will work in your facility and how to make the most of energy-saving opportunities. Energy Trust PDCs are located throughout Oregon and can work closely with your personnel to achieve your goals. Thermal efficiency is the percentage of total energy available in a given volume of fuel that is converted into usable heat for the interior of the greenhouse. Seasonal efficiency is the thermal efficiency value including heat-loss from unit heater.

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Discover how to continuously improve your energy performance. Talk with your PDC, or call Energy Trust directly at **1.866.202.0576** or visit **www.energytrust.org/industrial-and-ag**.

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Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural and Cascade Natural Gas save on energy costs. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future. **Printed with vegetable-based inks on paper that contains 100% post-consumer waste. 3/14**

UNIT HEATER EFFICIENCY



