

- Control system update-automated control systems can produce more consistent climates while minimizing energy inputs
- Reposition heating pipes
- Replace boilers and unit heaters with higher efficiency models
- Retrofit fan cooling systems with higher efficiency equipment

What are the energy savings from major retrofits, expansions, and new construction?

Consider the design of the greenhouse and all mechanical systems from the perspective of energy use in addition to the primary functional considerations. Good greenhouse design is the art of integration. Be sure to compare the following structures and components to determine the best way to save energy without compromising your production needs;

- Structural designs
- Covering materials
- Insulation methods
- Natural vs. forced ventilation
- Hot water, hot air or radiant heating systems
- HAF vs. fan and poly-tube air distribution
- Manual, semi-automated or fully automated controls

Each of these major component decisions have their own pros and cons and they often interact with the other greenhouse components selected. Keep reevaluating your design until

all components fall into place. Work with your greenhouse and equipment suppliers until you are happy with the integration compromises. If you lack the experience and knowledge required to do this, consider contacting an experienced supplier or consultant to assist you. The decisions you make at the design stage will be with you for decades to come.

Remember, whether you are building or retrofitting a greenhouse, to look at every component with regard to its energy costs, that are required for its functionality.



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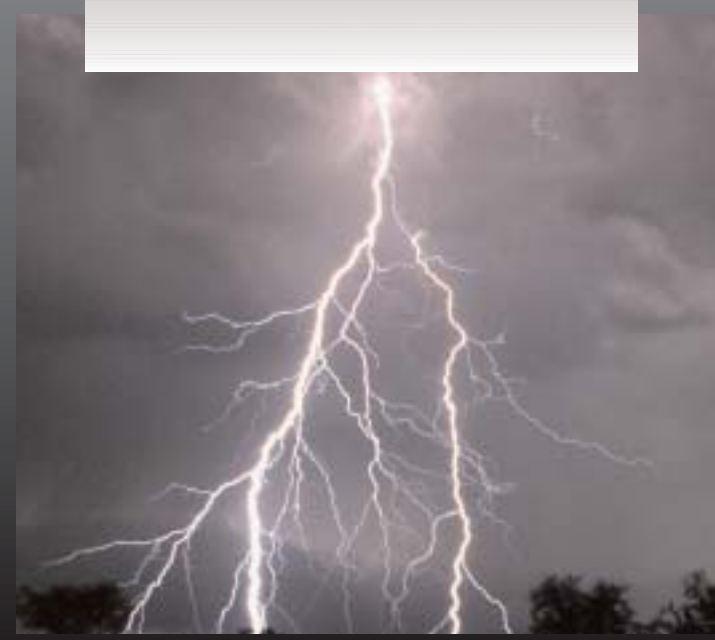
Printed in the USA

HELPFUL HINTS

ENERGY CONSERVATION



PUBLISHED BY:
 THE NATIONAL GREENHOUSE
 MANUFACTURERS ASSOCIATION



Why save energy?

- Purchased energy is a significant and ongoing expense for most greenhouse operations
- There is high probability that energy prices will continue to rise
- Most greenhouse operations have the ability to economize on fuel use

Energy is consumed all the time, year after year. Once it is consumed, you can never get it back. Anytime you can save energy costs, you are moving money directly to your bottom line, increasing your margins and competitiveness. Energy efficient systems are usually engineered for optimum conversion, distribution and retention of heat. They can often produce better, more uniform crops, as well as being good for the environment. Even if it takes additional capital to achieve the highest level of energy saving, today's interest rates are low, and the long life of many energy saving greenhouse system components make them sound investments.

Where can I save energy?

- Make the most of 'free' energy from sunlight by using light efficient structures and high quality glazing materials
- Use the lowest cost sources of energy
- Get the maximum benefit from the energy you buy through efficient energy conversion
- Reduce wasted or lost energy through conservation and insulation

- Reduce energy demands by adjusting crop timing and crop production regimes

Saving on energy costs is a multi-tiered effort. Once you have taken the obvious steps to reduce energy waste, careful investment in energy saving technology must be kept in balance with capital costs, additional maintenance and payback periods.

The following checklists detail a number of possible areas where you might be able to reduce energy use.

What are some inexpensive improvements with short term payback?

- Insulate pipes, foundation walls and north walls
- Use light reflective materials on inner greenhouse surfaces such as ground covers, north walls, posts and benches
- Close up fan housings with insulated covers
- Caulk and seal all air leaks
- Clean, service, adjust all louvers and vent systems and check to ensure they seal properly when closed.
- Make sure exhaust fans, pad and fan systems are in good working order
- Use poly liners to reduce heat loss and increase the RH factor in cold winter months

- Concentrate crops and shut unused greenhouses
- Plant later and grow warmer or plant earlier and grow cooler
- Check control settings for accuracy and proper temperature sensor placement (usually at the top of the crop canopy)
- Service and adjust boilers and unit heaters
- Make sure thermal curtain systems are working properly and are in good repair
- Isolate propagation areas from growing zones - only heat the areas you currently need
- Maintain clean glazing surfaces
- Reduce boiler water temperature in warmer weather
- In colder months, use the lowest heating setpoints and the highest cooling set points possible
- Use split day/night temperatures where possible
- Allow climate temperatures to rise naturally late in afternoon to reduce energy demands at night

What are some retrofit improvements with long term payback? (2 or more years)

- Thermal curtain installation or retrofit
- If you capture CO₂ from your boilers, consider heat storage options