Retrofitting a Greenhouse for Energy Conservation

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Introduction

Energy use to heat and operate greenhouses throughout the various planting and growing seasons can be one of the largest costs incurred by growers in the Northeast. Here we outline ways in which the grower can reduce energy costs by either replacing older inefficient infrastructure or through the implementation of several measures to help reduce heating and electrical energy costs.

Section 1: Tighten up the house and reduce heat losses

Weather strip, replace gaskets, and caulk joints

Heating costs can be reduced 5 to 10% b***y implementing these simple tasks***

1. Install quality insulated doors, and make sure the doors seal/seat properly (Fig. 1).

Fig. 1. Well-sealed, fitted door.

Fig. 2. Corner joint weather-proofed with expandable foam spray insulation.

2. Seal and caulk cracks around the edges and corners of the greenhouse with caulking or foam spray (Fig. 2).

3. Repair rips in plastic with greenhouse tape (Fig. 3).

Fig. 3. Rip in poly repaired with greenhouse tape and clear silicone caulk.

4. Line inside of insulated side or end walls with poly to achieve a double wall effect (Figs. 4 & 5).

Fig. 4. End wall insulated and covered with a layer of poly.

Fig. 5. Aluminum-faced foam board to insulate the end and side walls eliminates the need for the poly layer.

5. Seal outside air fans and vents in winter with poly or foam board and make sure fan louvers are well lubricated and adjusted to seat properly (Figs. 6 & 7).

Fig. 6. Fans of this type should be sealed from the inside with foam board or poly.

Fig. 7. Improperly adjusted louvers. Note the cracks (indicated with arrow) where heat can easily leak to the outside.

Additionally, if you have a glass greenhouse, especially an older one, covering it during the winter months with a single or double layer of poly can reduce heat loss by as much as 50%, although every layer of poly reduces light by 8 – 10%.

Section 2: Insulating walls, planting windbreaks and proper air flow

1. Insulate foundation perimeter and kneewalls from 24 inches below ground to bench height with 1 - 2 inch thick foam insulation board (Figs. 8 & 9).

Fig. 8. Insulate the perimeter foundation with foam board.

Fig. 9. Foam board insulation on a knee wall from the floor up to bench height covered with poly. Use of aluminum-faced board may eliminate need for the additional layer of poly.

2. Insulate the north endwall with 2 inch thick foam insulation board. The south wall can be insulated up to bench height but any higher than that blocks too much sunlight (Fig. 10).

Fig. 10. Insulated and poly-covered end wall.

3. Construct man-made fences or plant mixed deciduous and evergreen trees as windbreaks to the north and west (Fig. 11).

Fig. 11. Constructed windbreak.

4. Install horizontal air flow fans in the greenhouse to keep air circulating properly (Fig. 12). It is good for energy conservation and disease reduction.

Fig. 12. Properly installed horizontal air flow fans (red arrows). There should be one or more on each side arranged to keep air moving in a circular manner.

5. Use poly with an infrared inhibitor (IR) and anti-condensation film on the inner layer for 12 - 15% heat loss savings.

6. Install energy/thermal curtain system. Will reduce heating costs by up to 30% and also help with cooling in the summer (Fig. 13).

Fig. 13. Thermal curtain used for shade to cool plants on a hot sunny day.

Section 3: Improving efficiency by reducing electric demand

General considerations:

1. Inspect all wiring and circuit panels for corroded connections and nicks and repair as necessary.
2. Make sure all circuits are of adequate amperage and not overloaded.
3. Replace all 3 HP or larger motors with high efficiency ones.
4. Check belt tension and alignment on motors.

Fig. 14. New highly efficient fan.

Cooling system:

1. Replace ventilation fans with new high-efficiency models (Fig. 14).

2. Replace ventilation fans with roof vents and roll-up sidewalls (Fig. 15).

Fig. 15. Greenhouse with roll-up sidewalls.

3. Install energy-thermal curtain system to provide shade. (See Section 2, no. 6)

Heating system:

1. Install a high efficiency condensing type furnace. Choose a fuel source that is the most cost-effective for your area (Fig. 16).

2. Service furnace regularly, including cleaning the burners and changing nozzles and filters.

Fig. 16. High efficiency gas furnace.

3. Clean thermostats of dust, debris, and spider webs. Consider upgrading to newer electronic thermostats with 1^{o} differentials (Fig. 17). Calibrate for accuracy (Fig. 18).

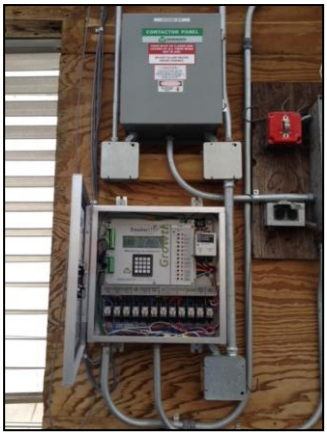

Fig. 17. Two types of new digital thermostats with 1° differential. These control the furnace, louvers and fans.

Fig. 18. Older thermostats that should be cleaned annually.

4. Move heating sources from overhead to floor or under bench locations (Fig. 19).

5. Insulate heating system pipes in areas where heat is not required to prevent heat loss.

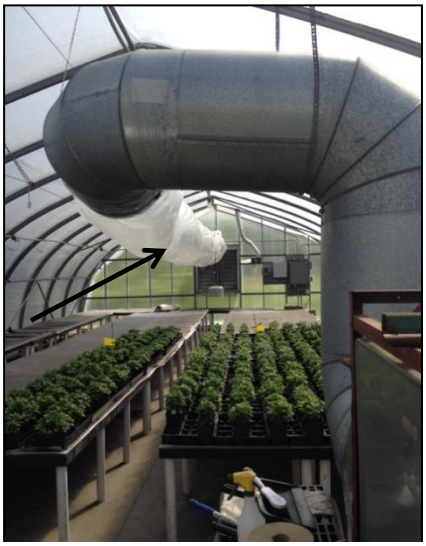

Fig. 19. An overhead heat system that would be more efficient if re-located under the benches. It should be noted that under-bench locations may require increased need for watering.

***Lighting*:**

1. Replace incandescent lighting with CFL (compact florescent lamp), HID (high-intensity discharge) or LED (light-emitting diode) bulbs to save up to 65% on lighting energy use. High-pressure sodium lamps are the most common high-efficiency lights used in greenhouses but LEDs are becoming available now which offer even greater efficiency, longevity and variable intensities.

Quick Growers' Checklist for Energy Conservation

Greenhouse #:_____ Date:_____

A. *Tighten the greenhouse up in the winter* Check off

1. Make sure doors seal tightly, or install new insulated doors. ☐
2. Seal/caulk cracks in edges and corners. ☐
3. Repair all rips in poly with greenhouse tape. ☐
4. Line inside of insulated kneewalls and endwalls with poly. ☐
5. Seal up outside fans and vents with poly or foam board. ☐
6. Make sure fan louvers are straight and seat properly. ☐

B. Insulate walls, establish windbreaks, create proper air flow

1. Insulate foundation perimeter and kneewalls. ☐
2. Insulate north endwall and south endwall to bench height. ☐
3. Construct or plant a windbreak. ☐
4. Install horizontal air flow fans. ☐
5. Use infrared inhibitor (IR) and anti-condensation poly for inner layer. ☐
6. Install an energy/thermal curtain system. ☐

C. Improve efficiency by reducing energy demand

1. Inspect all wiring and circuit panels for corroded connections. ☐
2. Insure circuits are of adequate amperage and not overloaded. ☐
3. Replace all motors over 3hp with high-efficiency models. ☐
4. Replace ventilation fans with new high-efficiency models. ☐
5. Replace ventilation fans with roof vents and roll-up sidewalls. ☐
6. Convert to high-efficiency condensing-type furnace. ☐
7. Service furnace. Clean burners, change nozzles and filters. ☐
8. Clean older thermostats of dust, debris, spider webs, etc. ☐
9. Consider upgrading to new electronic thermostats. ☐
10. Move heat source from overhead to floor or under-bench location. ☐
11. Insulate heating pipes in areas where heat is not required. ☐
12. Replace incandescent lighting with CFL, HID, of LED lighting. ☐

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