GREENHOUSE ENERGY CONSERVATION – A CASE STUDY APPROACH FROM PENN STATE

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The rapid rise in energy costs during the summer of 2005 should be a wake-up call for the greenhouse industry. While costs might drop again in the short term, the long term trend is for steadily increasing prices and increased price and market volatility. Greenhouse growers must adapt to this reality and once again evaluate their energy conservation efforts and the relationship between energy and other production costs. Research on greenhouse energy conservation was in vogue during the late 1970’s, and much of what was learned then is standard practice now, for example the use of double layer plastic and thermal blankets. Little has been done since then, and some growers have forgotten some of the lessons learned. Today’s students and some growers who did not go through the last energy crisis may not even be aware of the research done then. Energy conservation is a topic often covered in Greenhouse Management courses, but students lacking a frame of reference may not really grasp the importance of the topic. Most students learn better through hands on work and personal experiences, but how do you take something like energy use and conservation in the greenhouse and make it real? At Penn State we have begun using an energy audit case studies approach to teaching this topic. The new and exciting part of this is linking extension and outreach directly with resident undergraduate education by having students go into a commercial greenhouse and do an actual energy audit. This experience gives the students a chance to work directly with commercial growers, improves their communication and observation skills, and makes the topic real. And what do the growers get for their participation? They get a fresh and very critical set of eyes evaluating their greenhouse facilities and providing valuable feedback on potential areas where energy might be saved in their greenhouses.

The class greenhouse energy audit project was piloted during the fall semester 2005. There were two main objectives to the project; 1) to help greenhouse growers identify ways they could save energy in their facilities and production systems; and 2) to get students into a commercial greenhouse to work with a grower on a project with real meaning and impact but of a scope sufficiently limited as to be accomplished within the short time frame of a semester class. Students in the Greenhouse Management class at Penn State were divided into 3 groups of 6 individuals. Each group was assigned a commercial greenhouse to visit, study, evaluate, and provide recommendations on energy saving practices. Greenhouse growers were selected by extension specialists in three different regions of Pennsylvania. Selection was not based solely on greenhouse size or energy use, but also considered criteria such as past involvement in extension activities and the potential to implement and benefit from the energy audit report.

Student involvement began with regular classroom instruction covering greenhouse structures, heating, cooling and control systems as well as basic energy
conservation. In addition to these standard lecture topics a new lecture was added on how to conduct an energy audit. Les Evans a greenhouse energy systems consultant from TrueLeaf came to class and walked the students through the process of conducting an energy audit. After 10 classroom sessions, the students were ready to begin the actual audit process by meeting the growers. The three commercial growers accompanied by their regional floricultural extension specialists met with the students in the classroom on the University Park campus to discuss their business, production systems, and energy management and conservation concerns. The growers were asked to select 1 or 2 specific greenhouses or sections for the energy audit since the students had a limited amount of time and could not conduct a detailed audit of an entire large greenhouse range. Following this initial consultation, students planned a site visit to gather data. The students accompanied and assisted by a faculty member, traveled to the commercial greenhouse and then took detailed notes on the size, shape, construction material, and cover for the greenhouses. They also made notes on how energy was used, managed, and lost in the greenhouse crop production systems at that business. Digital photos and notes, and measurements of the structure and production systems were used to document observations.

After the site visit, the students in each group had 3-4 weeks to prepare a final report recommending up to 10 energy conservation or management practices for each grower. Suggestions for implementation as well as estimated costs and savings were included where the students could obtain sufficient data. A copy of the student’s report (unedited by the faculty) was delivered to each of the growers.

Although each of the growers’ structures, and production systems were different, some commonalities were obvious from the three student reports. These observations and suggestions were included in multiple reports; 1. Repair and maintain the greenhouse structure. The students suggested sealing cracks and repairing tears in the greenhouse coverings. In every case, students observed parts of the greenhouse where deferred maintenance was costing energy. Many of these areas were so obvious that the grower had looked at it so often that they just didn’t see it anymore. 2. Replacement of inefficient components. Two groups suggested replacing doors that did not close very well and the third group suggested replacing a side wall that was in poor condition. 3. Add insulation. The students suggested adding more insulation to the perimeter, north or other walls, over unused exhaust fans, and around distribution pipes for root zone heating. These are all simple energy conservation techniques that were common in the 70’s but have become less used when energy was inexpensive. 4. Thermal blankets. Two groups suggested that thermal blankets could reduce heating costs in multi-bay greenhouses. 5. Modify heating system or fuel. One group proposed installing more efficient unit heaters while another group suggested moving the convection tubes used to heat the greenhouse. The third group looked at changing fuel type. This is a big step for a grower and should only be made after careful consideration of all the ramifications. Predicting long term availability and costs for any fuel is not easy. There are however
several things most “experts” agree on. The price of natural gas and oil is going to continue to increase in the future and these markets will continue to be subject to disruptions due to weather and politics. Coal in contrast is expected to remain fairly stable in price. 6. Space utilization. The last commonality was using the space more efficiently either by placing a temporary wall in a gutter-connected greenhouse or moving more plants to one house while closing the other.

Involving students in this project provided a unique learning and teaching experience for both the students and the commercial greenhouse operators. Cooperating growers indicated that they would use the results to improve their production systems. The success of this project suggests that this approach could be used at other Universities and potentially with other “auditable” aspects of crop production, both in and out of the greenhouse.

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