Measuring for Curtains

Determining your needs — and evaluating their potential energy and economic ramifications — is the first step in selecting the curtain that's right for you.

Blackout curtains feature low light transmission and have the most energy savings of all greenhouse climate screens.

By Kurt Parbst

As the new president has just measured the White House windows for curtains, this may be an appropriate time to discuss a selection process for greenhouse curtains, or climate screens, which are used to either improve the plant growing environment or for energy conservation, or both. This is a popular time to be mindful of energy consumption, and there are many opportunities to explore.

Selecting the Right Type

Start by defining primary and secondary needs created by the demands of your crops, schedule, local climate and the limitations of your facilities. Make sure your primary needs are satisfied and that secondary needs are not compromised by your selection. The possibilities include screens for shading for temperature reduction, screens for energy saving, combination screens for shading and energy saving, and blackout screens for day-length control. Sometimes a single screen cannot deliver all of the necessary benefits and multiple layers are required.

In our current business climate, increases in the costs of inputs are outpacing the rate at which growers can raise prices. In order to preserve profits and avoid asking for price increases, it is necessary to become more efficient. In plant production, that comes via automating labor-intensive processes and reducing the cost of space heating. Once you have identified the space that must be heated, investments should be considered for making heating *economically* efficient. When opportunities for analysis, conservation and efficiency have been exhausted, consider alternative or renewable energy resources. The guiding principles here are that these investments will be large and long term, so minimize the size or capacity of these investments.

Calculating Payback Based on Energy Savings

An investment payback based strictly on the avoidance of heating energy would require the installed price of the system to be divided by the typical annual savings. Since weather and fuel prices both fluctuate, it is good to use 25-year or better weather data when calculating heating demand and a typical, likely or multiyear average fuel price. A payback calculation can be obtained from most providers of curtain systems.

Location Matters

There are scores of reasons behind greenhouses' locations. Some are related to a specific selection of the local climate, and others are related to their market proximity. Local climate and fuel prices have large influences over the energy costs of a greenhouse operation. Some growing areas have cost advantages whereas other areas have market or climate advantages. Whatever the reason you chose to erect or purchase your greenhouse in its present location, you can switch fuels, but you are not likely to pick up and move.

One technology that can be used to improve both the greenhouse growing climate and the heat-loss rate through the envelope are retractable energy or combination energy/shade screens, which function by slowing the rate at which heat escapes a greenhouse, much like insulation in the attic of a home. All important modes of heat loss are affected: radiation, convection, conduction infiltration, etc. Although the inherent heat-loss rate varies with different glazing types, the improvement in heat-loss rate applies across the board. Of course, the glazing type has a large influence over light transmission and heat loss.

Without getting too detailed regarding the selection of which screen or curtain is most appropriate, it is reasonable to assume that an annual savings of 35 to 40 percent can be achieved.

Getting the Light Right

Given the dynamic nature of year-round greenhouse growing, it is likely that there is no single ideal curtain type that can deliver maximum benefit in all seasons of the year. Most of the United States has a rather extreme climate, with some weeks being very hot and others that can be quite cold. It is important to

First Things First

There are a couple of ways to reduce the cost of spacing heating: burn less fuel, or burn cheaper fuel.

The cheaper-fuel route has become very popular lately, with all sorts of biomass materials and even coal being taken into consideration for the boiler. Heating demands can be satisfied with renewable energy sources. They are very clean, but not so reliable. For example, you only have solar power when the sun is shining and you can only generate wind power where and when the wind is blowing. The reliability of biomass will increase with demand, and its affordability will be determined by supply.

Switching fuel or using renewable energy sources may be the answer, but it should not come from the first question. The first question or step should be, "Have we conducted an energy analysis to identify opportunities to reduce energy use?" Once you know where the bulk of the energy is being allocated, you will know where to focus efforts. The second step should be along the lines of energy conservation, which is to change current behavior. The simplest example of this is to turn off lights when no one is in the room. In the greenhouse, this means consolidating early-production space to heat smaller areas and to adopt practices such as cooler poinsettia production or buying plugs or small plants rather than starting them. There is no point heating unnecessary space. The third step is to identify opportunities in increasing energy efficiency. Energy efficiency sounds a lot like energy conservation, but it is different in that it comes after conservation, and it means performing the same or remaining functions using less work — in other words, using more energy-efficient equipment.

The term "negawatt" emerged as a typo in a 1980s Colorado Public Utilities Commission report. It came to describe a watt of energy that wasn't used thanks to energy efficiency. This "virtual" generation of electricity can supply growth by increasing efficiencies rather than by increasing generation. The same concept can be applied to heating energy, and equipment used to increase efficiency in the greenhouse includes curtain systems.

select a curtain based on its most valuable benefit and to understand the consequences of compromises that may be created when making a selection.

Current dollar strength and falling petroleum prices notwithstanding, energy prices are growing, and efforts and incentives for conservation will be increasing. If a screen is to be used only during the night, it is not necessary to be concerned about light transmission. In fact, in this case a blackout-type curtain may be used and the possibility exists to use it for growing plants that may become more productive with short days. Often, a combination energy and shading screen is used. Material choice is a compromise between light transmission and energy savings as the greater the shading (which comes from reflective aluminum) the greater the energy savings as aluminum impedes radiation heat losses.

Choosing the right shading level is important, but one virtue of a retractable system is that the time of use can be variable and dependent upon light levels and temperature. If shade-level selection is driven by a wish not to exceed a maximum light intensity, then it is important to follow these steps. Start with the maximum outdoor midday summer solar intensity — use any units, but be consistent. Calculate the transmission through every obstruction until the plant level is reached. First, calculate transmission through the glazing. Consider multiple levels if appropriate, and apply a factor to account for dust or dirt buildup. Next, calculate transmission through the structure and any suspended equipment, such as irrigation booms and lamps. This level of shading is often ignored and normally underestimated. The calculation through the structure and equipment is probably not available anywhere and will need to be quantified with actual measurements. Once these overhead obstructions are quantified, the result is the amount of light available to reach the plants. The shading level of the screen is decided by correcting the available light to the predetermined maximum intensity.

Doubling Up

In general, a single climate screen is a compromise between energy savings and shading for cooling. With the popularity of naturally ventilated greenhouses, venting through the roof means that a screen with closed construction needs to be left cracked open to the extent that the area of the gap matches the area of the vent opening. This is not as efficient as completely closing a shading screen with open construction and leads to bands of unshaded light that may differentially dry the bench or floor and create the need for spot watering.

Some will find that a double layer of energy/shade screens is the right answer. Using a second layer is analogous to choosing attic insulation with a higher R-value, which has a higher resistance to heat loss. For example, a plug grower in New Hampshire is in a situation that makes heating their greenhouses expensive: Growing plugs is rather energy intensive during cold weeks at the beginning of the year. Additionally, the most reliable and available fuel is heating oil. This grower decided to add a second curtain that could ➧

Classifications of Greenhouse Climate Screens

Class	Features	Benefits
Energy Saving	High Light Transmission (80-88%) Moderate Energy Savings* (43-47%)	Can be used during the day and in combination with other screens at night
Shading (by solar reflection)	Various levels of light transmission (15-70%) Limited Energy Savings (20-35%)	Used during the day to control plant temperature and moderate light in naturally ventilated houses
Energy Saving/Solar Reflection	Various levels of light transmission (20-70%) High Energy Savings (50-70%)	Used as a night curtain and during the day with either mechanical ventilation or partially covered with natural ventilation
Blackout	Low Light transmission (<0.5%) Highest Energy savings (up to 75%)	Used to accomplish short days and a night-use energy curtain

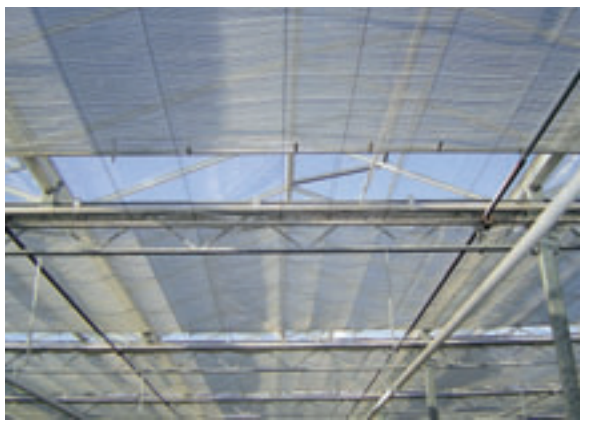
**Energy savings is defined as the benefit of having a greenhouse equipped with a well-sealed overhead curtain compared with an identical greenhouse with the same crop and weather and not curtain system. Sidewall losses are ignored which is more relevant for larger greenhouses. Savings is realized when the curtain is deployed. The energy savings number is used as a starting point for estimating annualized savings. Energy/Solar Reflection and blackout curtains contain aluminum foils.*

be used as a second layer at night and give their plugs a warm overhead surface during the day before the roof had a chance to heat up. Their function is especially noticeable on cold, dark days, when the boilers cycle rather than operating at full capacity. Satisfying light demands in this situation dictates the hours that a screen or second layer can be used. This grower estimates a three-year payback for the second layer and enjoys the extra control over the climate.

Paying the Bill

In our current economic climate, energy policy will be getting much attention, and the number of incentives available to support energy-efficiency investments will undoubtedly increase. There are federal monies available, as well as state and utility-based programs. Some utilities are giving rebates of 20 to 25 percent and financing the investment on the monthly energy bill without finance charges. Consult the Database of State Incentives for Renewables & Efficiency, www.dsireusa.org, and contact your energy utility to see what programs are available. It is likely that if there is not a formal program already in place in your area, there is a legislative mandate to offer incentives on a custom basis.

In case you were really expecting to learn about measuring your greenhouse for curtains, please rely on your trusted professional supplier for that. Greenhouse curtain systems are not overly complicated, but they are dynamic. So for a long system lifetime, it pays to have the sizing selected by a trained eye and the installation done by experienced hands. As you evaluate strategies for becoming more profitable, don't ignore the fuel of energy efficiency. To quote Amory Lovins, who coined the term "negawatt," "Energy efficiency isn't just a free lunch; it's a lunch you are paid to eat." GPN



Calculate the light transmission through every obstruction until plants are reached.

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