GROWERTALKS

Cover Story

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Cut Your Energy Bill This Year!

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Let's put this winter behind us. Repress the memories like what you learned in high school algebra. Forget about it like a psycho ex-boyfriend (or girlfriend).

For many of us, we have a reason to be more thankful than normal that spring is literally knocking on our door. Most of us had never heard of a "Polar Vortex" until this winter, when temperatures in many parts of the country were 20 to 30 degrees below normal. In your faithful scribe's hometown of Chicago, the temps got to as low as minus 15F with windchills minus 50F. The home furnace was working overtime and, thankfully, never quit on us.

Pictured: This greenhouse has 8mm Twin Wall and 16mm Triple Wall poly, which offers a higher R value and lower U value for more energy savings.

Of course, this memorable winter gave a lot of growers reason to have some sleepless nights, which are usually reserved during peak spring production. Keeping the greenhouse warm was a major worry, compiled with cuttings and plugs arriving half frozen and staff not even being able to make it into work because of stalled cars and piles of snow.

Jim Clesen of Ron Clesen's Ornamental Plants in Maple Park, Illinois—about 60 miles from Downtown Chicago—said that his heating bill increased about 40% to 50% in dollars spent compared to last year. Clesen's used about 20% more natural gas and they have seasonal Quonsets heated by propane that are open for eight to nine weeks during peak. All of this will have a major impact on their bottom line, said Jim.

"Luckily, after last year's bad April weather, we put up cold frames to house some of the early spring crops, shielding them from the elements," Jim explained. "We didn't plan on heating them, but you do what you have to do to ensure the customer's satisfaction."

According to the U.S. Energy Information Administration (EIA), natural gas prices skyrocketed in January—

obviously because the demand was so high—bringing their inventory to the lowest levels in 10 years. Natural gas prices went as high as $8.00 per million British thermal units (MMBtu) in February—almost double compared to 2013.

And it was the same story for oil and propane, as the price per gallon steadily climbed up to more than $3.00 a gallon wholesale for oil and $3.50 for propane. Last year, it was steady at about $2.30 per gallon for oil and less than a dollar for propane.

What if next winter is just as bad? There are a few things you can do to make sure you're prepared and to alleviate some of the pain of an extremely high fuel bill.

Take control of your controls

First, if you currently have a thermostat, you should think about getting rid of it. These may be inexpensive to install in the beginning, but they end up costing you money for the rest of that thermostat's life.

"We still see far too many thermostats," said Patricia Dean, CEO for Wadsworth Control Systems. "They are often off by five degrees, which makes it really hard to control the equipment. We see instances where the actual temperature in the greenhouse is 70 degrees. There will be a heater connected to a thermostat that thinks it is 64 degrees, while the thermostat next to it thinks it is 72 degrees and so it's got the exhaust fans running. Obviously, this is a huge waste of energy."

The best option, said Patricia, is to use a single temperature sensor, which comes with four stages of control. And it's pretty inexpensive because it doesn't have a lot of bells and whistles. However, Patricia said it's important that you include ramp with your sensor, which controls the transition between day and night temps.

"The issue is that if night is set to have a significantly cooler temperature than the day period, it will happen suddenly, which wastes a lot of energy," she said. "For example, if the day temperature is 70F and the night is 64F, there is a risk that a control without ramp will turn on the cooling equipment to drop the temperature to the night range. So ramp is important."

However, like everything in this world, you get what you pay for. The better the control, well, the better the control, said Patricia. More advanced controls will obviously have better features that allow you to truly control all aspects of your heating system. Two nuggets of advice from Patricia is:

- Don't just turn down the heat—it might prolong the time it takes your crop to get to market, costing you more in the long run. Or it might diminish the quality of the crop.
- There are crops that will tolerate cooler temps. Often plants care more about the average temperature, as long as it doesn't get too hot or too cold. Do some research so you know those parameters, then program them into your control.

"Your control system should provide accurate, adjustable set points for temperature and relative humidity for day, night and DIF," said Pete Hummert, Greenhouse Sales & Design Manager for Hummert International. "Your environmental controls should have 100% lockout of ventilation and heating equipment, sensor/controller calibration and have the capability to collect vast amounts of data to assist you in the decision-making process of your crop."

With a better system, you can include historical data for inside and outside temperatures, relative humidity, light levels, CO2 levels, pH and EC and the actual run time and operational cost of the equipment in real time, Pete explained. At the end of the day, you get much better efficiency from your environmental controls.

You can even get really high tech if you want with computer programs that help you control your heating system and adjust temperature settings from your smartphone, giving you access 24 hours a day whether you're at the greenhouse or not.

Keep it in with curtains

Look at your energy curtains. Are they still serving their purpose or do they look tattered and ratty? Regardless of the age of your curtains, you need to really inspect them often for flaws and functionality that may be costing you some heat.

If you don't currently have energy curtains, you should. Motorized heat retention systems can reduce energy costs, keeping the high temps low and the low temps high, said Pete. If you're a skeptic and don't think energy curtains are worth the money, take a look at Pete's example. (You can also use the USDA's Virtual Grower software to calculate heating costs on your own. And you can create two models—one with a curtain and one without.)

A 40,000 sq. ft. greenhouse costs $1.25 psf to heat in a typical winter or $50,000 per year. An energy curtain can save 57% when it's in its active position. Let's assume it's used only at night (when 80% of heating is needed) and there's no curtain to help insulate the sidewall area (which makes up 10% of the total greenhouse "skin" area). So multiply 57% x 0.80 and 0.90 to arrive at annual estimate of 41% savings. Say the energy curtain cost is $1.50 psf installed. You get $1.50/($1.25 x 0.41) = 2.9 years. This payback period should compete with other capital investments to set the priority, said Pete.

The example Pete gave should be multiplied by a use factor and a sidewall area factor, as all greenhouses are not the same size and shape. The use factor can be simply estimated to be about 80% of the potential savings if the curtain is used only at night when the sun is down and not helping to heat the greenhouse.

"Any easy calculation to make for evaluating capital projects, such as installing an energy curtain, is the payback period or the time it takes for an investment to break even or pay for itself," he explained. "The payback can be defined by the installed costs divided by the annual savings. The installed cost includes the sum of the cost of the textile [curtain], the mechanical deployment system and the labor to install the system. The annual savings is estimated by applying a couple of correction factors to the specified energy savings value that more accurately estimate a grower's specific situation."

You should also make sure that the curtain is installed properly. If there are gaps, then your heat is escaping into the air, which is like flushing money down the toilet. Pete said that if the panel-to-panel sealing and the perimeter seals aren't installed, you could lose up to two-thirds of your heat.

"Generally, the energy savings that can be achieved through the installation of a heat retention system makes it a good business investment," said Pete. "And a side benefit is better control over crop climate."

Let me vent for a minute

Another question to ask yourself is how are the vents holding up? Are they closing properly? Patricia said that she recently conducted an energy audit for a grower in New Hampshire and found there was a 3-in. gap on one end of the vent run. She said heat was pouring out.

"[Having] an advanced control will have a cold lockout, which will prevent the cooling equipment from opening if it's very cold outside," Patricia said. "This might sound strange—why would cooling run when it's cold? But we've seen cases where there was a leaky steam valve, which caused the temperature to spike. The cooling equipment turned on and the crop was okay. The grower saw the strange patterns and was able to troubleshoot by looking at the logs and seeing what happened at 2:00 a.m. on a cold night in February. Without a good control, they wouldn't have seen any of that and the crop could have been damaged."

In hot water? That's not a bad thing

What kind of heating system do you have? Bench heating? Gutter line heating? In-floor heating? Saving on energy also depends on the type of heating you have. For example, if you have bench heating in multiple zones, the heat will be easier to control. Pete said that the basic rule of thumb is that if you change from forced air (heating from above) to hot water (heating from under the plants), you'll save approximately 30% to 40% in fuel savings. "It is more efficient to create a microzone around the plant material rather than heat the air above the plants," he explained.

Another benefit of having hot water heating is that water absorbs about 3,500 times as much heat as the same volume of air, so using water increases the efficiency of your systems while reducing fuel consumption at the same time.

A few other tips from Pete:

- Use condensing heater technology to recapture heat from stack losses so it injects heat back into your system, thus increasing the efficiency of the equipment. You can save more than 10% off on your fuel bill.
- Use low-mass boiler systems, as they have higher combustion efficiencies in addition to giving you responsive on-demand heat with minimal standby heat loss.
- Use variable frequency drives (VFD) on pumps, along with pressure independent characterized control valves (PICCV) to reduce energy costs by distributing the right amount of heat only where you need it.
- Find out if you qualify for any tax credits and rebates—especially if the fuel source is natural gas or alternative energies. (Refer to the "Found Money" article by Dan Kuipers in the March issue of *GrowerTalks*.) Or visit the Database of State Incentives for Renewables and Efficiency at www.dsireusa.org and the Energy Conservation for Commercial Greenhouses at www.nraes.org.)

Glazing is not just for donuts

The type of greenhouse material you have also plays a large part in heat retention/loss. Pete said that heat loss is based on several factors:

- Square footage of surface area exposed
- R-value of the greenhouse glazing materials. The higher the R value, the greater the insulation. The U value is the reciprocal of the R value—the lower the U value, the greater the insulation.
- Infiltration loss

- Temperature differential from inside and outside the greenhouse, plus wind velocity
- Elevation

In laymen's terms, R value is the thickness of the material; i.e., the thicker the material, the higher the R value. U value is how the material conducts or transfers heat, so the lower the rate, the less heat it transfers. Think of a double-pane window: If it's cold outside and warm inside, a single-pane window will be cold to the touch because it's exposed to the outside temperature. The inside part of a double-pane window would not be as cold because the first layer captures it before it gets to the second layer.

Obviously, double or, better yet, triple layers are better for a greenhouse. This chart explains the differences in R and U value by material (hr °F square FT/BTU):

Material	R	U
Single Layer Glass, 1/8 in.	0.88	1.13
Double Layer Glass, 1/4 in. space	1.54	0.64
Double Layer Glass, 1 in. Clear/Clear	3.03	0.33
Single Wall Corrugated Lexan	0.88	1.14
Single layer Polyethylene Film	0.87	1.14
Double layer, Separated Film	1.43	0.70
Twin 6mm Lexan Thermoclear	1.64	0.61
Twin 8mm Lexan Thermoclear Plus	1.73	0.58
Triplewall 8mm Lexan Thermoclear	1.94	0.52
Triplewall 16mm Lexan	2.50	0.40
8mm Evonik Acrylite	1.78	0.56
16mm Evonik Acrylite	2.04	0.49

If you compare energy savings from an 8mm Lexan Thermoclear Plus Twin Wall to an 8mm Triple Wall to Lexan Greca Corrugated:

- 8mm Triple Wall—U Value is 0.52 (12% better than Twin Wall U Value)
- 8mm Twin Wall—U Value is 0.58
- Corrugated—U Value is 1.14. "You can increase energy savings with an energy curtain added to the polycarbonate corrugated greenhouse covering," said Pete.
- Pete explained that the 8mm Triple Wall provides better U and R values, but it offers less light transmission over the 8mm Twin Wall. The 8mm Twin Wall clear offers 81% light transmission, while 8mm Triple Wall offers 76% light transmission.

For growers with double layer polyethylene greenhouses, they should consider the use of combining 6 mil, 4 year, IRCC Thermal Film with condensate control as the inner layer with a layer of 6 mil, 4 year,UV polyethylene as the outer layer. Industry standard for fuel savings range from 10 to 18%.

Which brings us to another benefit of having decent glazing—it not only offers more energy savings, but better light quality.

Be prepared

What's the difference between a good grower and a great one? Constantly planning ahead. As we know too well, you can't really do this with the weather. But at least you can try and be as prepared as possible so you can be ready for any surprises.

“You can’t let the weather affect your planting schedule,” said Jim. “You can’t overreact. Minor adjustments are not gambles. We’re always looking at improving our systems, even if we need to break or discard old systems.” **GT**