

Efficient Greenhouse DESIGN

FIND OUT WHAT EXACTLY GOES INTO DESIGNING AN EFFICIENT GREENHOUSE AND HOW YOU CAN MAKE AN EXISTING STRUCTURE MORE EFFICIENT.

By Victor Encinias

I have been told that I am a greenhouse guru. I have also been told that I am frugal. When it comes to efficient greenhouse design, I'm a believer in the basics. The most economical structure is one that doesn't break the bank, either with the initial purchase or with the utility bill to keep it running.

I have been designing, building and working in greenhouses for more than 15 years and I have seen it all. From high-end retail garden centers to backyard hobby houses, the key feature for all of them has been efficiency! So what exactly goes into designing an efficient greenhouse and how can you make an existing structure more efficient? Well, it's always best to start with the basics.

Keeping it Simple

What are you going to be doing with your greenhouse? Is it going to be for growing plugs, annuals or perennials? Cloning or propagation? Overwintering? Hydroponics? No matter what your aim, knowing what you are going to be using the greenhouse for will help you determine the type of structure that you will need. There are a lot of greenhouse suppliers and manufacturers out there, so it may be a little overwhelming to decide what type of structure to choose, or even where to purchase it. Knowing what you want to do with your greenhouse will play a huge role in determining your budget and design.

There are many different types of greenhouses, and there is a big difference between a low-end and a high-end structure. A greenhouse can be as simple as a few hoops covered with a single layer of 6 mil poly film covering or it can be as complex as an A-frame greenhouse with automated environmental controls and watering systems, automatic sliding doors and countless other amenities. Sounds great, right? Of course it does. But

navigating through the different styles and design features can be challenging. It can be difficult to decide what features are necessary to make your structure the most efficient.

The best advice I can give you is to keep it simple. A simple and efficient greenhouse will give the same results as one with all of the bells and whistles. Most greenhouse manufacturers offer a broad range of structures to accommodate various needs in the industry. Whether you are in the market for a new structure or are looking for ways to make your existing structure more efficient, this

article will explain the features that will give you the most bang for your buck.

Structure Design

The materials that your structure is constructed of play a major role in how efficient it is. The frame doesn't contribute as much to efficiency as the covering, but it is still important. The frame is the bones of the structure and you want those to be strong to ensure durability and long life.

Applying covering to a greenhouse is not as simple as one might think. There are a variety



Natural ventilation can be achieved using roof vents, roll-up or drop-down sides, or open end panels.

of materials and methods that can be used when covering a greenhouse, and this is where it can get tricky. When is it appropriate to use a single layer of poly film versus a double layer with an inflation system? When should you use polycarbonate? It seems complicated, but it's all about the cover's ability to retain heat.

Got it Covered

A single layer of poly film will provide protection from the elements, but it is not very efficient at maintaining an internal temperature, especially when there are extreme temperature differences between the inside and outside of the structure. A double layer

of 6 mil poly film with an inflation system provides much more resistance to temperature variables from the outside to the inside of the structure.

An inflation system creates a pocket of air between the two polyethylene layers, which significantly increases the ability of the cover to retain heat. It will help maintain a warmer inside temperature over a longer period of time without the assistance of a heater.

A twin-wall polycarbonate cover is even more resistant to temperature variability and is a great option for efficiency. It lasts more than twice as long as poly film. It is important to keep in mind that no matter what covering is on a greenhouse, during the winter months it will lose a lot of heat, especially at night.

Retaining Heat

There are a few things you can do to improve heat retention during the winter. One way is to use a winter-ready poly film glazing, which is commonly used in northern climate regions and is heavier and more opaque. It is better at attracting heat during the day, and at night it reflects heat back into the greenhouse.

Another option is to install a water wall for passive solar heat. This is an inexpensive option and can be done with polyethylene bags filled with water. The water-filled bags absorb solar energy during the day and radiate it into the greenhouse at night.

In addition to these options, you can also install a suspended heat retention shade system. A suspended heat retention shade system can run on either a push-pull drive, cable drive or be operated manually. These systems are shade cloth suspended on monofilament wires, which are attached to the greenhouse frame. They help prevent radiated heat loss by reflecting it back into the growing area. These systems are also great during the summer. They can reduce your cooling and watering needs by shading plants on hot, dry days.

Greenhouse Heating

Now that your structure is covered and retaining heat, we should discuss the heat source. For most of the year, in most regions and depending on what you're growing, the sun provides a large portion of the necessary heat. On cooler days and in the winter, another heat source besides solar

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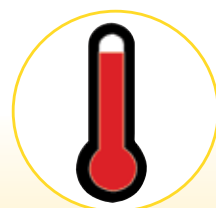
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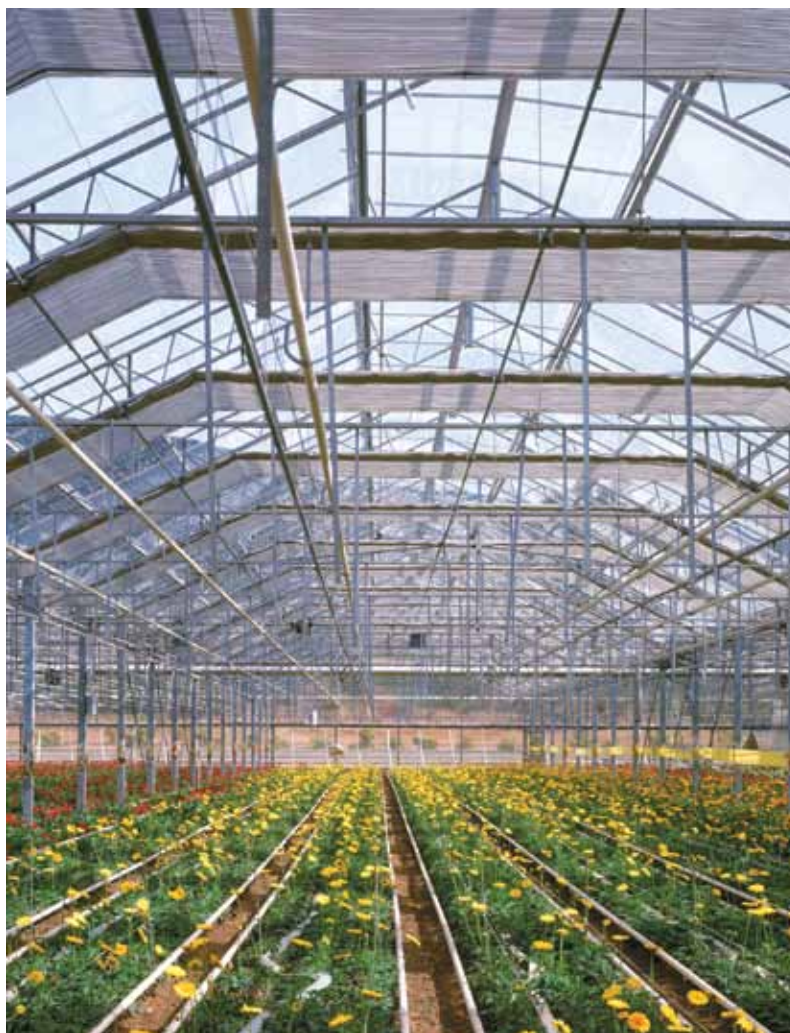
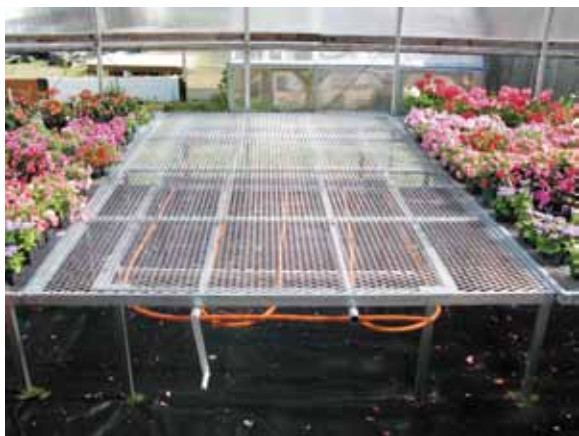
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Far left: Radiant heating systems apply heat to objects, not the air.

Left and below: Shading systems help prevent heat loss by reflecting it back into the growing area.

radiation may be needed. There are many options to heat a greenhouse including unit heaters, infrared heaters, radiant systems and more.

The most efficient of these options is a radiant heating system. Radiant heating systems heat objects and not the air. If you're building a new greenhouse, I highly recommend installing this type of heating system in the foundation. If you're using an existing structure, you can still use this heating option under benches or in the soil. No matter what heating system you have, performing yearly maintenance is the best way to ensure that your system is running at peak efficiency.

Preventing Heat Loss

The type of heating system you have makes a difference in the efficiency of your greenhouse. Just because you have an efficient heater does not make your greenhouse energy-efficient. We've already discussed heat retention and the role of greenhouse coverings, but there are a few other things to keep in mind. The best thing you can do is to install an electronic thermostat and controller that will automatically turn the heater on and off as needed. Also, using horizontal airflow fans will help keep the greenhouse at a uniform temperature.

The next thing to reduce heat loss is to make sure your greenhouse is free of air leaks. This includes keeping doors closed, using weather stripping around doors, vents and fan openings, repairing tears in the covering and using insulation.



Cooling Considerations

If you are using the greenhouse during the warmer months, cooling the structure becomes a consideration in the efficiency of your greenhouse. There are a number of options for cooling a greenhouse. A retractable shade system is a good option to reduce the amount of sunlight reaching the plants. Natural ventilation is the most common, and depending on

the design of your greenhouse, this can be accomplished in a few ways.

Roof vents, roll-up or drop-down sides, or open end panels are all common design features and allow a good amount of natural air flow within your structure. The goal of this type of ventilation is to maintain the same temperature inside the greenhouse as it is outside. Natural ventilation can be


supplemented with the use of mechanical ventilation. Using circulating fans, horizontal airflow fans and vents are ways to reduce the temperature in a greenhouse. An important thing to keep in mind for efficiency is to make sure that the equipment is properly sized for the area you are trying to cool.

Another option for cooling a greenhouse is an evaporative cooling system. These systems work by drawing air, which is cooled through the evaporation of water, across the growing area. An evaporative cooling pad is installed on one end of a greenhouse, and exhaust fans are installed on the other end. The exhaust fans pull air through the evaporative cooling pad. The air is cooled as it passes through the pad and is then drawn across the greenhouse, cooling the growing area.

Lighting

The next consideration for efficient greenhouse design is supplemental lighting. Natural sunlight will provide most of the light needed, but for growing in the winter or extending daylight hours, a supplemental light source will be needed. There are many different lighting options for growing and the most common are LEDs, high intensity discharge (HID) lamps and compact fluorescents. The most efficient lighting option is LEDs. They use between 40 and 70% less energy than HID lights, can run for more than 50,000 hours without light degradation and the bulbs last more than 10 times longer. The drawback to LEDs is that they are expensive. In the long run, you will save money, but the upfront cost is substantial.

Since we have covered the basics in efficient greenhouse design, let's circle back to my original advice, which is to keep it simple. There is a huge variety of products out there and it can become overwhelming to anyone in the greenhouse industry. A simple and efficient structure, with poly film covering, efficient heating and lighting will work well. Make sure you will be able to cover the expense of your investment within a few years of purchasing your structure. Keep in mind what your goals are for the structure and what you will be growing. Know what you want to do with the greenhouse, what you want to grow and what

your capabilities are. Talk to people in the industry or talk to the people you are looking to purchase the structure from, as they have the knowhow to get you started and can provide great advice and answer any questions you have. 

Victor Encinas is greenhouse system development manager at Growers Supply and has more than 15 years of experience designing, building and working in greenhouses. For more information on efficient greenhouse design, go to www.growersupply.com.

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