

# ENVIRONMENTAL CONTROL COMPUTERS

### **What is meant by the term “greenhouse environment”?**

To truly understand the value and benefits of an environmental control system and its impact on horticulture and the greenhouse environment, one must first understand the breadth of elements included in the term. The greenhouse environment encompasses a wide range of elements, including plants, substrates, equipment, air-treatment equipment, water, nutrients, light, insects and disease—even the grower and his/her staff. Environmental control systems can have an impact on—and make a positive contribution to— all these factors.

### **How can they minimize energy costs?**

Environmental controls help reduce energy costs by coordinating the operation of all the climate control equipment in the greenhouse, preventing equipment operation overlap that can occur when using separate, unlinked thermostats. Better temperature and humidity measurement and integrated equipment control means that energy inputs can be delivered with more precision and less waste. For example, lighting systems can be operated only when light levels fall below a prescribed threshold rather than for a prescribed time period, saving money on electrical costs. The environmental control system can manage this intelligently by measuring light levels and operating the lights in an efficient manner while protecting against unnecessary wear. Another example of energy savings would include the integration of variable frequency drives (VFDs) to operate fans motors and pumps at optimal speeds, which can reduce energy consumption by up to 70%. In a similar fashion, the control system can help reduce the use of costly heating fuel if it anticipates that outdoor conditions will soon cause a natural rise in the temperature inside the greenhouse.

### **How do environmental control systems benefit horticulture?**

The greenhouse environment must be accurately controlled to produce optimal growing conditions for crop production. In addition to controlling the humidity and temperature, environmental control systems can manage shade curtain systems and supplemental lighting, control carbon dioxide concentration, schedule, and sequence irrigation valves, and control the pH, EC, and temperature of the irrigation water. Because they integrate these functions into a single control system, environmental controllers can strategically integrate and manage the complex interactions between these elements, providing the grower with the tools required to optimize their crop production.

### **Do they respond to both the greenhouse and outdoor environments?**

Yes! The climate inside a greenhouse is dynamic, and it is rapidly influenced by changes in outdoor conditions. Many environmental control systems monitor wind speed, wind direction, rain, snow, humidity, temperatures, and light levels, to anticipate cooling and heating demands and to control the operation of the equipment. Monitoring outdoor conditions can also help to protect some equipment from damage, such as closing roof vents when the wind exceeds a certain speed. This type of anticipatory control enables greenhouse control systems to manage set-points within narrow tolerances despite large fluctuations in external conditions. For instance, energy curtain operation linked to outdoor conditions improves your return on investment (ROI) by maximizing its operation, closing the curtain when the outdoor light level and temperatures are low, then opening them once the light level and temperature increase. environmental control system. This creates more uniform conditions and prevents the ‘dead air’ pockets where diseases can gain a foothold.

## Can environmental control systems reduce chemical use?

Yes! By using it to closely manage humidity levels and temperatures, the incidence of diseases can be reduced along with the need for fungicide treatments. Internal air circulation equipment such as horizontal airflow (HAF) fans can also be managed by the environmental control system. This creates more uniform conditions and prevents “dead-air” pockets where diseases can gain a foothold. And certain crops can benefit from a morning temperature drop, or “DIF,” which can reduce or eliminate the use of plant growth regulators.

## Can you reduce labor with an environmental control system?

Controls can dramatically reduce the manual intervention needed from the grower to maintain the desired conditions. They do this by automatically operating equipment to achieve the desired setpoints over a range of conditions. This not only reduces labor to properly manage the climate, but results in better crop quality and crop uniformity, which can help reduce spacing, moving, grading and dumping costs. Automating watering can result in a huge savings in labor; and like temperature control, results in improved crop quality. Environmental controls can also be used to reduce equipment maintenance and manage maintenance schedules and create valuable equipment and sensor calibration and cleaning reminders. And low-temperature alarms and other types of notifications can reduce the potential for crop damage and destruction while minimizing or eliminating the need to have staff on site 24/7, again reducing overall labor costs.

## Can environmental control systems improve crop quality?

Because environmental control systems constantly monitor and control the temperature, humidity, VPD, light levels, daily light integral (DLI) and other critical environment factors, they can create the most ideal conditions possible for maximum crop quality and yield. Automated irrigation and fertigation help provide crops with the ideal water and nutrient mixes. Temperature and humidity tools help to lower the risk of insects and diseases. And data analysis, artificial intelligence (AI) modeling, advanced reporting and data graphing capabilities can help the grower replicate successes and correct failures.

## Do environmental controllers record and store data? If so, how can it be used?

Environmental control systems keep records of their sensor readings and equipment usage. This allows the grower to monitor past conditions and events, particularly helpful for monitoring nights and weekends. This data can be carried over from crop to crop and used as a tool in crop timing, modeling, forecasting and quality control. Equipment usage records can also help in the planning and tracking of maintenance schedules. With integrated irrigation and fertigation systems, environmental control systems can record the quantity and timing of nutrient mixes and delivery, overall soil moisture, and the resulting health and growth of the crops. This data, when integrated with overall crop quality and yield data, can help determine the best overall impact and utilization of irrigation and nutrients.

## Can the system help in plant modeling?

Most environmental control systems today store and organize crop-related data such as sensor readings (temperature, CO<sub>2</sub>, humidity, VPD, etc.), equipment usage and water and nutrient delivery. The environmental control system can then analyze and model this data alone or, via the use of APIs, can combine it with other crop yield and quality data to provide more complete analysis. Additionally, the data stored and managed by the environmental controller can be exported via these same APIs to external crop analysis systems. In either case, the data can then be analyzed and used via machine learning and other AI tools to model the theoretically ideal environment and growth strategies for individual crops. With the implementation and utilization of Cloud-based computing and storage, immense amounts and types of data can be monitored and maintained by control systems to provide growers with exceptional insight on their crops and the best strategies for moving forward in their growing operations. Ideally, the data management, modeling information and growth strategies can then integrate with the equipment controlled by the environmental control system.

## How does the system control the equipment?

The environmental control system monitors the sensor readings and operates the equipment to maintain the desired setpoints. Controls use programs specifically developed for each type of equipment. These settings are connected to the control's output relays, which in turn engage or disengage each piece of equipment according to the specific way it is operated. For example, the control system will operate your roof vents by turning on or off the drive motor for each vent to achieve the desired vent opening position. The control system will often use low voltage relays for switching the line voltage loads at relay control interface panels. Low voltage loads such as 24 VAC irrigation solenoid valves can often be operated directly using the low voltage relays supplied with the control system.

## What kinds of sensors are available?

A broad range of sensors can be used with an environmental control system. Climate temperature and humidity sensors are usually supplied in aspirated chambers to provide the most accurate readings possible. Depending upon your needs, humidity sensors can be either electronic or wet bulb/dry bulb types. Electronic temperature sensors provide reliable accurate temperature readings over the span of greenhouse conditions. Other sensors include pH, EC, water flow, soil moisture and temperature, equipment position, CO<sub>2</sub>, light level, wind direction, wind speed, rain detection, rain accumulation, and many other specialized sensors for each type of controlled application. The environmental control system company typically supplies the sensors that work with that specific control.

## Does the system generate alarms?

An environmental control system can generate alarms and notifications when it detects conditions that threaten the crop or equipment safety. Examples of alarm conditions include high and low temperatures and humidity, power failure, equipment failure, and any failure of the system to operate properly. Some environmental controllers are designed to have alarms function normally even during power failures. Through utilization of the Cloud, these alarms can be delivered directly to designated staff on their personal mobile devices and can even enable them to monitor and make adjustments in real time. The ability to be notified of any dangerous or damaging conditions via the Cloud reduces the need for staff to be on site to protect their crops.

## How will the system respond during a power failure?

Environmental control systems retain all your settings during power failures; however, a backup generator is recommended so that the system can continue operating. If your standby generator doesn't have enough capacity to operate all the equipment, consider a system that can selectively shed loads while on standby. When power returns, the system can gradually turn on the equipment to protect against startup overloads. If you have equipment that operates on three-phase power, consider a system that can detect phase failures, shut down three-phase equipment, and generate an alarm to protect your equipment.

## How can I learn to use my environmental control system?

Environmental control systems now include so many features and options that most users need some help learning to use them. Many options exist, including phone support, training videos, training classes and even onsite support and startup services for learning how to best utilize and operate these systems. You can learn more about environmental controls by contacting your NGMA greenhouse or environmental control manufacturers. Training and ongoing system support is an important part of your environmental control system.

## What features should I look for in an environmental control system?

Greenhouse environmental control systems are available in a wide variety of formats, from very simple to full-featured. In addition to the general features described above, many systems have special capabilities that may be of interest to you, such as remote management, irrigation, nutrient control, boiler limiting, CO<sub>2</sub>, extraction, heat recovery and storage, soil cooling, preventative and scheduled maintenance programs, task management systems, supplementary and photoperiod lighting, shading and energy curtains, modulating lights and more. As would be expected, the level of the environmental control system should match the needs, capabilities and availability of the greenhouse and staff.



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