Air$_2$O

Thermal Management
Innovation
an Eren Groupe Company

Indoor Agriculture

HVAC & Dehumidification Solutions

Air$_2$O Thermal Management Innovation
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Efficient and Effective Climate Control for Indoor Agriculture

"Air$_2$O's team of cultivation specialists provide comprehensive design support to the project engineers."

The Air$_2$O Cultivation product line offers effective and efficient temperature and humidity control solutions to create the most conducive environment for indoor agriculture. We utilize technologies such as indirect evaporative "free" cooling, water and air-side economizers for improved efficiencies, refrigerant, chilled water or hybrid DX cooling with heat pipe technology, and Hot Gas Reheat or rotary desiccant dehumidifiers for superior dehumidification.

With our expertise to produce solutions of limitless size, we have the capability to design and manufacture the most effective and efficient climate control solution for your indoor or greenhouse cultivation project. Air$_2$O's team of cultivation specialists provide comprehensive design support to clients and the design team.

Utilizing **DEN**, our unique performance predicting software, we can determine which product within our cultivation range line is optimum for your project by performing a detailed performance analysis considering local weather conditions.

Air$_2$O solutions are flexible, versatile, and capable of a quick and effective response to the phase-changing dynamic environment of indoor agriculture - while delivering precise temperature & humidity control with up to 50% energy savings.

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Thermal Management Innovation

Air$_2$O Cultivation Line

Features and Benefits

- Precise Humidity and Temperature Control
- Up to 50% Savings in Energy Consumption
- Extensive Global Expertise and Knowledge
- In-House Design Expertise and Support
- Custom Solutions for Design-Build Applications
- Reliability and Redundancy
- Project Climate Considerations and Local Code Compliance
- Low Maintenance
- Easy Access
- Worldwide Shipping and Deployment

Air$_2$O Cultivation solutions are instrumental making indoor agriculture production economically viable

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Air$_2$O Grow Cooling Technology Systems

Cultivation Line for Indoor Facilities

- Precise temperature and humidity control
- Offers up to 50% reduction in energy consumption
- Creates the most conducive indoor cultivation interior environment
- Broad capacity range: 2500 cfm to 100,000 cfm
- Custom units to meet any design criteria

Air$_2$O's cultivation line for indoor facilities employs a number of cooling and dehumidification means to create the most conducive indoor agriculture environment: an array of fans for superior airflow distribution and redundancy, an adiabatically cooled condenser, a heat pipe and winter economizers for improved efficiency, a low DX tempratures and desiccant systems for enhanced dehumidification, and an optional CW / HW coils for integration with a chiller / boiler if necessary.

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Air$_2$O Grow Cooling Technology Systems

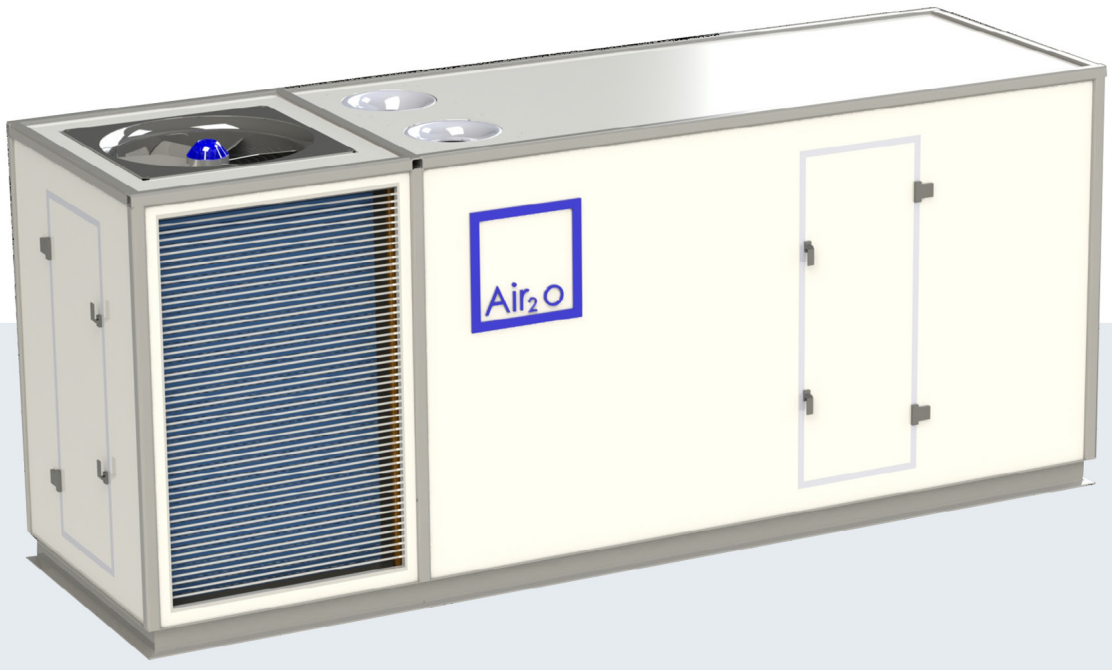
Cultivation Line with Heat Pipe Technology

Dehumidification is arguably the greatest challenge for HVAC systems when it comes to climate control of indoor cultivation facilities. The process of dehumidification by condensation requires lowering the temperature of the processed air, and upon removing the excess moisture, adding the thermal energy back into the system.

To increase the efficiency of this process and reduce the energy consumption, Air$_2$O utilizes a heat pipe technology that facilitate “free” energy transfer. This allows for efficient operations with up to 30% reduction in the size of the compressor and low operating energy consumption.

Air$_2$O Heat Pipe systems are flexible in configuration and they can be designed as packaged units or split systems with air- or water-cooled condensers and a various methods of heat rejection: adiabatic fluid coolers, cooling towers, etc.

- Precise temperature and humidity control
- Offers up to 30% reduction in electrical energy consumption
- Creates the most conducive indoor cultivation interior environment
- Custom units to meet any design criteria
- Packaged units or split systems; air- or water-cooled condenser
- Broad capacity range: 1,500 CFM to 100,000 CFM



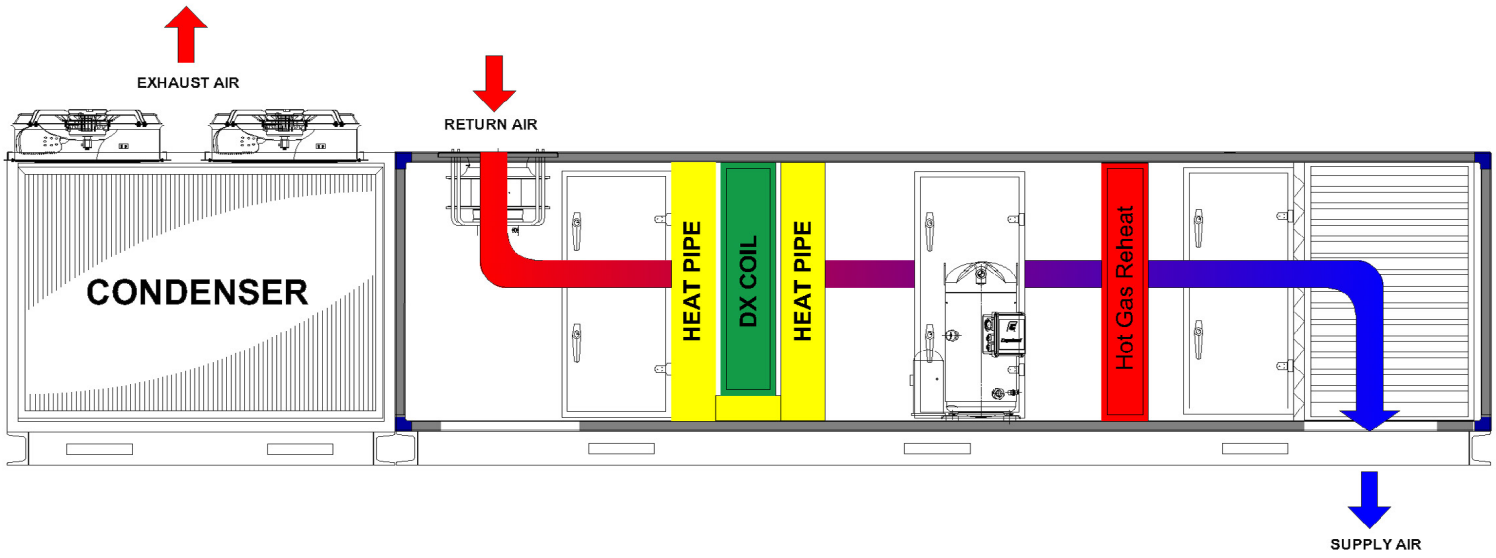
How Air$_2$O Heat Pipe Technology Works

Heat pipes are the most effective passive method of transferring heat available today. In their simplest form, a heat pipe is a sealed tube containing a phase-change fluid.

Air2O's heat pipe technology facilitates a transfer of energy between two parts of a wrap-around coil by pre-cooling the processed air upstream of a DX coil and introducing the same value of thermal energy downstream of the DX coil (in addition to hot gas reheat) in order to increase the temperature of the supply air to the design criteria levels.

This approach allows for reduction of the compressor size by as much as 30%, resulting in lower acquisition cost and reduced energy consumption.

Heat Pipe Operation



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Air$_2$O Grow Cooling Technology Systems

Cultivation Line for Indoor Cultivation with Rotary Desiccant Dehumidifiers (RDD)

Air$_2$O's cultivation line with rotary desiccant dehumidifiers offers enhanced environment control and efficiency. This solution utilizes a differentiated temperature and humidity control which has been designed specifically to meet the climate control challenges during the advanced flowering stage of 66-70°F and 30-40%RH.

This approach offers additional electrical energy savings, but it requires an input of thermal energy (natural gas, LPP or a cogen system). This solution is economically viable for projects that have limited power supply, high electrical energy cost or a source of waste heat.

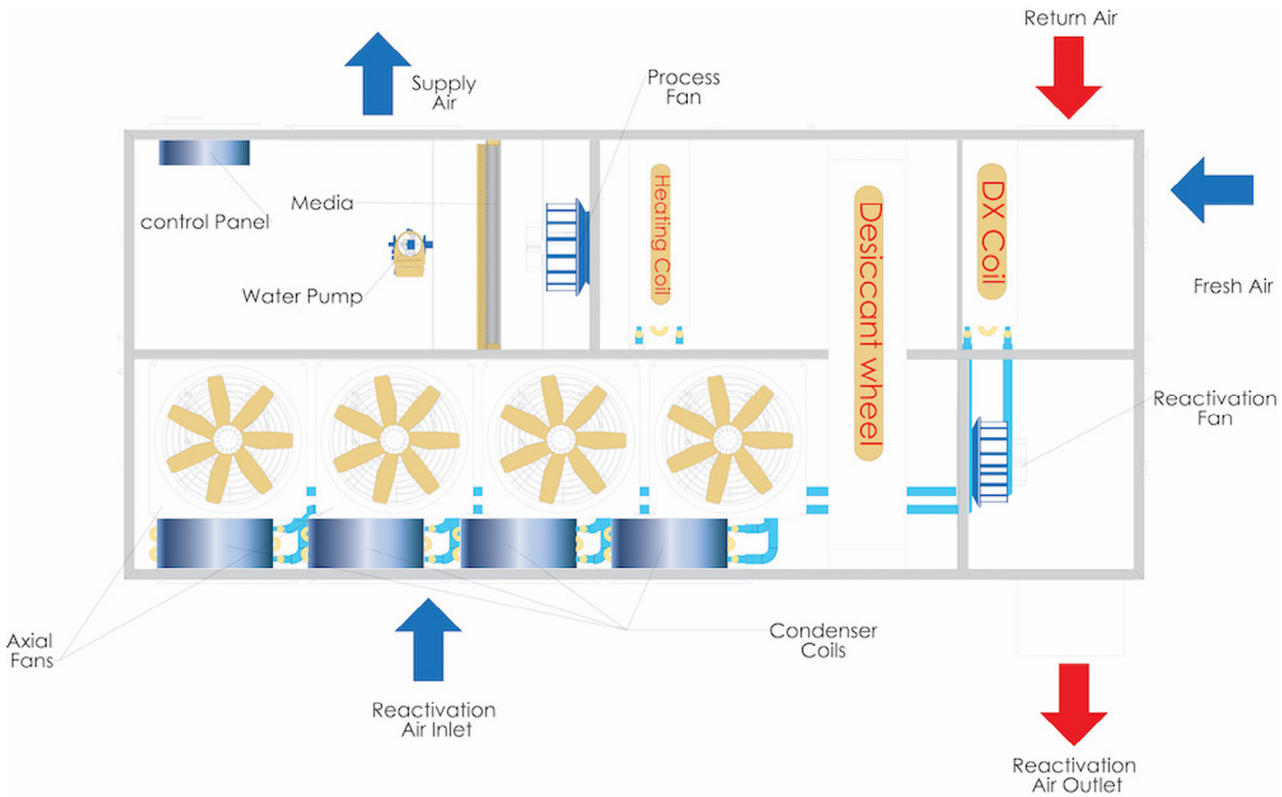
- Precise temperature and humidity control
- Offers up to 50% reduction in electrical energy consumption
- Creates the most conducive indoor cultivation interior environment
- Custom units to meet any design criteria
- Broad capacity range: 2,500 CFM to 100,000 CFM

How Air$_2$O Rotary Desiccant Dehumidifiers Work

The Rotary Desiccant Dehumidifier (RDD) line is a desiccant augmented system for enhanced dehumidification with a two-step moisture removal. As the processed air is cooled to its dew point temperature and partially dehumidified with a DX coil, being fully saturated, the air enters the desiccant wheel, where it is further dehumidified beyond the capacity of traditional systems.

As the desiccant wheel absorbs moisture from the processed air, it introduces residual heat of dehumidification and increases the temperature of the supply air to the design criteria. The thermal energy for the desiccant reactivation comes from the condenser's hot gas reheat. It is one of many innovative techniques that Air2O has implemented in order to lower the acquisition and running costs of the system by over 30%.

Rotary Desiccant Dehumidifier Operation



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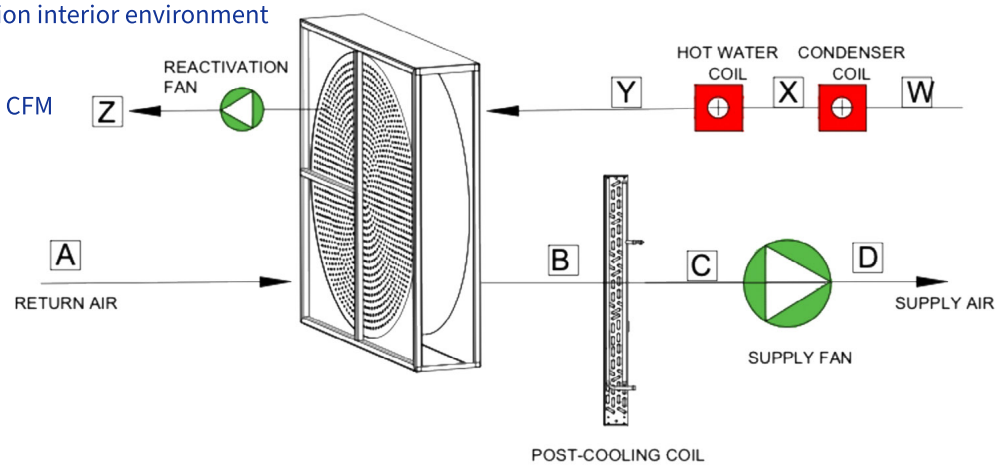
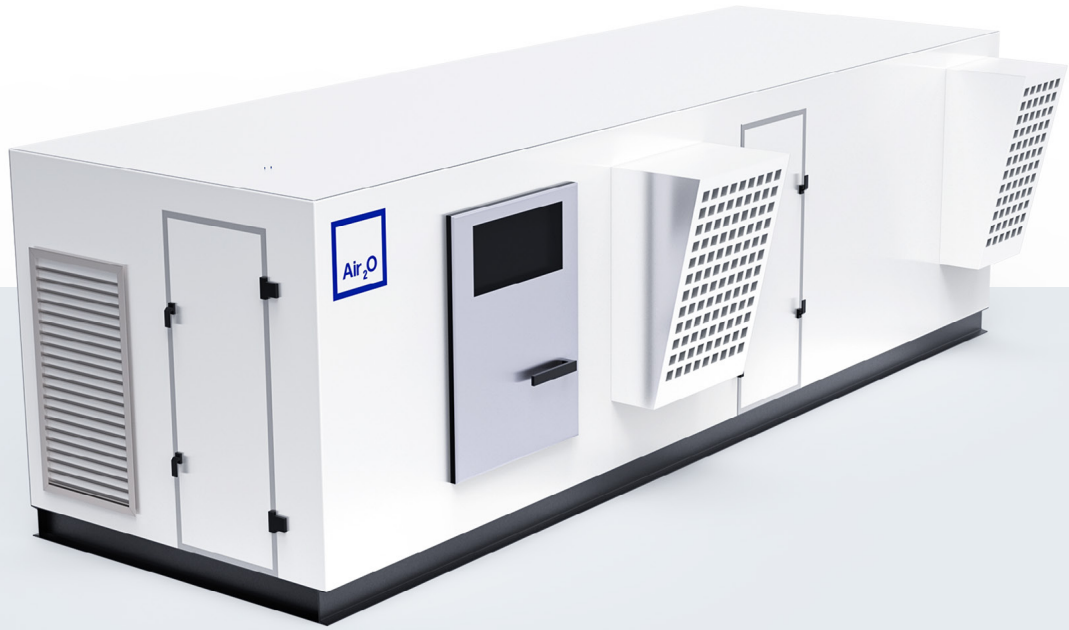
AIr$_2$O Solution to Cultivation Spaces with Water-Cooled Lighting

Enhanced dehumidification capabilities at low T/RH design conditions with over 60% energy savings

The system offers enhanced dehumidification capabilities even at at low T/RH design conditions with over 60% energy savings. The waste heat from the water-cooled lighting effectively drives the dehumidification process. The system can be scaled for any size cultivation area and to meet even the most rigorous design conditions.

- Precise temperature and humidity control
- Offers up to 50% reduction in electrical energy consumption
- Creates the most conducive indoor cultivation interior environment
- Custom units to meet any design criteria
- Broad capacity range: 2,500 CFM to 100,000 CFM





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Air$_2$O Grow Cooling Greenhouse Climate Control System

Cultivation Line for Sealed Greenhouses in Hot and Dry Climates

Air$_2$O's Cultivation Greenhouse line is designed to enhance greenhouse climate control beyond "fan and pad" cooling. It helps grow better quality product and increase the yields by over 25%.

The basic approach to active cooling of greenhouses in hot and arid regions is "fan and pad" cooling with many design-inherent shortcomings that adversely affect the quality and quantity of the crops.

Traditional AC systems generally are not economically viable for greenhouses (except for northern territories). Alternative cold production technologies are often unavailable, ineffective or costly.

Air$_2$O has developed a novel climate control system for sealed greenhouses in hot and dry climates. The technology uses stagged heat rejection to produce cold water only a few degrees above the ambient dew point temprature. this allows for an effective cooling and dehumidification of greenhouse spaces.

The proprietary process with over 130% wetbulb effectivness is arguably the most efficient thermocinamic cooling principle based on indirect adiabatic process.

- ☐ Superior climate control/ Reduced T/RH fluctuations
- ☐ Full or partial air recirculation
- ☐ Percise CO_2 concentrations
- ☐ Vertical airflow startification
- ☐ High-pressue misting augmentation
- ☐ Positive pressure
- ☐ ROI < 12 months
- ☐ Superior IPM
- ☐ Higher production yields
- ☐ Higher crop quality
- ☐ Custom units to meet any design criteria
- ☐ Broad capacity range: 10,000 CFM to 100,000 CFM
- ☐ COP > 12

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Boltonfield

Indoor Cannabis Cultivation Facility

Columbus, OH

40,000 sq.ft.of canopy

Water-cooled indoor units of multiple capacity with dedicated outdoor fluid coolers

Total 56 indoor and outdoor units for flower, veg, mother, and dry rooms.

The Challenge

The project is consisted of large flower rooms with up to 250 lights each. The mechanical specifications called for 2 units per each cultivation space placed in the narrow hallways. The water cooled systems required individual heat rejectors in order to distribute the dead load on the roof evenly. No other HVACD manufacturer was able or willing to custom-design units that could conform to the project's requirements without compromising on the performance.

The Solution

Air$_2$O design team matched the required physical parameters by orienting the interior units vertically. The access panels and doors as well as the control panels were redesigned to leave ample clearance for servicing and maintenance. There were no compromises made on the hot gas bypass or reheat capacity in order to reduce the units' overall dimensions.

The Results

The units have been successfully installed and commissioned. Air$_2$O Automatic Logic Controller was integrated with the Growlink environment control platform via BACnet for full optimisation of the operations. An Air$_2$O commissioning team was present at the site until all the work was completed to the satisfaction of the client.

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Cresco FloralCal

Indoor Cannabis Cultivation Facility

Santa Rosa, CA

Retrofit Project

22,000 sq.ft.of canopy

30 x 4,500 cfm/18-ton rooftop AHU's.

The Challenge

This retrofit job required a replacement of the old rooftop equipment with more effective and efficient models. The main challenge was to match the footprints of the Bryant units while increasing the cooling and dehumidification capacity. The existing ductwork had to be utilised in order to avoid the interior construction work as the facility remained operational.

The Solution

The housing and the configuration of the rooftop units were designed precisely to match the footprint and the ductwork openings for rapid and cost-efficient installation. The weight of the equipment was reduced in order to limit the dead load on the roof since the quantity of the units had been doubled. The cooling and dehumidification capacity of the systems was increased to match the revised loads.

The Results

The units were installed sequentially to mitigate the interruptions to the cultivation as the facility remained fully operational during the retrofit process. The Air$_2$O controls were integrated with Tridium controls software that allowed for superior environment control in the grow spaces with a narrow trending of the set points. During the commissioning stages the HPS lighting was upgraded to LED which prompted a number of mechanical modifications as well as remote programming adjustments. An Air$_2$O commissioning team was present at the site until all the work was completed to the satisfaction of the client.

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One Point One

Vertical Strawberry Farm

Phoenix, AZ

18 x 4,050 cfm/10 ton indoor units

4 x adiabatic fluid coolers

The Challenge

The facility space climate control strategy called for the interior units to be placed on small platforms inside of the cultivation space. The original mechanical plans had specified a chiller with multiple FCU's, but it proved to be cost prohibitive. The interior space constraints for installation of the units presented serious challenges for designing the units and

the space to augment dehumidification.

The Solution

The housing of interior units and the components were custom-designed to physically fit in the available space while leaving sufficient clearance for servicing and maintenance. A heat-pipe technology was added to the design in order to reduce the required reheat capacity, which resulted in lowering the system's tonnage by 30% and the overall energy consumption by 20%.

The Results

The units were successfully installed, integrated, and commissioned. The cost of the climate control system for the facility was significantly reduced compared to the original chiller designs.

Within the 12 months of the initial startup, the client expressed intentions to run he space conditions during the dark phase periods at 50°F-54°F, which is significantly below the design criteria of 72°F/50%RH. The Air$_2$O team was able to make appropriate adjustments to the mechanical components and the controls in order to achieve the new parameters.

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Stratus

Indoor Agriculture Cannabis Cultivation and Processin

British Columbia, Canada

10 x 7,000 cfm/23 ton indoor units

Passive Wrap-Around Heat Pipe results in approximately 15% energy savings, without adding any additional complexity to system operation or Controls programming

The Challenge

Industrial manufacturing facilities typically install separate AHU and BMS controls. However, large-scale indoor cannabis cultivation and processing facilities require exceptionally fine-grained control of AHUs to ensure the environment is continually maintained for optimal growing and processing conditions, each of which can vary significantly—and minutely—throughout the cycle. Stratus Designs Ltd., the controls and automation contractor for the facility's BMS, wanted controls for the two tightly integrated, as they would also

rate with Air$_2$O in a unique way to ensure the client's precise environmental specifications could be efficiently and precisely maintained at all times.

The Solution

Air$_2$O invited Stratus technicians to install their Reliable Controls™ system onsite at Air$_2$O's manufacturing plant in Phoenix, Arizona. Sensors and wiring were brought to a terminal strip within the unit by the Air$_2$O factory team for Stratus to then install the AHU controls. Stratus worked closely with Air$_2$O staff to complete the installation and start up the AHUs as part of the Factory Acceptance Testing procedure before the units were shipped to the facility.

The Results

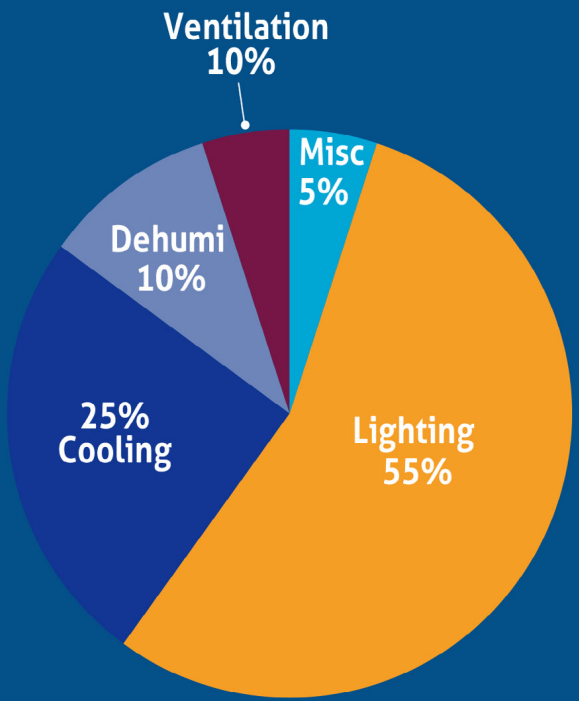
Integrated the Building Management System (BMS) controls directly into the air handling unit (AHU) controls.

Achieved more "fine-grained" control of the AHU, resulting in exceptionally tight environmental control.

Extra visibility of AHU components allows for faster troubleshooting and reduced downtime in case of component failure or maintenance.

ntegration of the BMS and AHU controls results in less complexity and less duplication of system components, ultimately resulting in a lower install cost and a simpler system.

Each grow operation is unique, and every facility has different environmental climates as well as different political climates. Air_2O can be your business partner to help you navigate all of these obstacles.

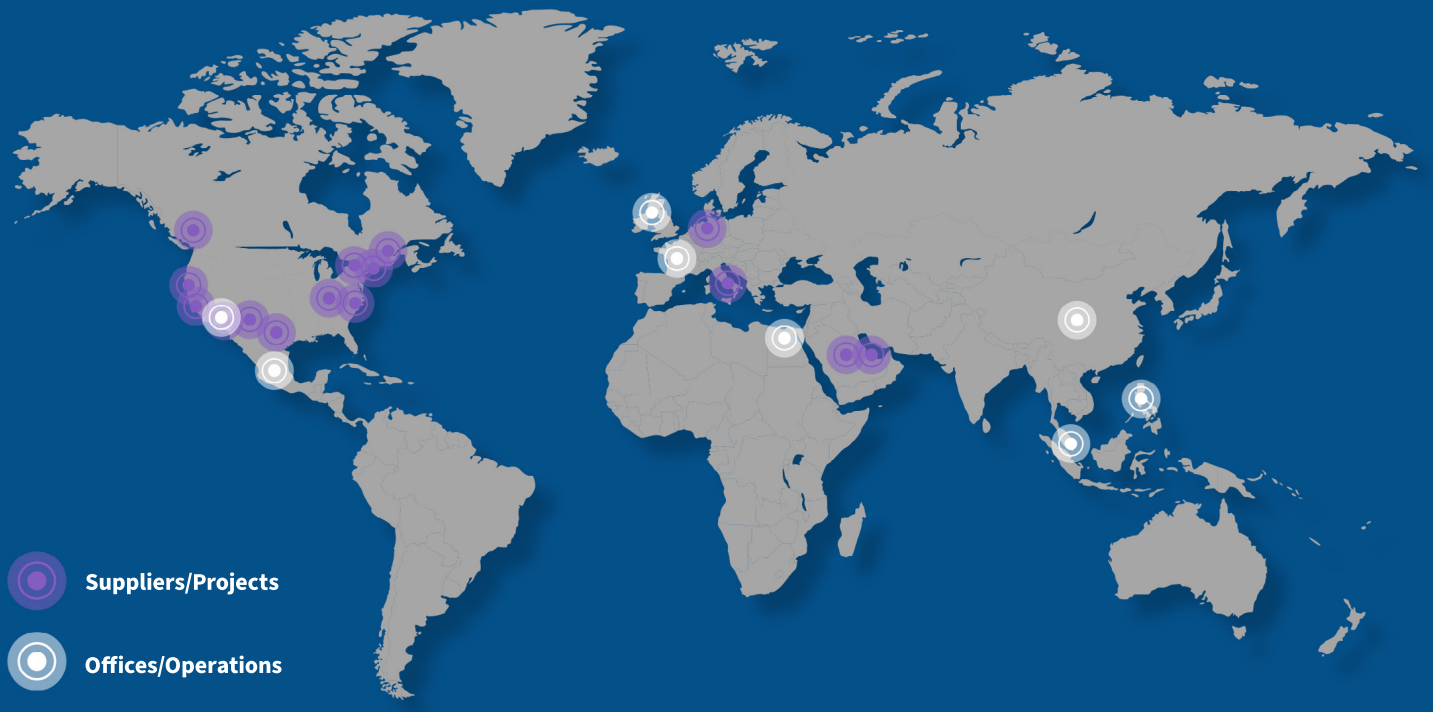


There is no single solution in selecting the right climate control system for commercial cannabis cultivation and many factors must be considered: budget, geographical location, energy cost, facility structural constrains, ROI, etc. Selecting an experienced company in cannabis cultivation HVAC is a crucial step in securing the operational success.

Air_2O Grow Facility and Dehumidification Solutions are the right partner for companies that strive to produce top grade product and reduce their operating expenses.

Figure 1 - Average breakdown of cooling, lighting etc for indoor cannabis grows
Data Source: Energy Trust Of Oregon, Resource Innovation Institute

Air$_2$O Operations & Supply Chain



Air$_2$O sources the highest quality components from vendors worldwide for a consistent flow of products that ensures your project is completed on time and on budget, even during supply chain disruptions.

- ☐ Faster time to completion
- ☐ Minimize risk of project disruption
- ☐ Adjust quickly as requirements change

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