CASE STUDY

GLASE

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CO_2 LASSI Pilot: Wheatfield Gardens

Niagara County, New York

CO_2 LASSI Pilot Launches Evaluation of Energy Use and Crop Performance in Greenhouses

Background:

This series of case studies presents findings from pilot demonstrations of the Light and Shade System Implementation (LASSI), a project supported by the New York State Energy Research and Development Authority (NYSERDA). The work focuses on three approaches to advanced lighting control in greenhouse environments: Basic LASSI, CO_2 LASSI, and Real-time LASSI. Each version was implemented in commercial facilities to evaluate its effectiveness in improving energy efficiency and crop productivity under real-world conditions.

The pilots represent a collaborative effort to translate scientific research into practical applications for greenhouse operators. Over the course of one year, each facility collected data on sensors, crop yields, and utility use, which was normalized using weather data and compared to baseline performance.

These case studies highlight operational insights, economic considerations, and user benefits related to each lighting system. They include product descriptions, lighting demand calculations, cost estimates, and return on investment projections.

Operations at a Glance:

Company: Wheatfield Gardens
Industry: Agriculture
Location: North Tonawanda, NY

A variety of crops are grown at the 550,000 ft^2 hydroponic indoor Wheatfield Gardens facility, including lettuce, culinary herbs (e.g., basil), industrial hemp, adult-use cannabis, nursery plants (bedding, landscaping, and hemp), and blackberries.

CO_2 use at Wheatfield Gardens

Wheatfield gardens has been very progressive in investing in technology to improve the energy efficiency of their production. A combined heat and power (CHP) unit operates to produce electricity and heat that is used onsite and for potential electricity sales to the grid. In addition a CO_2 recovery unit was installed to collect and purify CO_2 from the boiler for use in the greenhouse. To further improve the usefulness of the collected CO_2, an absorption chiller uses surplus heat from the CHP unit to air condition the greenhouse air. By cooling and dehumidifying the greenhouse with the absorption chiller, rather than through traditional venting, the recovered CO2 can be used for more of the year without being vented out. Dehumidification also reduces the need to vent and rewarm humid greenhouse air during the winter months.

CO_2 LASSI

The CO_2 LASSI algorithm takes advantage of the fact that photosynthesis is improved when CO_2 levels are increased above normal. Essentially, plants are able to grow more with the same amount of light, if the CO_2 is higher, within certain limits. Cornell has undertaken several projects to quantify the crop specific effects of CO_2 supplementation and has developed a control algorithm to optimize supplemental light and CO2, taking into account such factors as the cost of electricity and CO2, as well as minimizing the amount of CO_2 lost to venting.

CO_2 LASSI at Wheatfield

Due to the integrated nature of the CO2 supplementation system with the absorption chiller and the fact that the CO2 and chilling affects the whole greenhouse, Cornell was not able to take control of the CO2 system as we were demonstrating our control algorithm in a small portion of the greenhouse. Nevertheless, even though we couldn’t directly control the CO2 concentration, we were able to directly measure the benefit of the CO_2 supplementation.

Benefits of CO_2 supplementation at Wheatfield

During the main supplemental lighting season (October to April), the CO_2 supplementation added approximately 7% to the growth of the lettuce crop at Wheatfield gardens. A major limiting factor was that the installed lighting capacity was only 50 umol/m2/s, and that lighting was limited at night (due to neighbor relations). Using a simulation model we developed of the Wheatfield system, we found that with an increased lighting capacity of 180 umol/m2/s and the installation of night screens to reduce light escaping the greenhouse, electricity used for lighting could be reduced by 30%.

Recommendations:

Supplementing crops with CO_2 is a great opportunity to reduce the energy use and cost of producing light intensive crops during the darker winter months. Even with purchased CO_2, it is likely that significant saving can be realized. However, it is important that your system be properly evaluated for suitability, with a particular focus on the supplemental lighting capacity, and the needs of the crop you’re growing.