

2017 GLASE NCERA-101 Station Report

Erico Mattos

Executive Director

Greenhouse Lighting and Systems Engineering (GLASE)

Established in 2017 the Greenhouse Lighting and Systems Engineering (GLASE) consortium is a public-private partnership to integrate advanced energy-efficient LED lighting with improved environmental controls for more efficient and sustainable greenhouse production. The consortium is led by Cornell University's Controlled Environment Agriculture group and the Center for Lighting Enabled Systems and Applications (LESA) at Rensselaer Polytechnic Institute (RPI) and is supported by the New York State Energy Research and Development Authority (NYSERDA).

Technologies underlying horticultural lighting and control systems are rapidly evolving providing academics and private companies with new tools to explore their value-added applications in controlled environment agriculture (CEA) facilities. The improved capabilities offered by new integrated lighting systems are expanding the market opportunities for lighting, sensing and control companies.

The Greenhouse Lighting and Systems Engineering (GLASE) consortium is bringing together industries and researchers from different sectors in an open platform to integrate advanced energy-efficient LED lighting with improved environmental controls for more efficient and sustainable greenhouse production.

The industries being influenced by GLASE include:

- **Basic manufacturing:** Large manufacturing companies serving a broader market beyond horticultural applications interested in serving the CEA market.
- **Lighting, sensing and controls:** Product and service companies providing greenhouse growers with systems and controls used for crop production and greenhouse management operations.
- **CEA producers:** All controlled environmental agricultural production facilities including greenhouses, indoor farms and urban agriculture.
- **Retailers:** Food and ornamental crop vendors buying directly or indirectly from CEA producers.
- **Auxiliary companies:** A broad range of service providers, trade associations, government and private agencies, working to support the other segments of the CEA supply chain.
- **Policies and regulations:** Government and private agencies developing horticultural lighting standards and regulations and energy rebate programs.

The GLASE consortium is developing a framework to support collaboration with lighting companies aimed to promote technology development and increase the adoption of horticultural lighting and control systems by CEA producers. Having identified lighting companies as the consortium's primary beneficiaries and CEA producers as target customers, GLASE will work with its industry members to demonstrate the benefits of energy-efficient technologies and expand the market for all segments of the CEA supply chain.

Guided by both the needs of CEA producers and GLASE researchers' findings new technologies will be validated through multi-phase processes from scientific proof of concepts to implementation in commercial greenhouses.

GLASE has secured a \$5 million investment to develop a multi-year holistic research program with more than 350 specific technical milestones ranging from new LED encapsulants and drivers to integrated greenhouse control systems implementation. Working together, Cornell University, Rensselaer Polytechnic Institute and Rutgers University are combining complementary areas of expertise to design and develop innovative greenhouse lighting and control systems.



GLASE core research program areas include:

1. Development of high efficiency dynamic LED systems

- Improved high refractive index (RI) encapsulants.
- Most efficient way to add green light to the spectrum.
- Improved thermal management.
- High efficiency wide bandgap LED drivers.
- LED fixture design and testing.

2. Spectrum/irradiance optimization and plant sensing

- Define combinations of wavelengths for optimal crop growth.
- Determine narrow regions of the spectrum that contribute to nutrition in leafy greens.
- Automation of dimming in growth chamber studies.
- Automation of dimming in greenhouse studies.

3. Energy efficacy and radiometry

- Annual test reports for commercial lamps designed for horticultural applications.
- Lamp test reports for prototype lamps.
- Validate test protocol for lamps designed for horticultural applications.
- Report on the light distribution patterns observed in tall plant canopies such as tomato and how lighting systems can be used most effectively to achieve optimum plant response.
- Report comparing energy and cost impacts of various lighting systems designed for horticultural applications.
- Determine biological efficacy of lighting systems.

4. Carbon dioxide enrichment studies

- Equations modeling interactions for daily light integral (DLI) and CO₂ concentration versus photosynthetic parameters, morphology and biomass.

5. Greenhouse experiments with energy efficient lighting and control systems

- Validation of light and shade system implementation integrated with CO₂ control (CO₂ LASSI) in research greenhouses for tomato and strawberry production.
- Validation of energy efficient LEDs with CO₂ LASSI in research greenhouses for lettuce, tomato and strawberry.

6. Engineering and modeling

- Integrated CEA buildings energy simulation engine.
- Baseline energy models for pilot facilities.
- Devise and simulate integrated control system for lights, shade, CO₂, temperature and humidity.

7. Pilot/demonstrations

- Identification of small- and large-size commercial greenhouse pilot facilities.
- Baseline data collection at pilot facilities.
- Implementation of light and shade system (LASSI) at pilot facilities.
- Implementation of integrated light and shade system and CO₂ control (CO₂ LASSI) at pilot facilities.
- Implementation of real-time (10-minute interval) light and shade system control (real-time LASSI) at pilot facilities.

For more information, please visit the GLASE website at www.glase.org or contact GLASE executive director Erico Mattos at em796@cornell.edu.