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Capturing the value of LED horticultural Lighting: a market research study

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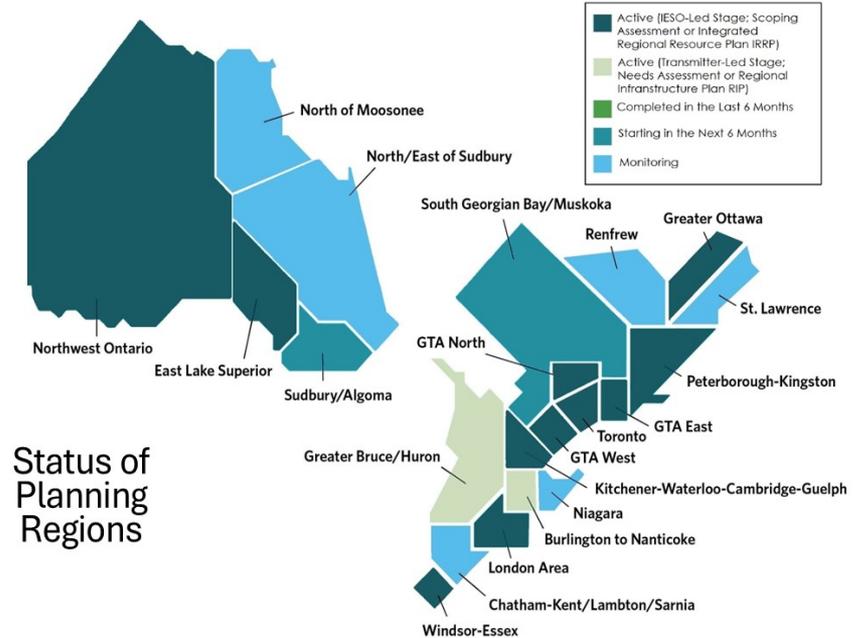
The IESO

- Operates the bulk electric system in **Ontario, Canada**
- 1 of 10 independent system operators in North America
- Manages the power system and oversees the electricity market
- Plans for future needs – forecasting and infrastructure development
- Electric **DSM** is part of the capacity toolbox integrated into the planning process



The Horticultural Lighting Market in Ontario

- Rapidly growing, particularly in the **SW region** since 2018
- Significant cause of **local grid** constraints
- This led the IESO to investigate **non-wires solutions** through its demand side management programs
- Support economic development within electricity constraints
- Largest concentration of vegetable greenhouses in North America



IESO's Horticulture Lighting Incentives

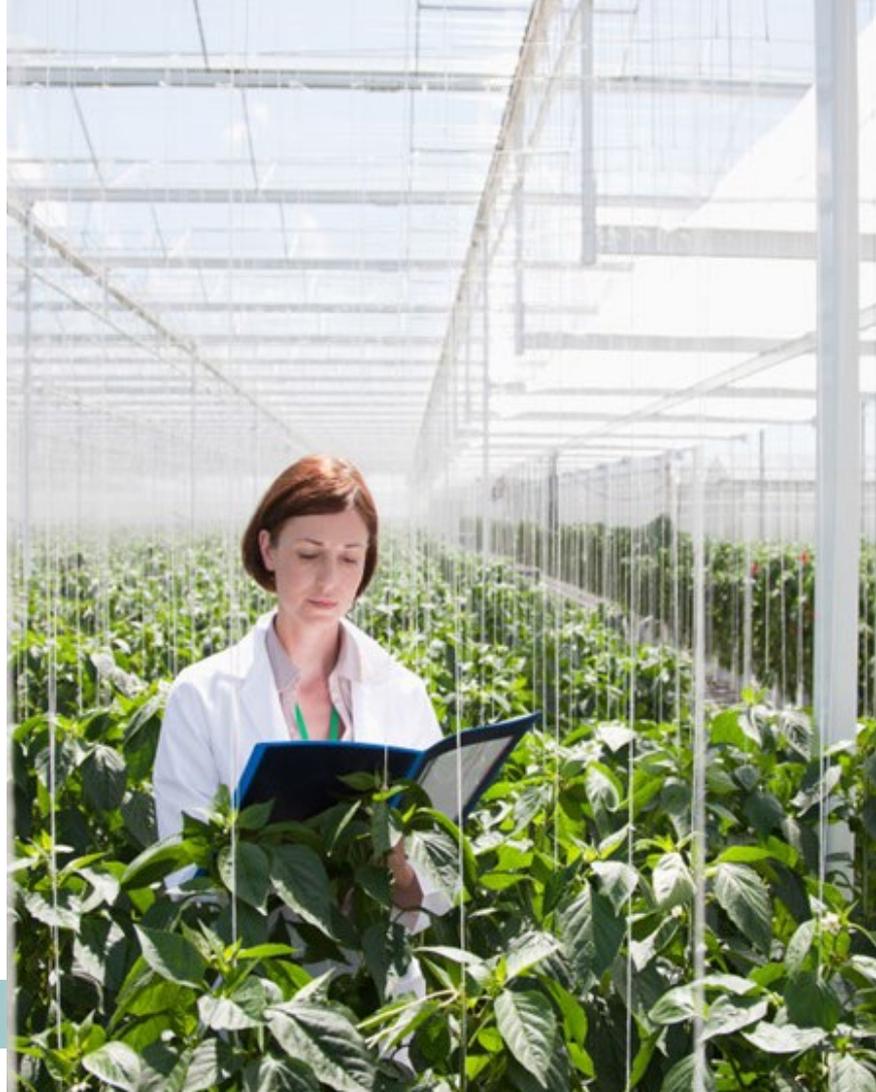
- LED Horticulture Lighting incentives through the Save on Energy Retrofit Program since 2019
- The program has been very popular, resulting in a **dedicated greenhouse stream** under the program
- Time limited (2020) – **3x standard incentive** to encourage up-take
- In 2024 greenhouse lighting savings of **180 GWh** and **52 MW** of local peak demand savings accounted for nearly half the total Retrofit program

Horticultural Lighting Market Study

- Resource Innovations identified the need for Market research to augment impact and process evaluations

Goals:

- Inform program design enhancements
- Understand the existing market share of each lighting technology
- Identify the main market actors
- Highlight barriers to EE adoption
- Investigate distinct needs across crop types
- Research historic trends and future trends



Research Methodology and Sources

Literature review and jurisdictional scan

- Potential studies, utility program evaluations, scientific research, manufacturer's data, guidebooks, best practice documents, testing results

In-Depth Interviews with Market Actors

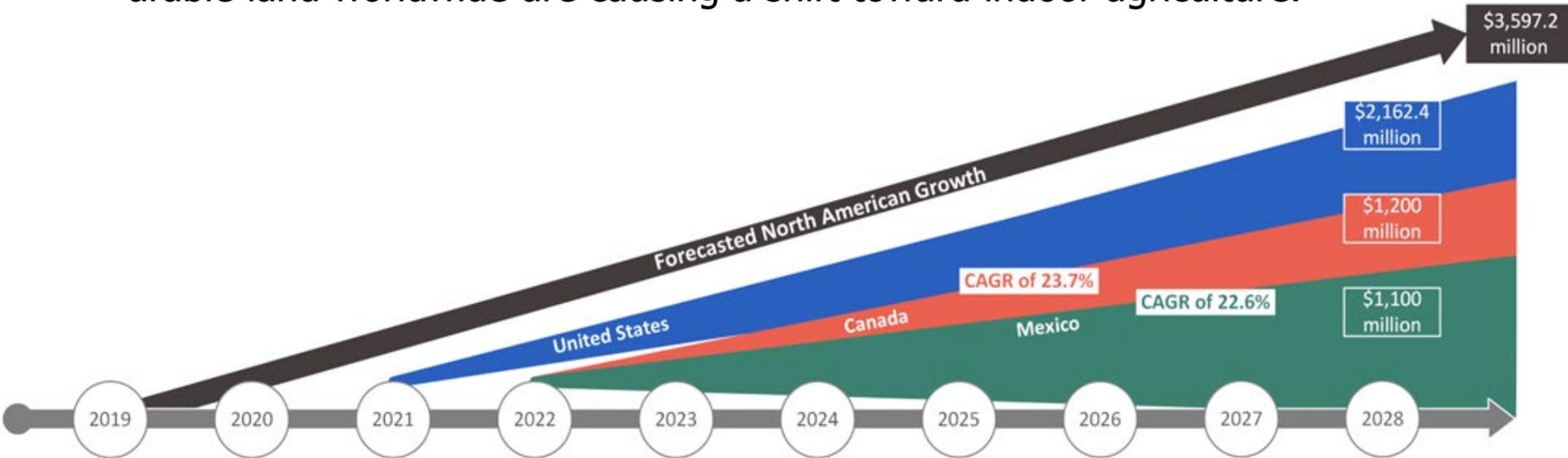
- 3 industry associations
- 4 growers
- 1 government ministry (OMAFRA)
- 4 manufacturers
- 1 delivery agent



Findings

Trends in Horticulture Lighting

- Global greenhouse market size: expected CAGR of 9.9% through 2030
- Horticulture lighting market: expected CAGR of 20.7% through 2027
- Increased food demand, modern farming technique, and the decline of arable land worldwide are causing a shift toward indoor agriculture.



Evaluating Local Peak Demand Impact of Greenhouse Projects

- The IESO's provincial peak demand definition (**Summer 1pm – 7pm**) does not adequately capture the value of these projects to local grid constraints
- The IESO identified 3 transformer stations that experience localized transmission needs due to greenhouse development
- Local peak demand definition is **November & December 8am – 11am**
- Evaluated greenhouse projects with hourly data (**71 GWh verified savings**) have a high coincidence with local peak demand (**77% CF**)

Lighting Technologies Used in Ontario Greenhouses

Crop Type	Most Common Light Type Used	Reasons for Choosing Light Type
Tomatoes	HPS	<ul style="list-style-type: none"> • Broad light spectrum • Heat generated • Tried-and-true -> trusted • Dominates existing stock
Cucumbers		
Florals		
Lettuce	LED	<ul style="list-style-type: none"> • Tunable light spectrum • Lack of heat • Majority of new equipment
Strawberries		
Peppers	None	<ul style="list-style-type: none"> • Sunlight is sufficient

“Capital cost of switching to LEDs is too high for most growers”

Factors Considered When Choosing Lights



Plant Related Considerations

- Plant quality that can be achieved
- Colour, wavelength, and spectrum needed for the specific crop
- Heat requirement of the plants
- Risk to plant quality and production results by switching systems
- How to increase plant yield
- Ability to increase crop diversity



Non-Plant Related Considerations

Cost

- Return on investment
- Cost of lighting technology
- Incentives available

Other

- External weather
- Energy efficiency/sustainability
- What other growers in the region are doing

Lighting Logistics

- What lights are available
- Electricity access
- Design of the greenhouse – e.g., are the ceilings tall enough for top lighting?
- Light abatement concerns
- Ability to change lights in the future should that be needed
- Support available for maintenance

Grower Awareness of Lighting and Controls

- Generally high
- Manufacturers rate grower knowledge the lowest of all market groups

More education is still necessary...

- Lighting Recipes by crop
- Incentives Available
- The importance of controls and how sensors work
- Case studies of successful LED applications

Average Rating of Perception of Grower Understanding of Lighting and Controls

Market Actor	 Associations	 OMAFRA	 Growers	 Manufacturers
Average Understanding Rating	4.7	4.9	4.8	3

Challenges With Adopting Energy Efficient Lighting

1

Knowing the light recipe

Challenge: Lighting recipes (spectrum and color) to maximize growth are unique by crop type. Floriculture sector specifically is impacted by a lack of research.

2

Growers are risk averse

Challenge: Changes in light type could impact crop quality and production.

Consideration: Case studies of successful use of LEDs on various plants, more research into the correct light recipes for plant growth.

Challenges With Adopting Energy Efficient Lighting

3

Cost

Challenge: LEDs are ~4x the cost of HPS with ~10-year ROI. Systems require more complex design considerations.

4

Rapid Technology Changes

Challenge: Hesitance to make large investments in technology that may become obsolete.

Consideration: Review and increase incentives and provide more technical and design support.

Thank You

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