Ontario Ministry of Agriculture, Food and Rural Affairs

Greenhouse Vegetable Production in Northern Ontario

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Presentation Objective and Outline

Objective: To provide an overview of greenhouse (GH) vegetable production in northern Ontario, including key opportunities and challenges.

Outline:

- GH sector in Ontario
- Production system
- Examples of northern vegetable GH

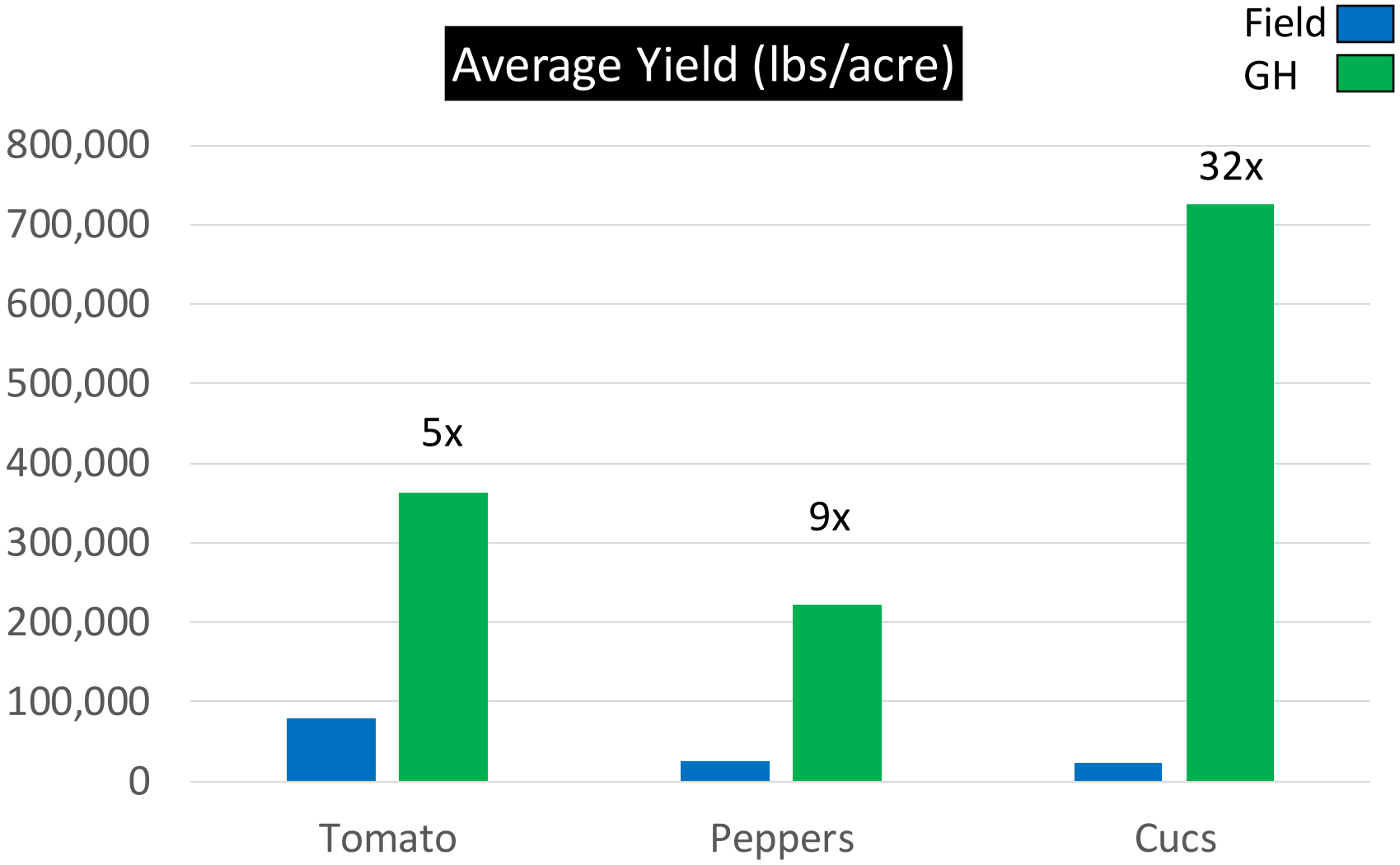
What is GH agriculture?

- A form of controlled environment agriculture (CEA) where crops are protected from environmental hazards using a structure (a.k.a. covered agriculture)
- Greater control over the growing environment than field agriculture
- Extended growing season
- Greater production per acre than field agriculture

What do GH grow?

- Vegetables: the big three (tomatoes, peppers, and cucumbers)
- Some fruits (strawberries)
- Flowers and Cannabis

Ontario Field vs. GH vegetable production (2019)



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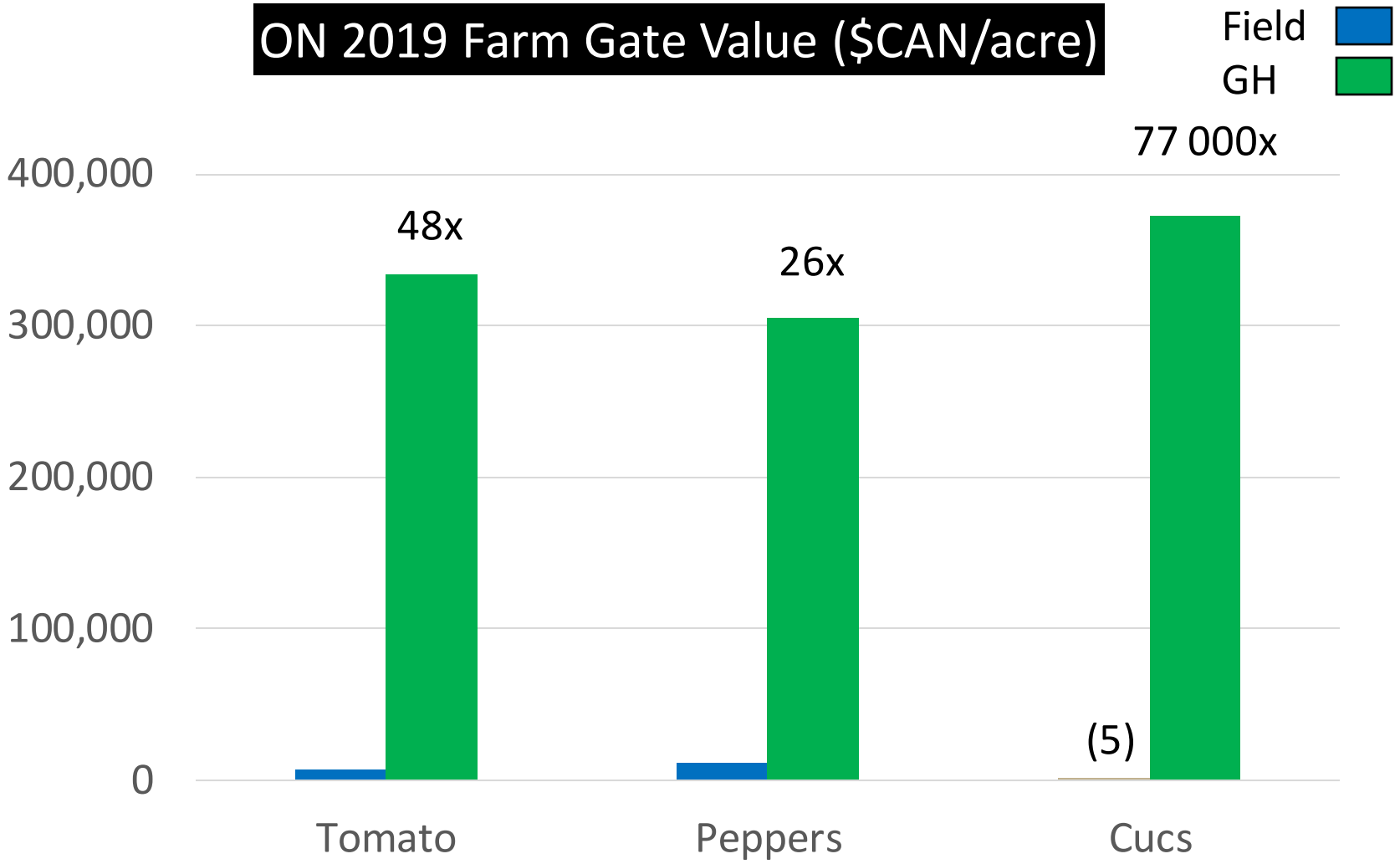

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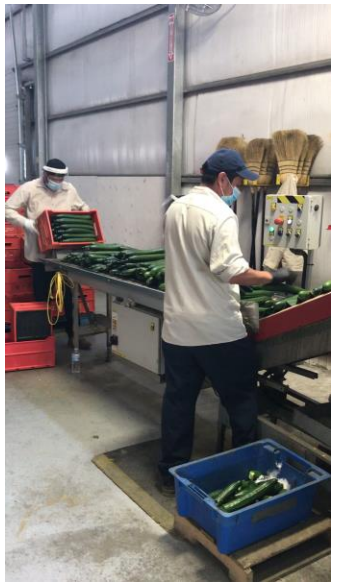
Ontario GH sector overview (2019)

- Over $1 billion (CAN) farm gate value
  - Tomato ($376 million)
  - Cucumbers ($339 million)
  - Peppers ($301 million)

- Over 3000 acres and growing
  - Tomato (1126 acres)
  - Peppers (986 acres)
  - Cucumbers (909 acres)

- Over 1 billion pounds of food
  - Cucumbers (660 million pounds)
  - Tomato (408 million pounds)
  - Peppers (219 million pounds)



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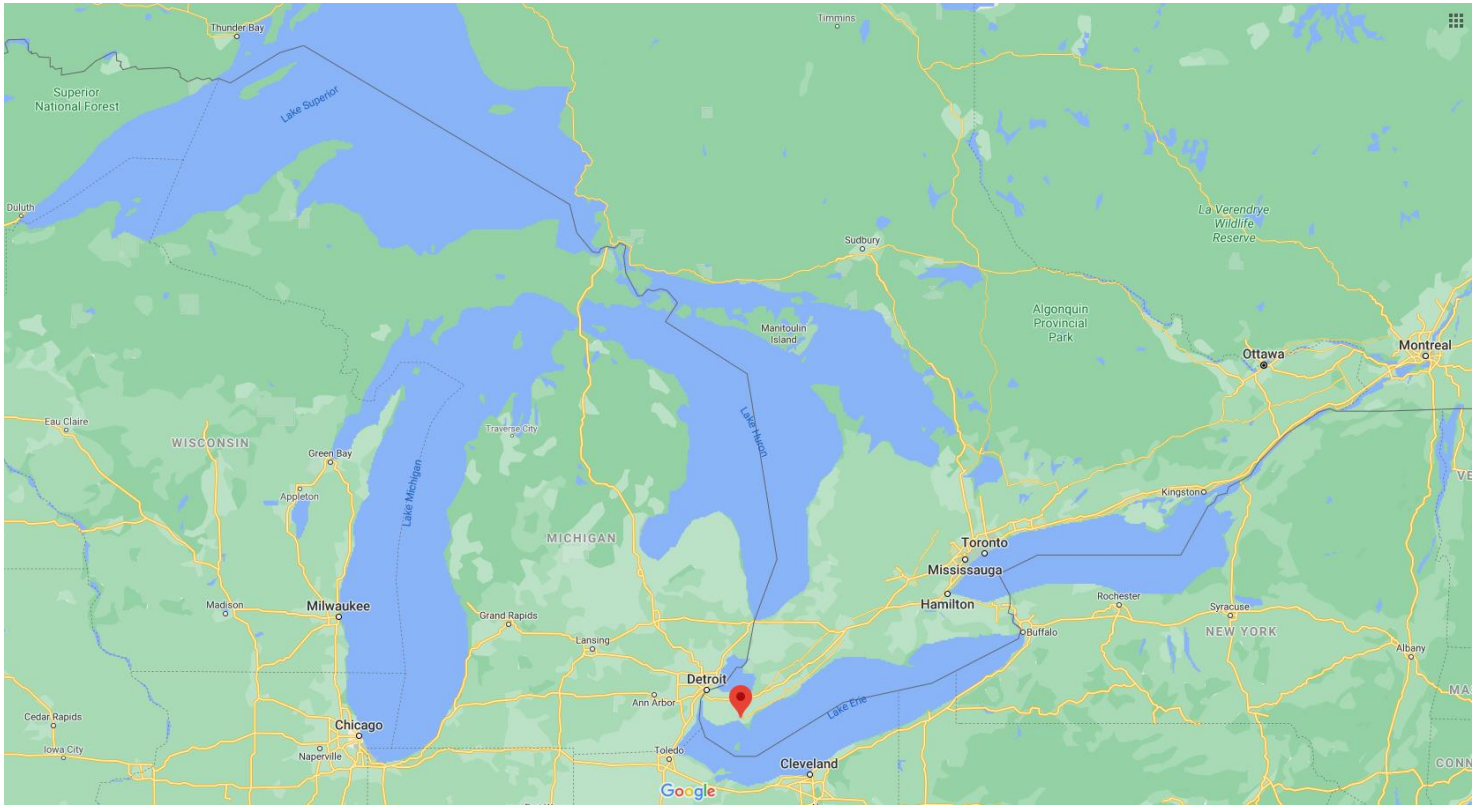
Ontario GH sector overview (2019)

- Highest concentration of GH in North America is in southwestern Ontario (Leamington and Kingsville in Windsor-Essex)



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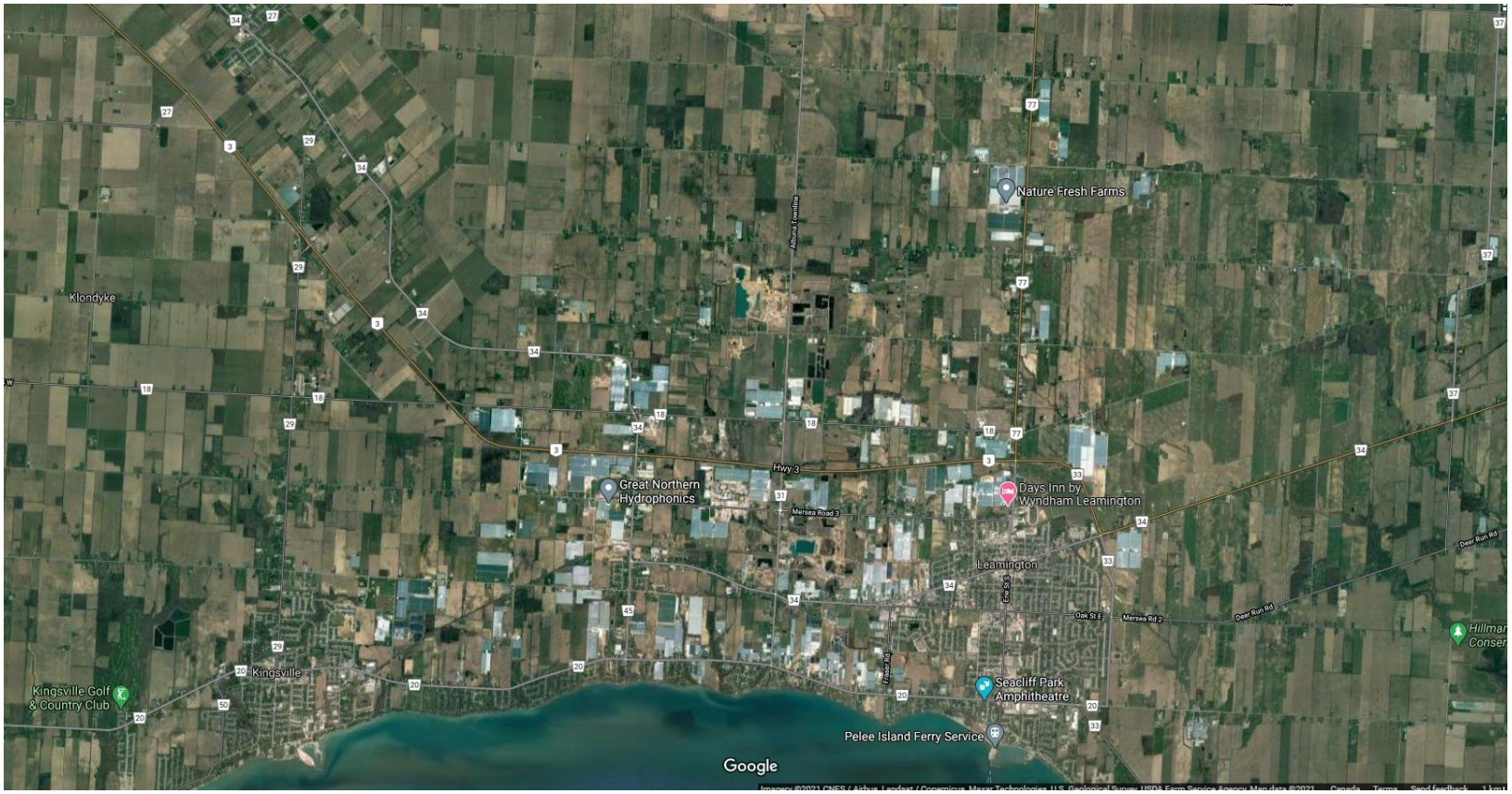

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Production System: what is GH agriculture?

- Structure:
  - Greenhouse
  - Hoop house / High tunnel
- Cover material:
  - Plastic
  - Glass

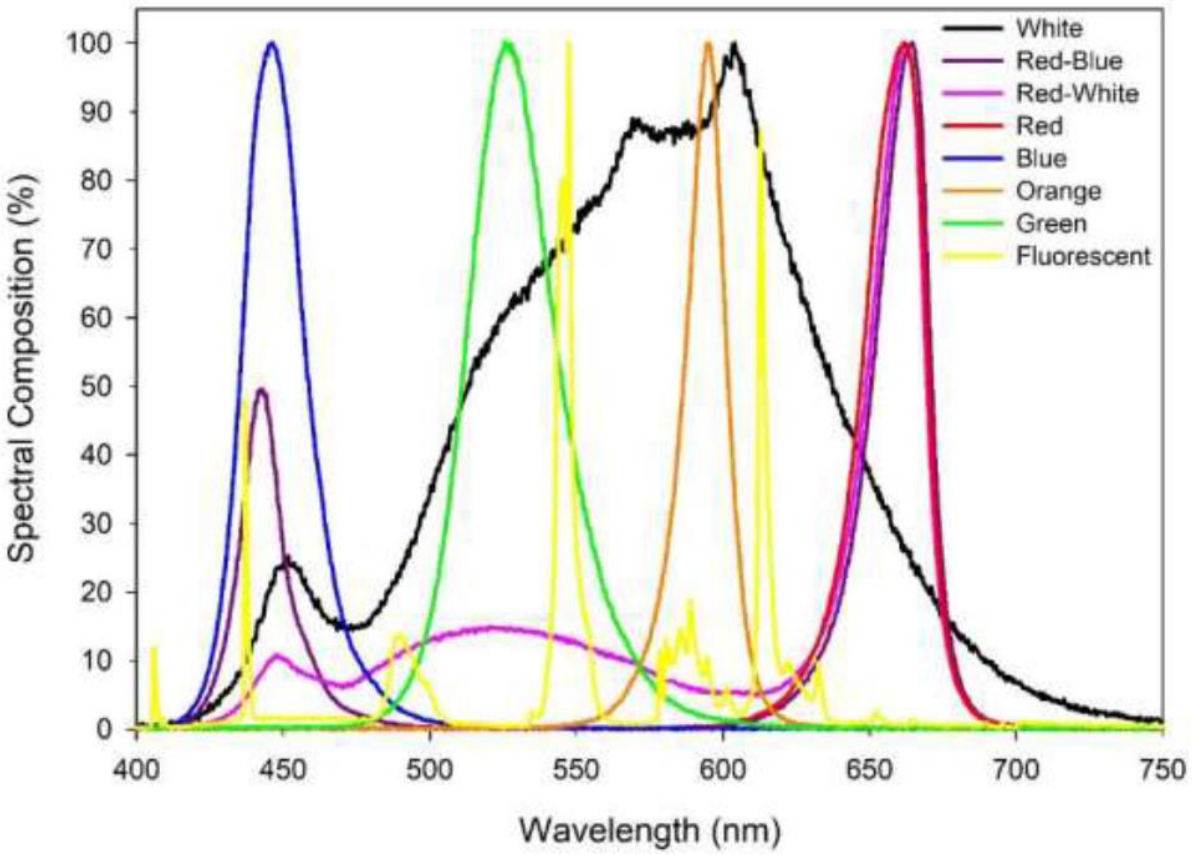
Greenhouse Canada

Rimol Greenhouse Systems

GH cover material affects light and heat

Cover Material	% light transmission (PAR)	Heating demand (% of glass)
Glass	high	high
Polyethylene	less	less
Acrylic	less	less

GH cover material affects light spectrum



Photosynthetically Active Radiation (PAR) (400 – 700 nm)

Lanoue (2020)

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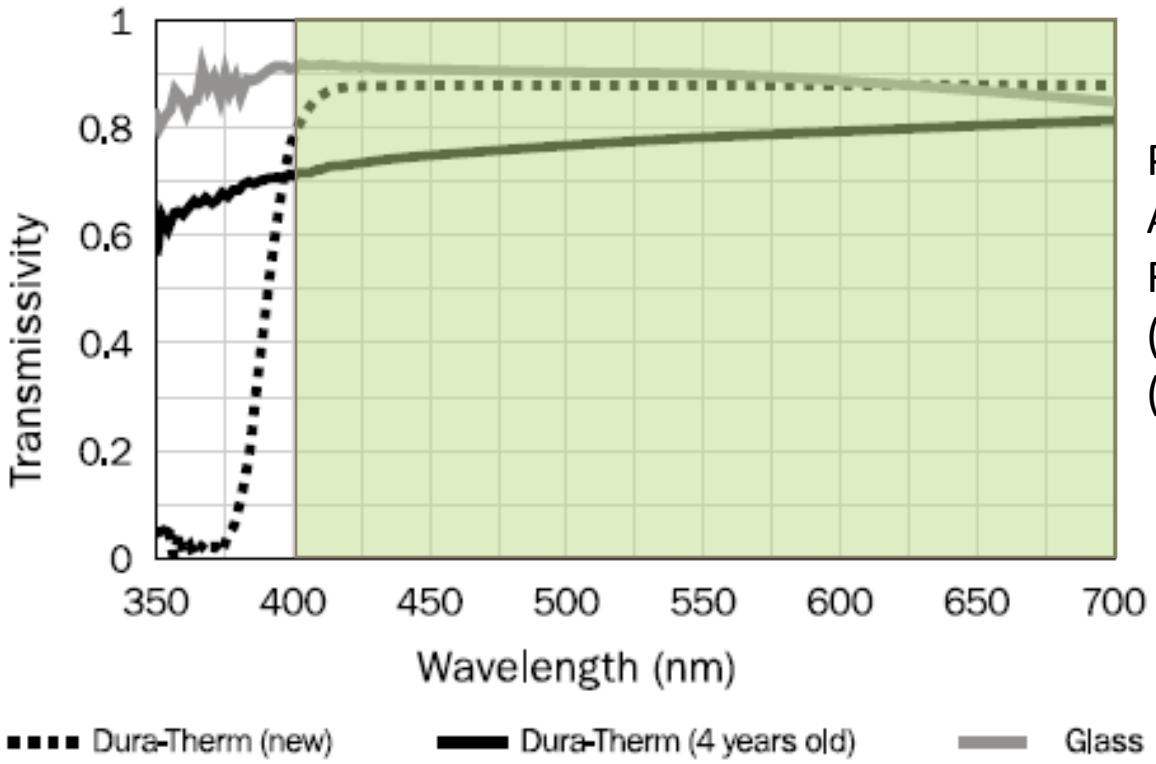
GH cover material affects light spectrum

Figure 1–6. Comparison of Light Transmission Between Glass and Double Polyethylene



Photosynthetically Active Radiation (PAR) (400 – 700 nm)

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Production System: what is GH agriculture?

- Cover material:
  - Plastic
  - Glass
- Growing media:
  - Soil
  - Soil-less

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Growing Media

- Soil
- Hydroponics
  - Rockwool
  - Coir
  - Peat
- Nutrient film technique (NFT)
- Deep water culture (DWC)
- Aeroponics

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Growing Media

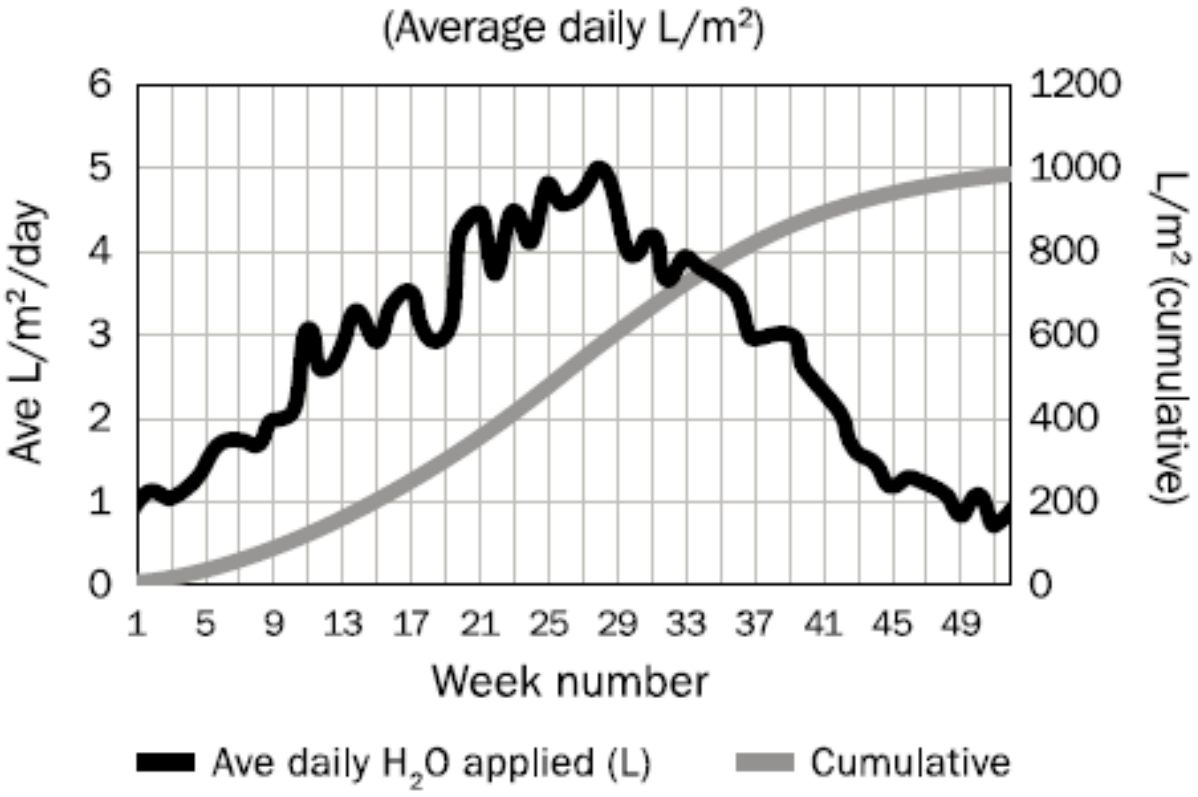
System	Consistency and precision	Water use	Biological control of pests and disease	Requires aeration
Soil	No	Most	Yes	No
Hydroponics • Rockwool • Coir • Peat	Yes	Less	No	Yes
Nutrient film technique (NFT)	Yes	Less	No	Yes
Deep water culture (DWC)	Yes	Less	No	Yes
Aeroponics	Yes	Least	No	Yes

Production System: what is GH agriculture?

- Structure:
  - Plastic
  - Glass
- Growing media:
  - Soil
  - Soil-less
- Water
  - Quantity
  - Quality

Water Quantity

Figure 1–7. Water Application in Greenhouse Vegetables



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Water Quality

Table 1–6. Classification of Water Quality

Class	Electrical Conductivity (mS/cm)[1]	Sodium (ppm)	Chloride (ppm)	Sulphate (ppm)
1	0.5	<30	<50	<100
2	0.5–1	30–60	50–100	100–200
3	1.0–1.5	60–90	100–150	200–300

Class 1: Good
Class 2: Should only be used for salt-sensitive crops if enough leaching is possible
Class 3: Not recommended for salt-sensitive crops (cucumber)

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Production System: what is GH agriculture?

- Structure:
  - Plastic
  - Glass
- Growing media:
  - Soil
  - Soil-less
- Water
  - Quantity
  - Quality
- Nutrient solution:
  - Recirculated
  - Sterilization treatment

Recirculated nutrient solution sterilization techniques

- Sand filters
- Ultraviolet light (UV)
- Pasteurization
- Ozone

Recirculated nutrient solution sterilization techniques

System	Advantages	Disadvantages
Sand filter - physical filter	Inexpensive Allows biocontrol	Inconsistent
Pasteurization - heat	Consistent	Hot water in summer Kills beneficials
UV - light treatment	Consistent	Does not penetrate deep Not ideal for high turbidity solutions\ Kills beneficials
Ozone - O3 gas in water	Consistent Oxygenation of nutrient solution	Could damage crops is left in solution Kills beneficials

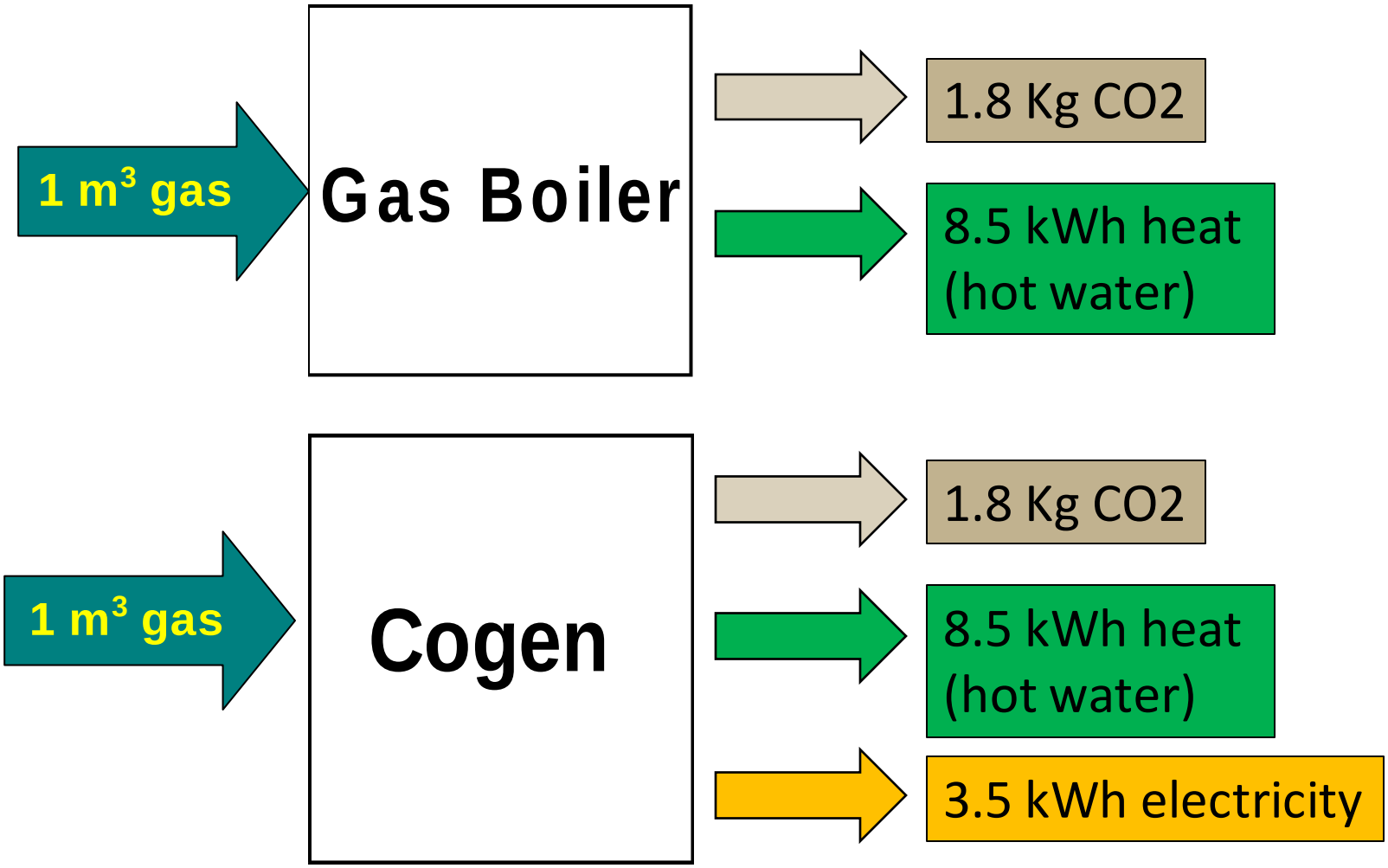
Production System: what is GH agriculture?

- Structure:
  - Plastic
  - Glass
- Growing media:
  - Soil
  - Soil-less
- Water
  - Quantity
  - Quality
- Nutrient solution:
  - Recirculated
  - Sterilization treatment
- Environment control
  - Heat (natural gas)
  - CO2 enrichment
  - Humidity

GH Vegetable Growing Environment

Environment Factor	Range
Temperature (24 hr avg)	Lettuce, 17-18 oC Tomato, 19 oC Pepper, 19 oC Cucumber, 21 oC
Relative Humidity (RH)	70-85 %
CO2	800-1300 ppm

Heat, CO2, and Electricity Generation (cogeneration)



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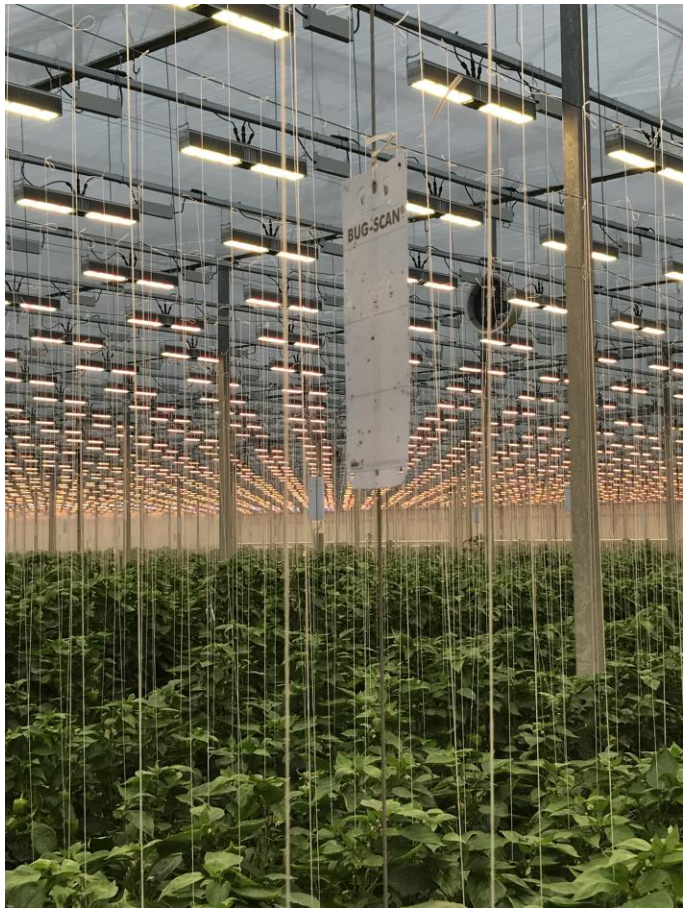
Energy curtains

Production System: what is GH agriculture?

- Structure:
  - Plastic
  - Glass
- Growing media:
  - Soil
  - Soil-less
- Water
  - Quantity
  - Quality
- Nutrient solution:
  - Recirculated
  - Sterilization treatment
- Environment control
  - Heat (natural gas)
  - CO_2 enrichment
  - Humidity
- Supplemental lighting:
  - high pressure sodium (HPS)
  - Light-emitting diodes (LED)



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Supplemental Lighting

Light source	Advantages	Disadvantages
High Pressure Sodium (HPS)	- Producer familiarity - Cost less than LED	- High heat - Low photosynthetic photon efficacy (PPE, 1.3-1.7 µmol J^{-1}) - Fixed spectral quality (high in orange and yellow spectra)
Light-Emitting Diodes (LED)	- Low heat emission (~50% less than HPS) - Small fixture size (inter-canopy lighting options) - Higher PPE than HPS (2-5 µmol J^{-1}) - Adjustable spectral quality (regulate plant growth)	- New and unknown - Higher cost than HPS

Production System: what is GH agriculture?

- Integrated pest management (Cara McCreary, OMAFRA)
  - Better application of biological controls

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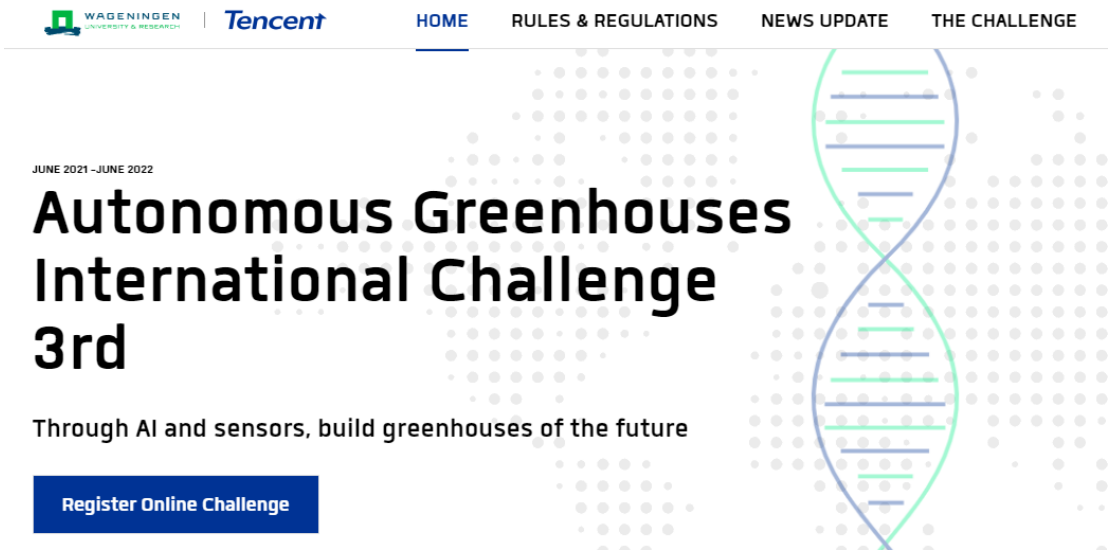
Environment Control Systems

- Sensors
- Central computer systems
- Autonomous growing

PRIVA.com



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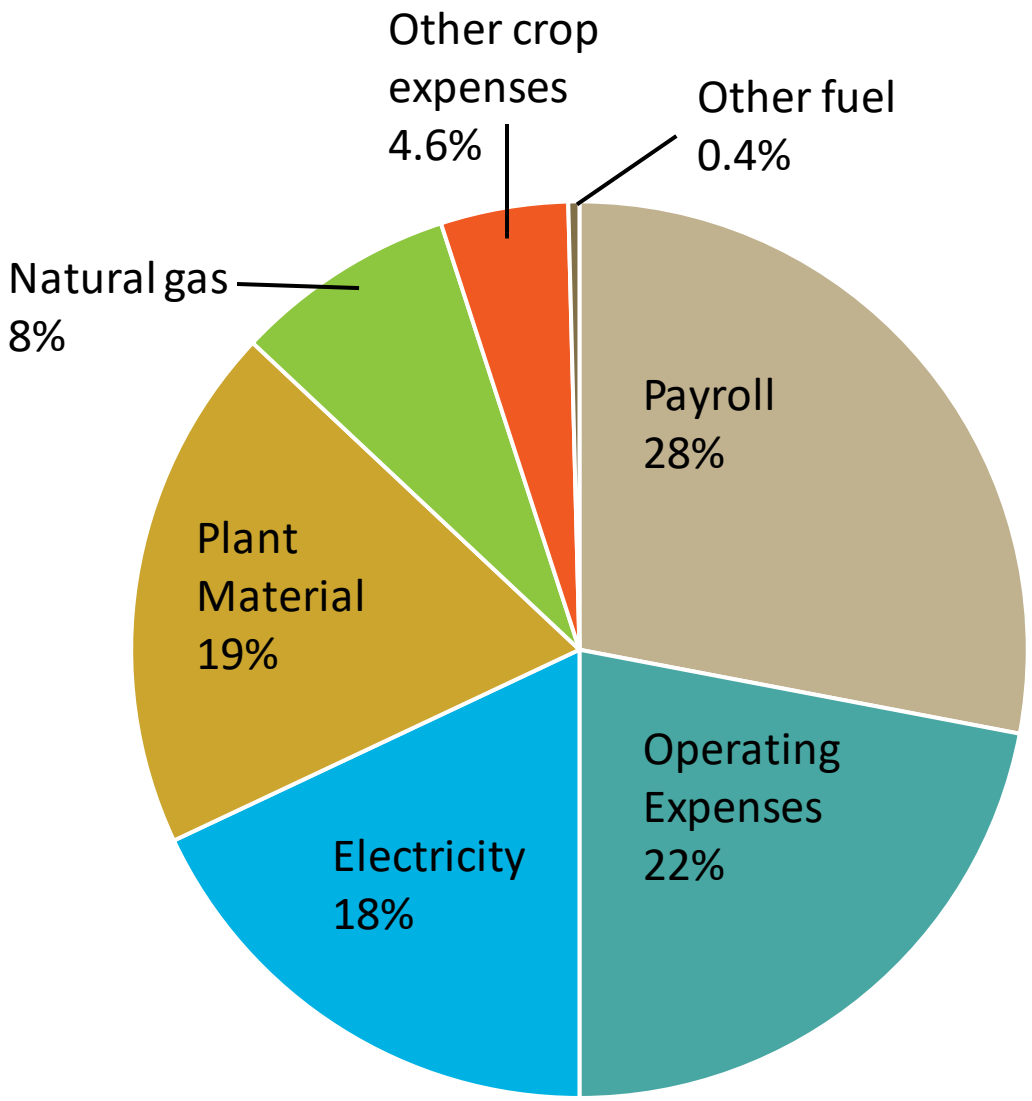
Production System: what do GH producers need?



Statistics Canada. Table 32-10-0245-01 2019 Greenhouse producers' operating expenses

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GH adaptable to different communities

- Urban and sub-urban communities
- Traditional agriculture communities
- Northern and remote communities

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GH in remote and northern communities

- Increase food security
- Training and employment opportunities
- Examples:
  - Yukon Gardens (Whitehorse, Yukon)
  - Inuvik Community Greenhouse (Inuvik, Northwest Territories)
  - Green Iglu (Naujaat, Nunavut)

CBC

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Yukon Gardens (Whitehorse, YT)

- 0.7 acres (30 000 sq ft) hydroponic vegetable greenhouse built in 2018
- Trees, shrubs, annuals, perennials, cucumbers, tomatoes, peppers, lettuce
- Automated biomass boiler for heat (wood chips) and heat curtains (saves 45 % heat loss)
- Humidity control in winter is an issue because cannot open vents, dehumidifier
- Grow until mid-February with no lights, 10 month production
- Seeds from Netherlands, grow own seedlings, 1/3 of plants come from propagators in BC
- GH vegetables priced 5-15% more than imports, but more fresh

CBC

Greenhouse Canada

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Inuvik Community Greenhouse (Inuvik, NT)

- Transformed old arena into a fully functioning greenhouse in 1998
- 18 000 sq ft greenhouse grows leafy greens, squash, tomatoes, and flowers
- Only summer production

Inuvikgreenhouse.com

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Green Iglu (Naujaat, NU)

- Growing North; U of Toronto and Ryerson U students
- Towers to grow leafy greens, soil boxes to grow root veg
- Reflector captures heat from sun and heat is stored in water tub
- 3-4 hours of sunlight a day is needed to maintain the correct temperature
- Re-circulates water
- Fully automated monitoring system
- Production 7 months per year

cbc

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GH Education and Training

- University of Guelph Ridgetown Campus
- Niagara College
- Greenhouse Canada Magazine
- Canadian Greenhouse Conference
- OMAFRA:
  - Greenhouse Vegetable Course
  - Publications
  - Blog
  - Webinars
  - Workshops

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Dr. Sarah Jandricic (Greenhouse Floriculture IPM Specialist)
Jennifer Llewellyn (Nursery Crop Specialist)

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