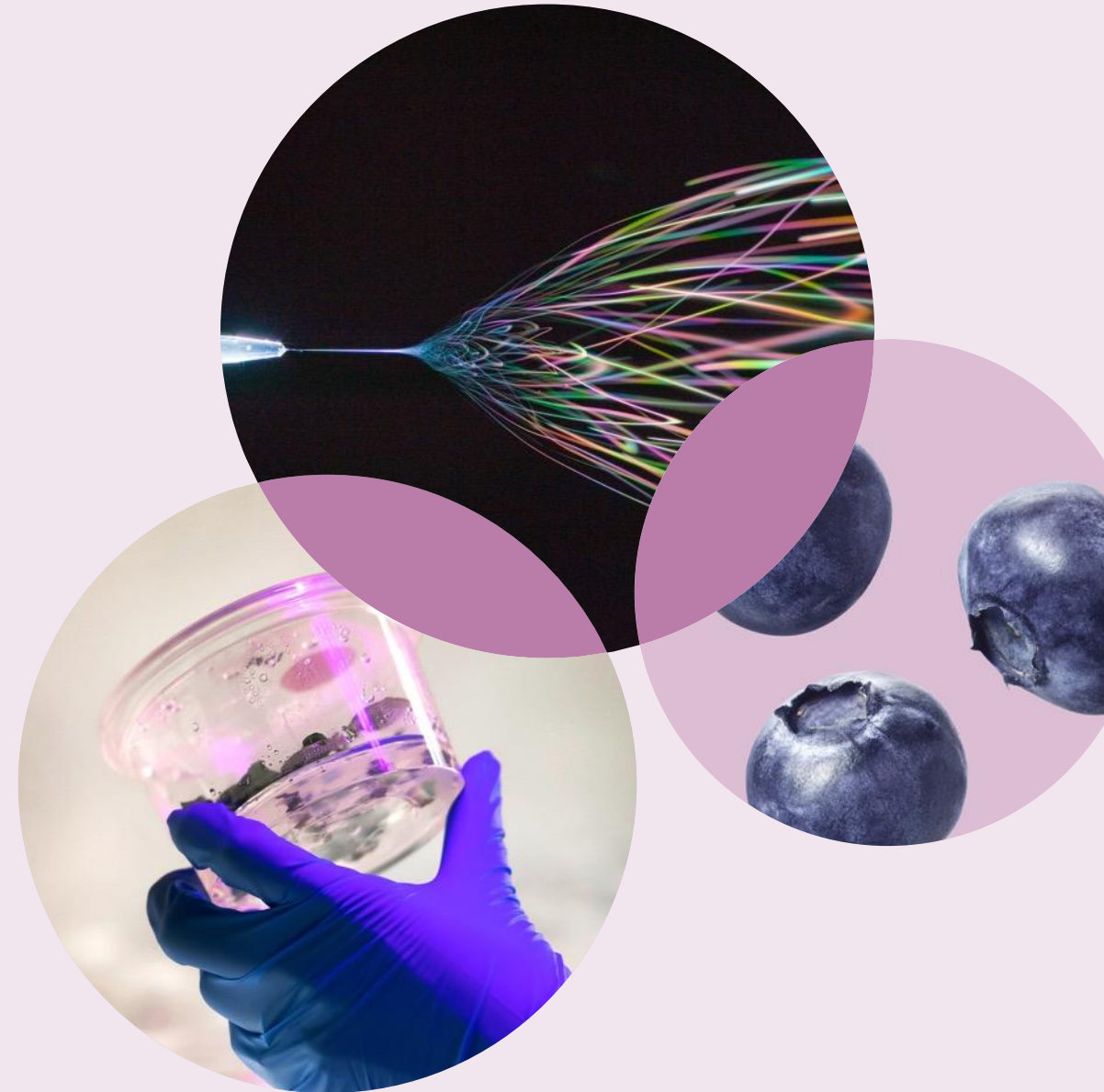




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# Growing the Future Indoors: CEA101

**Jenny Green and Samantha Baldwin**





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# Hua ki te Ao Hort goes Urban

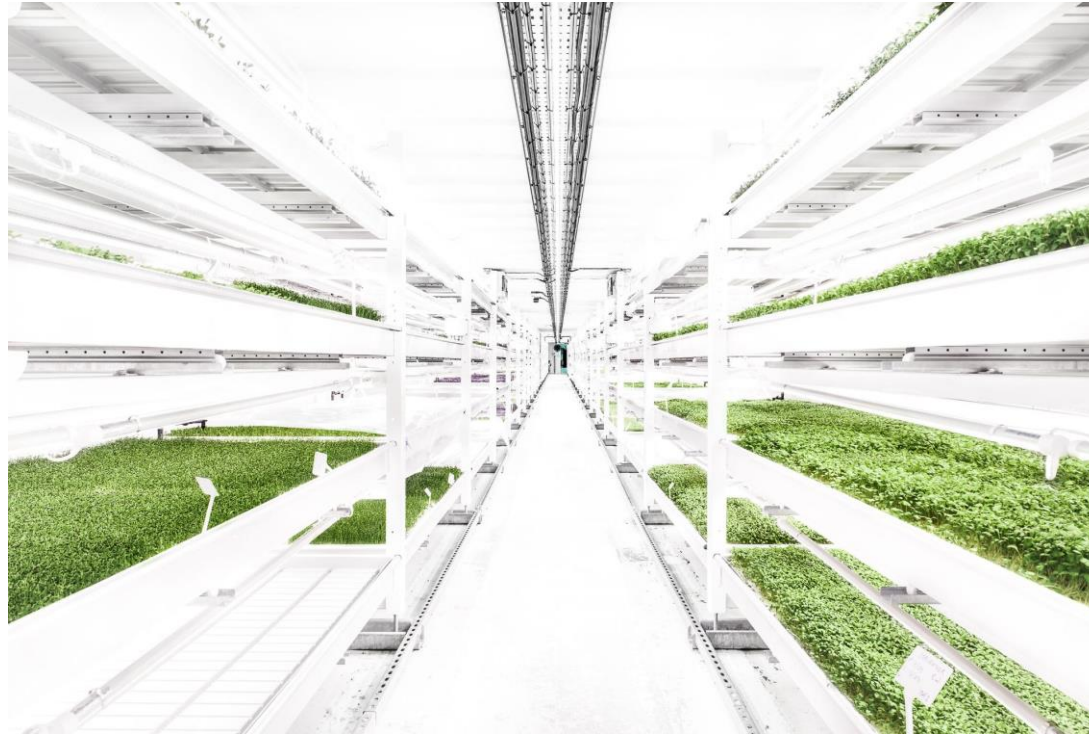
**Direction Leaders:**

**Jenny Green and Samantha Baldwin**





## Indoor growing packages for woody perennials and vine crops



High-yielding, healthy (nutrient dense), woody perennial and vines grown sustainably for urban consumers

Exportable packages (cultivars, management systems and knowledge) that enable remote growing close-to-consumption

# Growing The Future Indoors: Plant and Food Research



This Summit was developed in collaboration with Callaghan Innovation because we wanted to connect those interested in the wider Indoor Growing sector and work towards building collaborations.

From a Plant and Food Research perspective we want to:

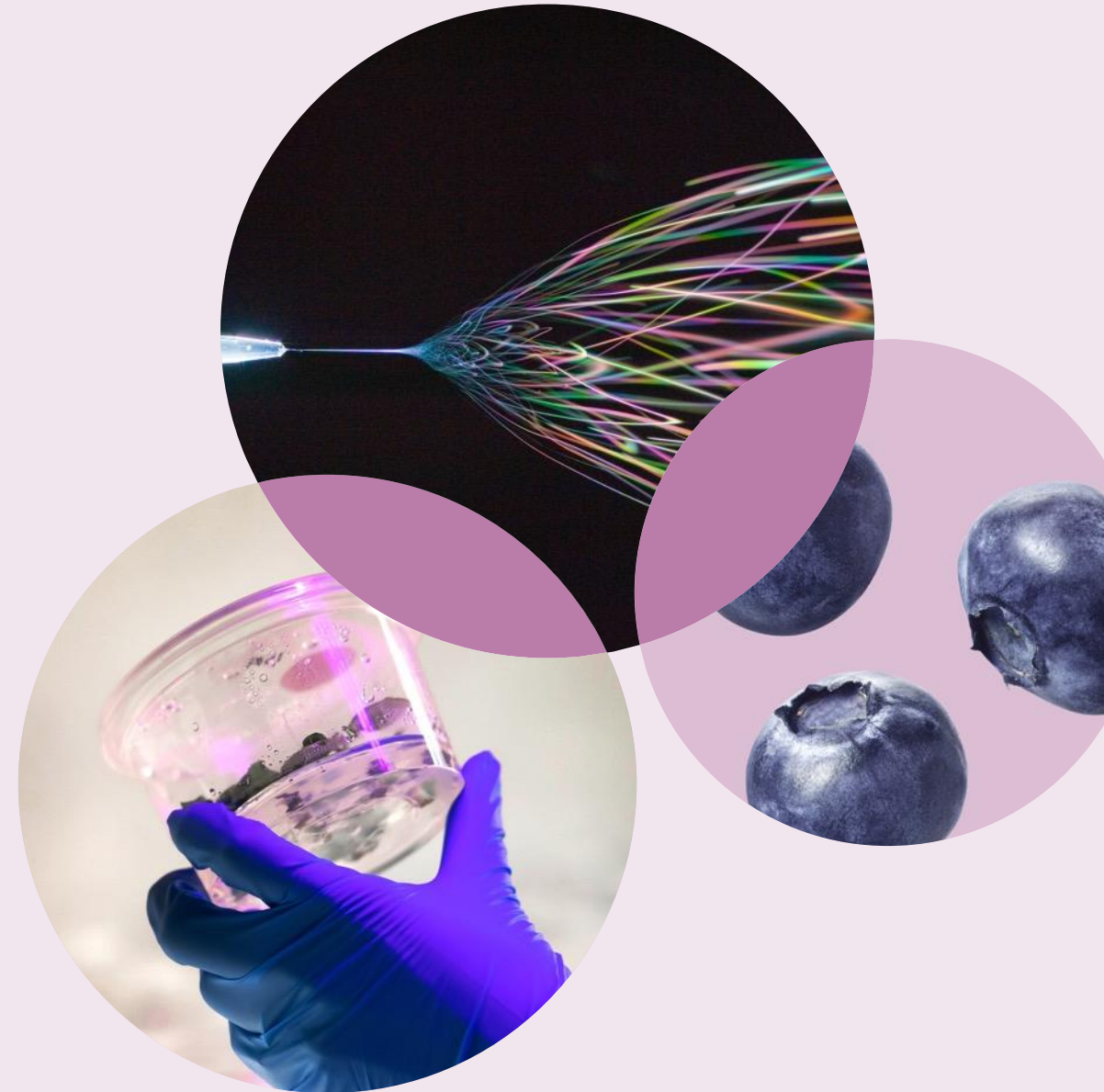
1. Connect with stakeholders
2. Identify the opportunities, challenges and gaps where research could deliver impact
3. Understand what infrastructure and knowledge resources are required to collectively move us forward



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# Growing the Future Indoors: CEA101

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# What is Controlled Environment Agriculture (CEA)?



*A production system where the environment can be controlled to create desired conditions for the crop.*



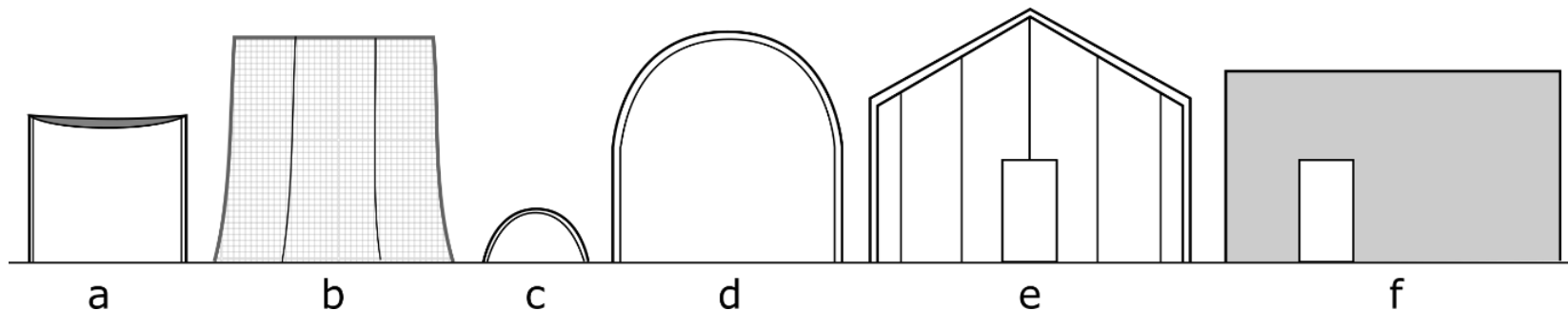
# CEA by any other name...



CEA *Indoor farming* Indoor agriculture **Container farms** ***Covered cropping***  
Protected cropping *Vertical farming* **Controlled Environment Horticulture....**

## Forms of CEA

- Plant factories/vertical farms
- Greenhouse/Glasshouse/Plastic house/Hybrid-Glasshouse/Tunnel house/Shade house/Hoop house
- Growth rooms/growth chambers/ etc...



*Types of protected cropping system examples : a) shade house, b) net house, c) low tunnel, d) high tunnel, e) glasshouse, f) indoor*  
Broussard 2021

# Technology spread in indoor growing

- Low tech tunnel house –provides protection and maybe some temperature sensing but not control

## Increasing add-ons:

- Environment control options manually set and adjusted
- Fully automated environmental control through multiple sensors and a digital farm operating system
- Fully automated with nutrient and water recirculation and treatments, energy recovery...
- Fully automated, digital farm operating system, recycling systems, *supply chain modelling decision and prediction tools*





# The Plant is the Star

In theory, we can provide what's required, continually monitor and dynamically control the plants environment to deliver increased crop yields with high consumer quality.

Higher, faster yields in less space with controlled inputs\*



# So many options



## Fertigation

- Soil-based
- Hydroponics
- Aeroponics
- Aquaponics
- Gelponics



## Lighting

- Sun, Supplemental, artificial (LED....)
- Fixed, variable spectrums and intensities
- Photoperiod changes



## Substrate

- Soil
- Solid e.g. Rockwool
- Gel
- None



## Environmental

- Temperature
- Humidity
- CO<sub>2</sub>

# Why do we need new growing systems?



Global issues facing food security:

- Climate disruptions to outdoor production. We need more resilient systems
- Decreasing productive land due to urbanisation and climate change
- Increasing global population need access to healthy food (>9 billion by 2050)
- Increasing number of megacities (>10 million people)
- Resource limitations (water and nutrients)

**We need to produce more with less and have supply chains that can access large cities**



# What is enabling new growing systems



We have new technological advances such as:

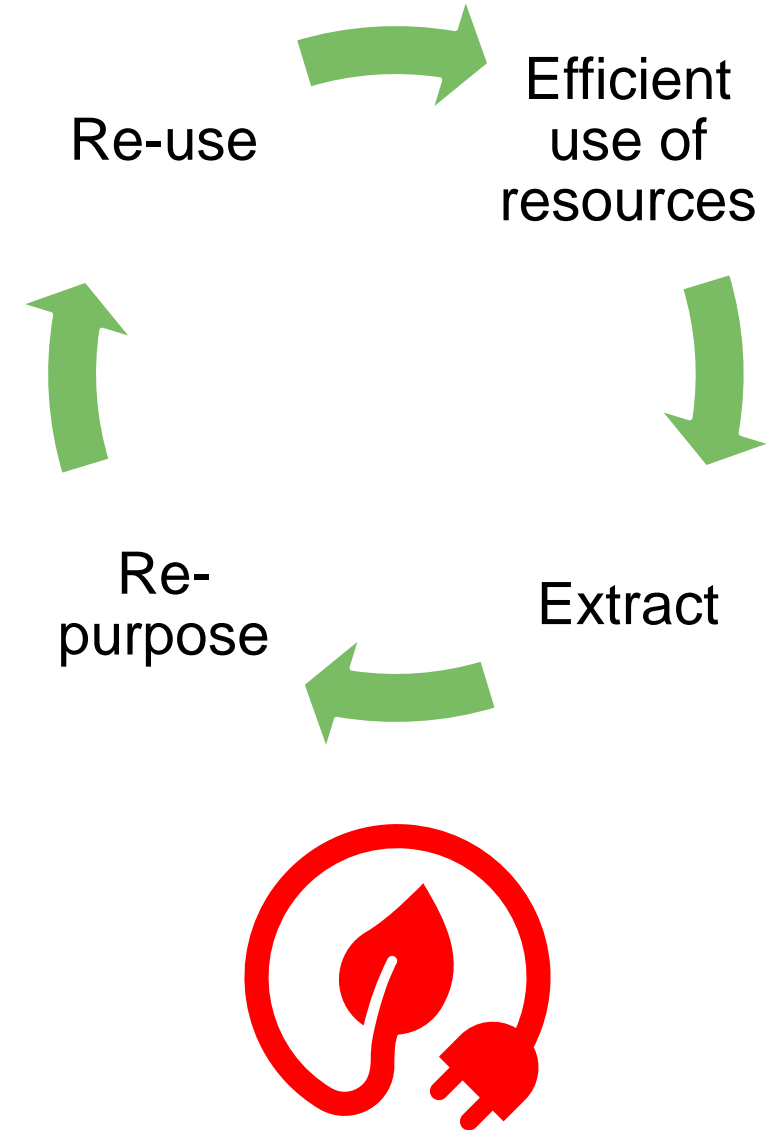
- Smart-data driven farming
- Hardware such as LEDs
- New breeding tools

# Potential for closed systems: Sustainability

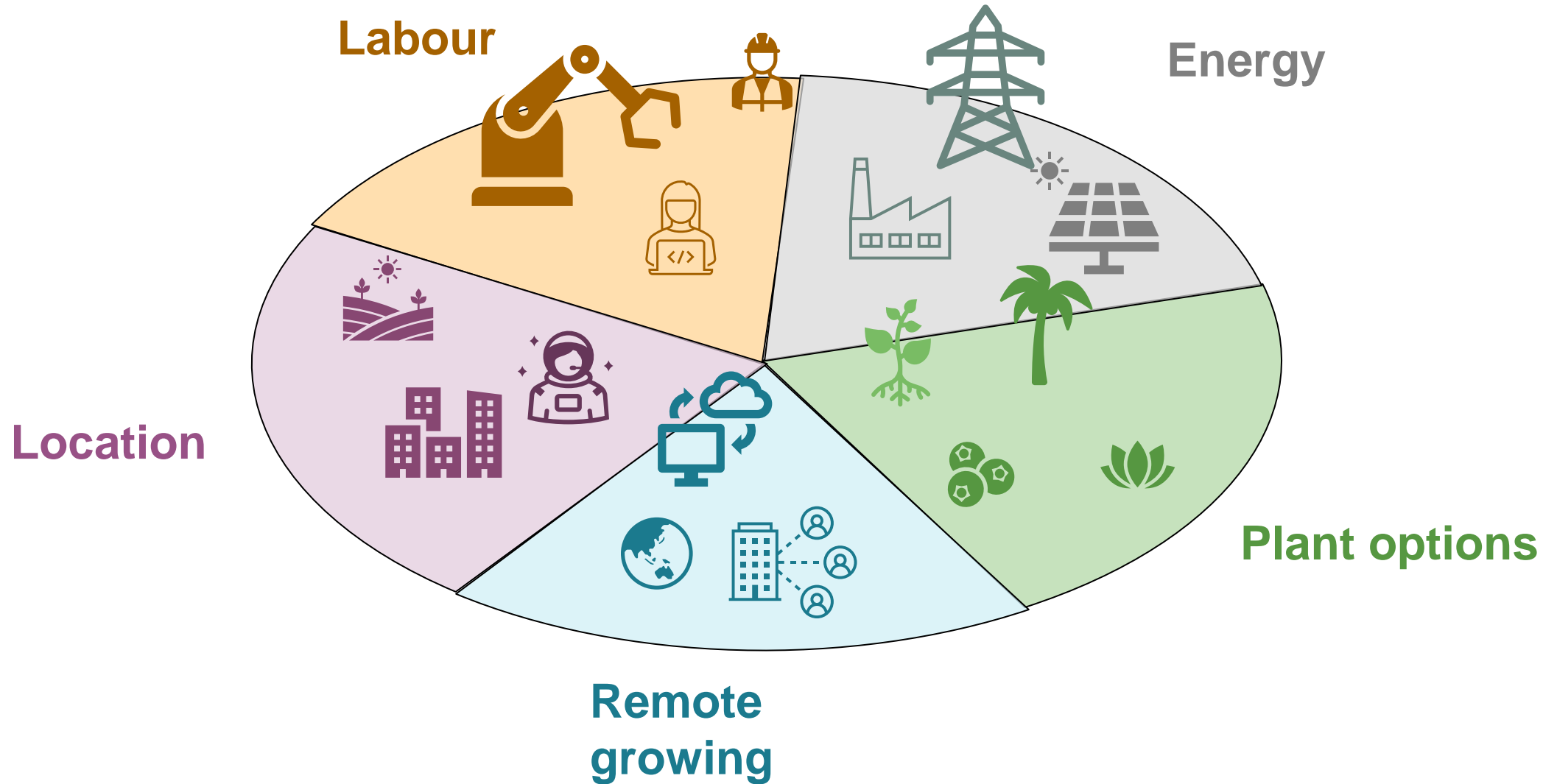


Maximise, re-purpose, re-use and recycle:

- 95% less water used per product compared to outdoor
- Ability to re-claim water extracted from the system through transpiration
- Re-use nutrient with minimal waste or run off
- Consistency leading to reduced food waste
- 'Clean' harvestable biomass for other uses
- ? Co-locate and use excess from other industries – dairy?



# Potential for closed systems: Flexibility



# Potential for closed systems: Premium value proposition

- Reduced chemical input
- Year round production
- Ready to eat
- Consistency of product
- New purpose bred cultivars
- Maximise consumer qualities



# Current indoor grown crops



- Leafy greens and salad greens
- Herbs
- Tomato, Capsicum, eggplant (check)
- Cucumber
- Berries: strawberries, blueberries, raspberries...
- Medicinal Cannabis
- Ornamentals
- Various nursery production
- Rapid seed production



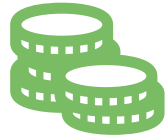


# Challenges for industry



## **Environmental**

Energy inputs are high  
Dealing with waste products  
Regulations



## **Economical**

High upfront capital and operation costs  
Scaling up  
Profitability  
Size of the NZ market



## **Commercial**

Vertical integration?  
Consumer awareness  
Limited crop options



## **Social**

New way of growing  
Industry collaboration  
Different farmers: High-tech and data-rich horticulture

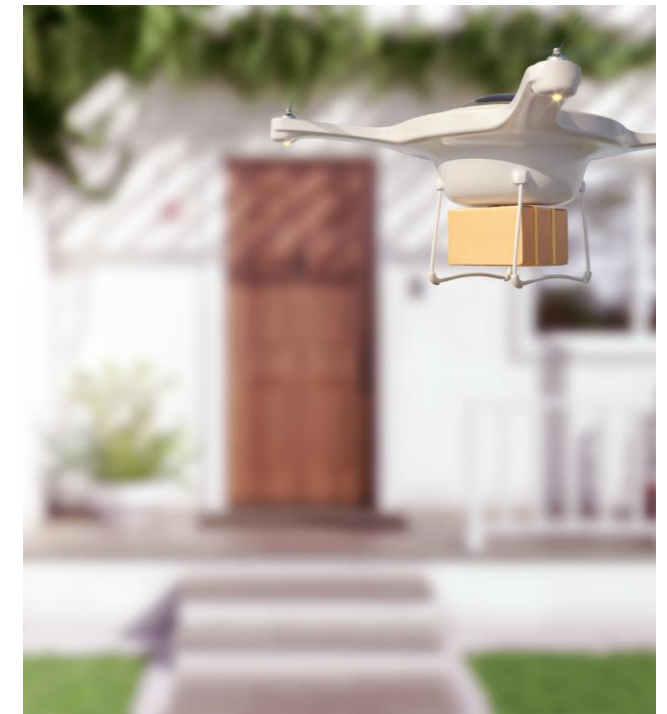
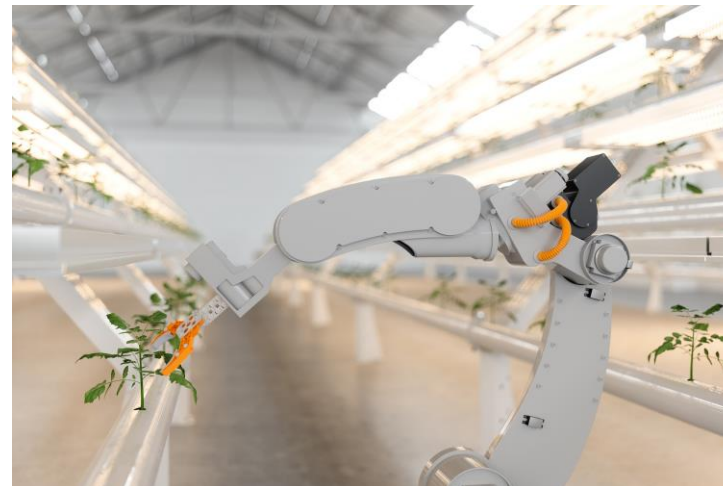
# Challenges for R&D

- Crop options
- Closed inventing and re-inventing
- Standard metrics (CEA)
- Supporting infrastructure
- High capital costs
- Multi-disciplinary
- Supporting a developing industry with many players often with specialist technology
- Funding



# Disruptive technology

- New market types
- Local domestic production (here *and overseas in our export markets*)
- Potential new genetics and crops
- New Agritech solutions
- Climate resilient supply chains
- Less focus on disease, shelf-life more focus on consumer experience
- New production-support export industry?





# What will be the NZInc story?

- We are good at growing, feeding the world and technology
- How do we continue feeding the world through indoor growing?
- We might need to become the growing experts rather than final producers?
- We have R&D abilities and innovative skillfull growers so :

**What do we need to do to turn indoor growing into a successful industry for NZ?**



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Thank you

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The New Zealand Institute for Plant and Food Research Limited

# Hua ki te Ao- Horticulture Goes Urban 2023



World leading research in designing plants to fit new future growing environments to create the wants of the future urban consumer.

**Consumer Centric:** Predict the future needs around the world.

**Plants by Design:**  
Re-imagined plants

**Environment by Design:**  
design new controlled environment growing packages.