

Thesis Labs
Leiden-Delft-Erasmus Universities



Energy-Efficient Horticulture through Circular Practices

2025 - 2026



Universiteit
Leiden

 **TU**Delft


ERASMUS UNIVERSITY ROTTERDAM

Interested in joining this Lab?

Get in touch with or submit your application online



Prof. dr. ir. Jan van den Ende

Scientific Coordinator Circular Horticulture & Agrifood



Dr. Elise Blondel

Scientific Coordinator Circular Industries

Caseholders



provincie
Zuid-Holland

Contact: Ide_thesislabs@cml.leidenuniv.nl

Main Challenge

How can the horticulture sector speed up the transition towards resource circularity, and to which degree can that lead to reducing energy use?

Research Themes

Within the Lab, this challenge will be tackled from technical, social, economic and managerial perspectives. Students may also develop scenarios for the future of circularity in the sector, envisioning how the supply chains might evolve and what organizational impacts this transition could have.

Eight thematic challenges have been defined that connect to the overall Lab challenge, each with a set of possible questions to be researched within a master or a HBO thesis. Students are invited to apply for one of these themes and to develop a thesis topic that addresses one or more of the proposed questions.

Students are also free to adapt the questions to meet the requirements of their specific study program, or to propose their own research questions.

Each student will be matched with (an) organization(s) to ensure real-world relevance and impact.

Research Themes:

1. Circularity and energy use
2. New growing systems
3. Analyses of material flows
4. Interdependency of material flows with other sectors
5. Data management on resource circularity
6. The ecosystem of a circular sector
7. Transition
8. Public opinion

#01 Circularity and energy use

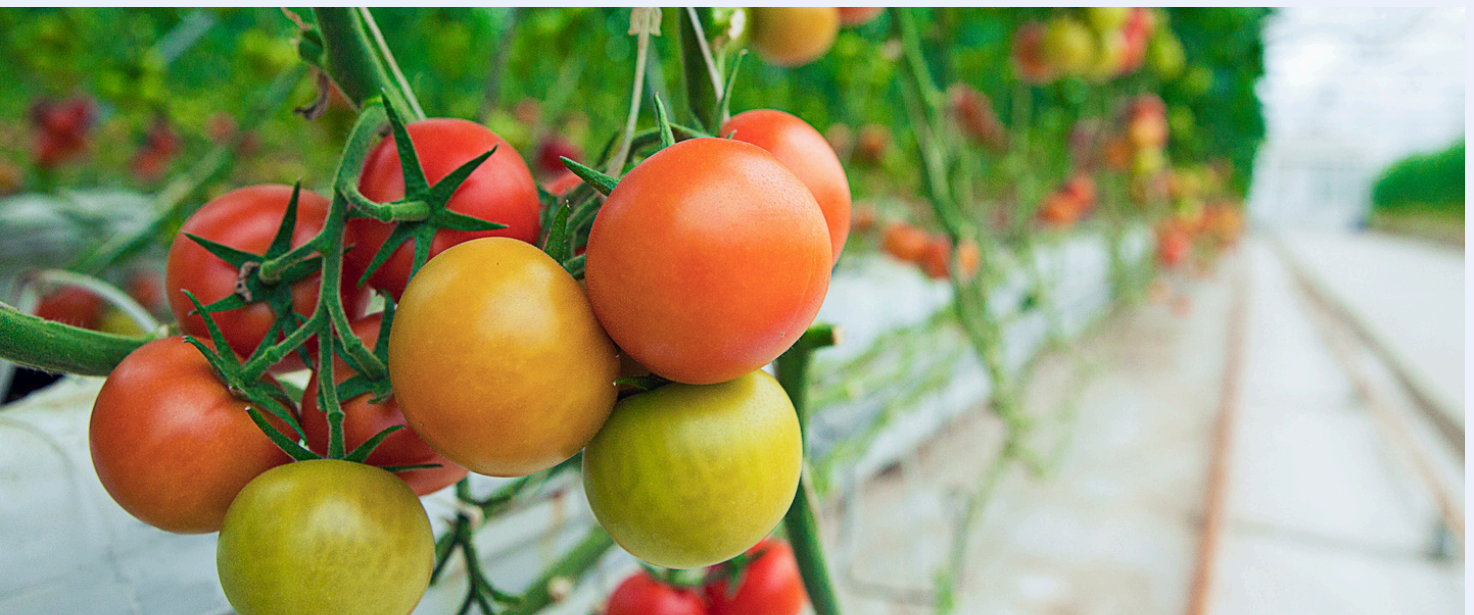
How do we define resource circularity in the horticulture sector appropriately?

Is recycling waste into lower quality products sufficient, or should original materials be recovered from waste streams? Are other circular strategies applicable and meaningful? To what extent is the energy consumption of the sector reduced by implementing circular practices?

Specific research questions could be:

- The literature speaks of the R-ladder: Refuse and Rethink, Reduce, Re-use, Repair, Refurbish, Remanufacture, Repurpose, Recycling and Recover. Which of these strategies are applicable in the horticulture sector, and for what types of resources or products?
- What are the effects of circularity on energy use? How much reduction in energy consumption can be expected from implementing circular practices?

Relevant disciplines include, but are not limited to: industrial ecology, material science, management, engineering.



#02 New growing systems

Several components of crop-growing systems are not circular or hindering circularity. What alternative material or technologies could be used to improve circularity? What is necessary to successfully implement them?

The research could focus on the following components:

- **Covering foils:** Each year, around 5.5 million kilograms of plastic soil covering foils come out of greenhouses, most of which is incinerated after just one harvest. Recycling is difficult due to contamination with soil and crop protection agents. What are sustainable alternatives to these foils? What solutions can be developed to take over the role of these plastics in reflection of light, reduction of weeding and collection of waste?
- **Substrates:** Substrates are essential for crop production in greenhouses, but contamination with roots and agrochemicals, complex material composition, high production and transport impacts, limited recycling options make their circular use difficult. To which extent can new types of substrates be more circular and less energy consuming than the current ones? What is needed to implement them at large scale?
- **Starting materials in vertical farming:** Can production of starting materials for crops in vertical farms close to the grower instead of in a specialized company help reduce transport costs?
- **Composting-friendly systems:** At present, several crops are grown using plastic ropes to guide plant growth, which hinders composting of plant waste. How can plants be grown in a way that composting of remains is facilitated?
- **Water and energy use:** What is the effect of irrigation of plants on energy use? Can the energy of evaporation of plants be reused?

Relevant disciplines include, but are not limited to: biology, engineering.

#03 Analyses of material flows

To which extent should material flows be adapted for the future? Which opportunities are there to replace resources by other, more circular ones?

Examples of research questions can be:

- How can Life Cycle Assessments (LCA's) help improve circularity in the sector? What impact will the transition from 16 to 19 impact categories in LCA's have in practice?
- Are there alternatives for the use of covering foils in the greenhouses?
- Are alternatives needed for the use of plastics packaging or is recycling plastics the better option?

Relevant disciplines include, but are not limited to: engineering, industrial design.



#04 Interdependency of material flows with other sectors

Material flows in the horticulture sector are connected to those in other sectors.

The horticulture sector may use waste energy from other sectors. Alternatively, waste from the horticulture sector may be used in other sectors. And horticulture growers may produce new products, such as wasabi, banana or cannabis, in a way that requires much less resources than the current production system.

Examples of research questions are:

- From which other sectors can the horticulture sector use waste energy and resources? Which opportunities exist to add positively to resource circularity and energy savings in other sectors?
- To which extent can waste materials from the horticulture sector be used in other sectors?
- Can CO₂ from composting of manure be used in the sector to stimulate plant growth? Which other potential sources of CO₂ are there?
- Can plant waste be used for extracting proteins?
- Which new more circular crops can the sector develop?

Relevant disciplines include, but are not limited to: industrial ecology, biology.

#05 Data management on resource circularity

To which extent should data be managed on resource circularity? Are new measurement systems for circularity required? Are new institutions or circularity control systems needed?

Examples of research questions are:

- Can AI help to reduce the use of resources in the sector?
- Can the data that are produced for, and managed in the certification process, be used to increase circularity in the sector?
- Would something as a product passport (used on other sectors) support circularity in the sector?

Relevant disciplines include, but are not limited to: management, information systems, engineering.



#06 The ecosystem of a circular sector

How will the ecosystem of the sector look like in the future, and what steps have to be taken today to facilitate the transition towards this ecosystem? Should so-called “minimum viable ecosystems” be developed, and how?

Concrete research questions could refer to:

- Which business models are needed to facilitate circularity? Are premium prices needed for circular products or circular production processes, and how should these premiums be created and maintained? Do we need new labels to show degrees of circularity to consumers?
- Are new organizations needed to manage the material flows, potentially with tariffs, subsidies or mandatory rules?
- Will so-called service business models contribute to circularity in the sector. such as the initiatives that sell orchids to consumers for the blooming period and take them back afterwards?
- What effect will the transition to circularity have on the organization of the two subsectors (floriculture and vegetable production) in terms of consolidation, scale, internationalization, start-up activity etc.? In other words: how will the required investments affect the organization of the sector?
- Which role do supermarkets and trade organizations have in improving circularity in the sector?

Relevant disciplines include, but are not limited to: management, economics, policy sciences.

#07 Transition

The transition towards a circular sector has to be managed.

How can the sector develop a roadmap of investments towards resource circularity, and how can decisions of growers and other entrepreneurs be directed for this purpose over time?

Research questions can be:

- Which changes in rules and regulations are needed to facilitate resource circularity? What are the economic effects of such rules for the competitive international position of the Netherlands or Europe?
- Which means does the sector and do governments have to increase the level of circularity and to promote the transition to a circular future?

Relevant disciplines include, but are not limited to: transition management, policy science, law, economics.



#08 Public opinion

The horticulture sector has a legitimacy problem: several opinion leaders question the viability of the sector, and particularly of the floriculture subsector, for Dutch society and the economy.

A recent survey showed that 50% of the population has a positive attitude towards the floriculture sector, 42% is neutral and 8% is negative (Middelburg, 2024). Examples of research questions are:

- How can a roadmap towards a circular future contribute to the legitimacy of the sector?
- How should the sector communicate with the general public on this topic?

Relevant disciplines include, but are not limited to: sociology, communication and media sciences.



References

Below you'll find some interesting reading materials to get your thesis started!

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