

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



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Caseholders



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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

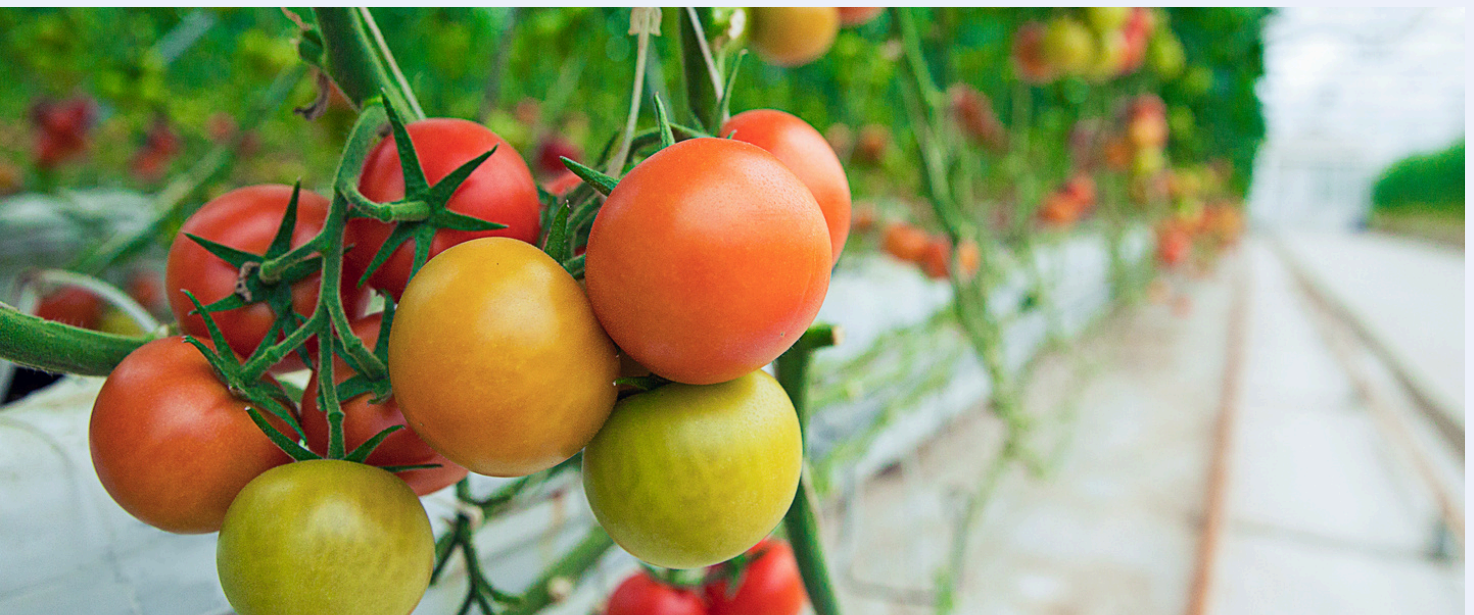
How do we define resource circularity in the horticulture sector appropriately?

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

Thesis topic: Alternative sustainable solutions for plastic walking foils (loopfolies)

Organization: Province South-Holland

Contact: Bowine Wijffels (Transition manager Circular Economy, Plastics)

Challenge: Walking films, also called substrate films, are mainly used in high-wire crops such as tomatoes, peppers, cucumbers, and eggplants. These films are used as ground covers for protection of the soil (from contamination by substances and weed), for collecting waste (such as leaf debris), and for reflecting or absorbing light (either shading or enhancing plant growth). Every year, in the province of South Holland alone, around 5.5 million kilograms of walking 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. The dependence on large quantities of single-use plastic walking films poses a challenge for the long-term sustainability of the sector and for growers' ambition to produce fully circularly.

Research question: What innovative solution(s) could drastically reduce the amount of single-use plastic walking films in greenhouse horticulture? These could include:

- New types of flooring materials
- Alternative cultivation methods
- Entirely new approaches

The solution(s) should be widely implementable across the horticultural sector.

Student expertise: For example industrial design, material science, industrial ecology, etc.

Available data/reports: (in Dutch)

Verkenning land- en tuinbouwplastics, Eindrapport, Tauw & Rebel in opdracht van het Ministerie van IenW (in Dutch), 2024. <https://open.overheid.nl/documenten/66ab9e52-14bc-44af-933a-873dc1000ba8/file>

Circulaire plastics in de tuinbouwsector in Zuid-Holland, Schuttelaar & Partners in opdracht van het Ministerie van IenW (in Dutch), 2022. <https://transitieagendakunststoffen.nl/actueel/circulaire-plastics-tuinbouwsector-zuid-holland/>



#02 New growing systems

Thesis topic: How to facilitate composting and circular use of organic materials?

Organization: Renewi

Contact person: Joop Suurmeijer (Business Development Manager Commercial Waste)

Challenge: Renewi is the largest waste recycling company in the Netherlands (with a turnover of around 2 billion euros), operating in five European countries. Every year, Renewi processes about 1 million tons of biowaste in the Netherlands and Belgium, originating from both households and the horticulture sector. Most of this waste is composted in industrial facilities and converted into (enriched) compost for agricultural use. Due to increasing environmental and health standards, the quality requirements for agricultural compost have become stricter: industrial compost must now contain less than 0.015% contaminants by weight. However, the biowaste processed by Renewi often contains a significant amount of contaminants—mainly plastics used in horticulture. For efficiency and cost reasons, greenhouse waste is typically not sorted after harvest. Instead, entire greenhouses are cleared out at once, including substrates, soil, plant residues, and growing materials such as plastic foils, clips, and other components. Sorting is carried out at Renewi before composting, but despite these efforts, some plastic still ends up in the biomass.

Research question 1: What is the flow of materials entering and leaving the processing facility? How much, and what types of materials — including plastics — are coming from greenhouses to Renewi? And where do these materials ultimately end up after being processed?

Research question 2: How can cultivation systems be designed so that plant residues can be more easily composted? What alternative growing systems could facilitate composting and circular use of organic materials? And what conditions are needed — technical, organizational, legal, economic — to successfully implement these alternatives in practice?

Student expertise: For example industrial ecology, industrial design engineering, resource & waste engineering, etc.



Source: Renewi

#02 New growing systems

Thesis topic: Biobased alternatives for EPS plant trays

Organization: Hordijk

Contact person: Annelie Verstraaten (Strategic Marketing Development Manager)

Challenge: Royal Hordijk is an international supplier of plastic packaging and a producer of sustainable greenhouse systems and related products for the food & agriculture industry. The company produces EPS (expanded polystyrene) for the horticultural sector. These trays are used for growing tables, sowing or transplanting plants and can be delivered filled with substrate. Thanks to its insulating properties, EPS is a convenient material to minimize temperature fluctuations which has a positive effect on plant growth. Most of these trays are used only once to prevent disease transmission and then downcycled. Although the company is also investigating reusable trays, it is also interested in biobased alternatives to limit fossil fuel use.

Research question: What biobased alternatives are suitable for EPS trays? What is the environmental impact of these alternatives? What would be the implications on the supply chain of the implementation of these alternatives at large scale?

Student expertise: For example industrial design engineering, material science, biotechnology, industrial ecology, supply chain management, etc.



#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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