

Energy-Efficient Horticulture through Circular Practices

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

FRAGMENTATION IN THE INDUSTRY

Overview of Individual research

Circular alternatives to EPS plastic trays

This thesis explores how propagation tray systems in horticulture can become more circular while remaining compatible with current growing practices.

- Hygiene concerns are the primary barrier to tray reuse.
- Circularity requires system changes beyond material substitution alone.
- Reusable tray systems show the strongest balance between feasibility and environmental impact.
- Further development focuses on validating a reusable HDPE tray supported by cleaning, return logistics, and traceability supporting circular economy.

Substrate circularity verification

This thesis asks whether circularity of stonewool, coir, and wood-fibre substrates can actually be demonstrated across the chain, not just modelled in indicators.

- The main barrier is a verification gap: producers, growers, and waste processors each see only part of the chain, so the sector cannot prove what happens to substrates after use, even when circular options exist in principle.
- Treating stonewool, coir, and wood fibre under one generic circularity framework hides where each material actually fails; mineral and bio-based substrates face different challenges that require tailored solutions.
- Shift effort from designing new composite scores toward substrate-specific pilots that put in place concrete chain-of-custody tracking, standardised data handovers, and contractual accountability for end-of-life outcomes, so that circularity becomes a verifiable performance condition.

What makes growers go circular?

This thesis examines why Dutch horticulture growers intend to adopt or reject circular plastic practices, and how these decisions are shaped by behavioural, organisational, and contextual factors across major plastic cultivation aids.

Adoption of circular plastics depends on three factors: grower motivation, organisational fit, and wider chain conditions.

Frontrunners act from sustainability values, future readiness, and strategic positioning, while most growers wait until alternatives are proven, affordable or required.

Alternatives must fit existing cultivation systems without increasing labour, reducing crop performance, or creating hygiene and supply risks.

Barriers differ by product category: foils, pots, and trays need more focus on better recycling and logistics, while twine and clips require redesign or biodegradable alternatives.

Wider adoption requires product-specific pilots, collective purchasing, supplier cooperation, clearer policy, and shared responsibility for costs and risks.

Learning from growers

This thesis explores how a leading data-driven growing platform provider in the horticulture sector institutionalises user feedback to enable the adaptive evolution of its digital tools, especially of those for resource efficiency and circularity.

- The feedback-to-adaptation loops depends on a combination of plural feedback channels, domain expertise, internal capacity, cross-team coordination, and client relationships.
- Institutionalised feedback is both a technical and an organisational process.
- The language practitioners use affects whether resource-related signals become visible and actionable, as platform feedback is often framed by clients in operational and cost terms, and not in explicit circular economy language.

Redesigning the Cultivation System Toward a Circular Composting

This thesis investigates the root causes of plastic contamination in greenhouse bio-waste and explores the redesign of the tomato cultivation support system to reduce plastic entering the compost stream at its source.

High-wire growing method, in which plastic twine and clips become inseparably entangled with plant material, forming a mixed waste stream that cannot be effectively separated at end of cycle.

- Adopt biodegradable twine as an immediate substitution if the current system is retained.
- Develop a new cultivation support system that eliminates twine, though this requires extensive testing and grower confidence-building.
- Policy and regulation should actively incentivise transition and provide risk safeguards for growers.

Data management to enhance circularity

This thesis explored how data management can support the implementation of circular strategies in Dutch horticulture by improving collaboration across decentralized supply chains.

- Although organizations collect large amounts of data, fragmented systems and limited interoperability prevent effective data sharing and joint decision-making. The main challenge is not collecting more data, but integrating existing data to support ecosystem-wide circular strategies.
- To accelerate the transition to a circular horticulture sector, organizations should invest in shared data platforms and ecosystem governance. This enables secure collaboration, maintains data sovereignty, and helps turn circular ambitions into practical action.

Barriers to circularity for tomato growers

This thesis investigates barriers perceived by Dutch tomato growers to achieving full resource circularity.

- Economic feasibility is the most important barrier to adopting circular practices.
- Additional barriers include technical limitations, hygiene concerns, complex regulations, and limited consumer demand.
- Growers view circularity as a system-level challenge requiring collaboration across sectors.
- Key enablers include innovation, financial incentives, clearer regulations, and stronger supply-chain cooperation.
- Most growers support greater circularity but consider full circularity unrealistic under current conditions.

Greenwashing in the Dutch horticulture

This thesis examines how growers, trade associations, regulators and policymakers in the Dutch greenhouse horticulture sector perceive greenwashing, and whether they view it as environmental harm or crime.

- Perceptions of greenwashing vary widely among actors, depending on their position within or outside the sector.
- Most actors view greenwashing mainly as a communication issue, rather than as environmental harm or a criminal offence.
- Without a shared definition of "sustainability" or "greenwashing", misleading claims are hard to identify and address consistently.
- None of the actors see themselves responsible: misleading claims are mainly attributed to external factors, such as unclear regulation, market pressure, or how the sector is portrayed, rather than by actor's own communication.
- Growers often see their practices as genuinely sustainable, but find it difficult to communicate this clearly.
- Complex, fast-changing regulations create a knowledge gap, leading to misleading claims being made unintentionally rather than deliberately.



Retail innovation

This thesis examined how retailers influence the adoption of circular practices among growers in Dutch horticulture and how they can accelerate the transition to a circular sector.

- Main findings:
- Retailers both enable and constrain circularity: they encourage sustainability through standards and certifications, but price pressure and supply requirements often limit innovation.
 - Growers see circularity mainly as a way to improve efficiency, reduce waste, and ensure long-term business viability.
 - Circularity is a supply-chain challenge that requires collaboration between growers, retailers, and policymakers.

WHAT NOW?

Overview of collective findings/recommendations

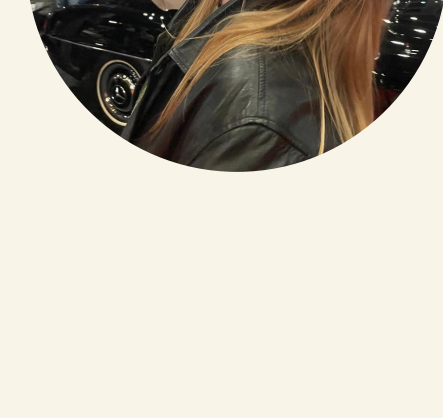
Throughout this project, it became clear that the transition towards a more circular horticultural sector is not limited by a lack of ideas or innovation. Across interviews, case studies, and literature, stakeholders consistently demonstrated a willingness to embrace circular practices and highlighted numerous examples of successful initiatives already taking place. However, these efforts often remain isolated, making it difficult for the sector to realise their full impact.

A recurring theme across our findings is the need for stronger collaboration throughout the value chain. Growers, suppliers, researchers, policymakers, waste processors, and consumers all influence the success of circular systems. Rather than focusing on individual responsibilities, participants emphasised the importance of creating shared ownership, where knowledge, resources, and best practices are exchanged more openly. Circularity is ultimately a systems challenge that requires collective action instead of isolated interventions.

Our research also revealed that many of the barriers are not primarily technical. While innovative solutions for reducing waste, reusing materials, and closing resource loops already exist, their implementation is often constrained by economic uncertainty, fragmented regulations, limited access to information, and the absence of supportive infrastructure. Addressing these challenges therefore requires not only technological innovation, but also enabling conditions that make circular practices practical, accessible, and financially viable.

Taken together, these findings suggest that the next step is not simply developing more solutions, but strengthening the connections between the people and organisations that are already working towards the same goal. By fostering collaboration, sharing knowledge, and aligning efforts across the sector, the horticultural industry can move beyond individual initiatives and build a more resilient, resource-efficient, and truly circular future.

Meet the researchers



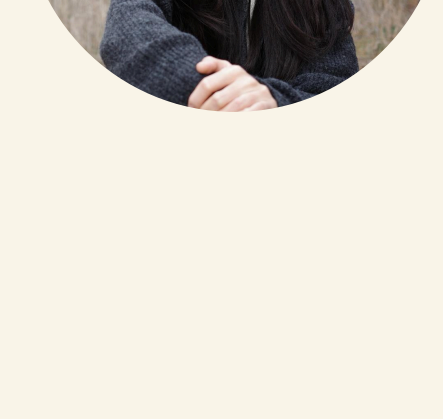
Retail innovation for a circular Dutch horticulture

Research question: How do retail companies help or prevent circularity among growers in Dutch horticulture, and what innovative pathways can strengthen circularity within the sector?

Maxime Akkermans - MSc Management of Innovation, Erasmus University Rotterdam

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Redesigning the Cultivation System Toward a Circular Composting

Research question: How can we redesign a cultivation system that reduces source contamination in greenhouses by lowering the proportion of plastic contaminants in bio-waste, thereby improving composting efficiency in subsequent processes?

Yiyi Wang - MSc Integrated Product Design, TU Delft

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Circular alternatives to EPS plastic trays

Research question: How can propagation tray systems be designed to enable circularity while maintaining compatibility with existing horticultural practices?

Kalina Kuzmanova - MSc Integrated Product Design, TU Delft

Thesis: Link to be added

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What makes growers go circular

Research question: Which behavioural, organisational, and contextual factors shape Dutch horticulture growers' intentions and decisions to adopt circular plastic practices, and how do these factors differ across major plastic application categories?

Leander de Stigter - MSc Global Business and Sustainability, Erasmus University Rotterdam

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Data management to enhance circularity

Research question: How do organizations within an ecosystem formulate and implement circular strategy?

Kiki Koppers - MScBA Management, Erasmus University Rotterdam

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Data Management for Resource Circularity and Energy Efficiency

Research question: How does an agri-tech firm institutionalise user feedback to enable the adaptive evolution of its digital tools, especially for resource efficiency and circularity?

Paola D'Incecco - MSc in Business Information Management, Erasmus University Rotterdam

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Circularity in practice: barriers and opportunities identified by Dutch tomato growers

Research question: How do Dutch tomato growers experience the transition towards full resource circularity and what barriers do they perceive?

Shirley Kouwenhoven - MSc Management of Innovation, Erasmus University Rotterdam

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Greenwashing in the Dutch horticulture

Research question: How do growers, trade associations, regulators, and policymakers perceive greenwashing in the Dutch greenhouse horticulture sector, and to what extent do they consider it a form of environmental harm or environmental crime?

Roos Hofman - MSc Forensic Criminology, Leiden University

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Substrate circularity verification

Research question: How can circularity be meaningfully measured and verified across the Dutch greenhouse substrate chain, and what governance, data, business-model, and material-design arrangements would be required to close the verification gap for stonewool, coconut coir, and wood-fibre substrates?

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