

**Interdisciplinary Thesis Lab  
2023-2024:**

**Changing Mega  
Systems: Towards  
a Circular Carbon  
Industry Cluster in  
South Holland**

**LDE CfS Industries-Hub**



**Universiteit  
Leiden**



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# Colofon

This document includes the challenge and explanation of the thesis lab 'Changing Mega Systems: Towards a Circular Carbon Industry Cluster in South Holland'

LDE Centre for Sustainability - Industries-Hub

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# Introduction

## Thesis Lab

The lab-program 'Changing Mega Systems: Towards a Circular Carbon Industry Cluster in South Holland' runs from the beginning of February until the end of June 2024. It is a biweekly program where students participating in the lab come together to follow in-depth lectures and workshops related to their sustainability challenge formulated together with this year's partners, The Province of South Holland, InnovationQuarter and The Economic Board South Holland (Taskforce Circular Economy). In this thesis lab we focus on the chances, opportunities and challenges of a circular carbon industry cluster in South Holland related to the following main question: How does the South Holland circular carbon industry cluster look like in 2050? What is its role in the new circular system and how do we get there?

This challenge will be addressed by unpacking the following themes with a diverse group of student researchers:

1. Natural sciences (environmental impact, innovative technologies)
2. Social sciences (public attitudes, multi-stakeholder collaboration, governance)
3. Engineering
4. Design
5. Law & regulations
6. Economics
7. Management
8. Humanities and Philosophy

Make sure to check the [website](#).

## Interested in joining the Thesis Lab?

Get in touch with or submit your application online  
Registration opens on the 27th of September 2023



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Academic coordinator of the Thesis Lab

For more information on enrolment and selection procedure, [click here](#).

# Circular Industry in South Holland

The region of South Holland is one of the carriers of the Dutch economy and has a lot of potential to play a key role in the transition towards a circular industry. The

*“WITH THIS THESIS LAB WE AIM TO GET A NEW GENERATION OF TALENT EXCITED TO TACKLE ONE OF THE REGION’S BIGGEST CHALLENGES: HOW TO TRANSITION TO A SYSTEM WITH LESS HARMFUL ENERGY AND RESOURCE USE.” – MELLE SIJBRANDIJ, BUSINESS DEVELOPER CIRCULAIR, INNOVATIONQUARTER*

region has the largest petrochemical cluster of the world, the largest biobased cluster of Europe, the largest sea harbor of Europe, infrastructure to the hinterland, strong ecosystems and world class knowledge institutions.

The taskforce Circular Economy of the Economic Board South Holland has created

*“THE ROTTERDAM HARBOR-INDUSTRIAL COMPLEX HOUSES A VERY EFFICIENT AND INTERCONNECTED ECOSYSTEM OF STILL MOSTLY FOSSIL-BASED INDUSTRY. MY PROFESSIONAL CHALLENGE IS TO FIND WAYS TO CHANGE THIS LINEAR MEGA SYSTEM INTO A CIRCULAR ONE. WITH THE THESIS LAB OF THE LDE CENTRE FOR SUSTAINABILITY I’D LIKE TO INVITE STUDENTS TO USE THEIR FRESH IDEAS AND TALENTS TO OVERCOME THIS GREAT CHALLENGE.” ELS BOESVELD – POLICY ADVISOR CIRCULAR INDUSTRY – PROVINCIE ZUID-HOLLAND*

the ‘Circular Action Agenda South Holland’. The agenda focus on accelerating the transition to renewable, recyclable resources on a commercial, industrial level in South Holland. The following circular ambitions are mentioned:

In 2030, it is the aim of the region to use 10 million tons of renewable materials as a replacement of fossil based materials in the production of materials, chemical products and biofuels. And also to stimulate a sustainable business case in the petrochemical sector with 1.600 FTE of employment opportunities. In 2050, the sector wants to be 100% circular. To make this systems shift – and create the circular carbon hub South Holland – collaboration between the industry, government and knowledge institutions (‘triple helix’) is key.

## ■ Documents

[Circulaire Actieagenda Zuid-Holland](#) (in Dutch)

[Sustainable Port](#)

# Partners

The thesis lab is supported by three partners:

1. Province of South Holland
2. InnovationQuarter
3. Economic Board South Holland

During the lab you can expect the following things of these partners.

## ■ Collaborative Question Formulation

Partners work together with other stakeholders and the thesis lab facilitators to formulate questions that you as a student can investigate.

## ■ Mentorship for Student Researchers

Partners are matched with a group of students who are conducting research relevant to the partner organization’s interests and needs.

## ■ Regular Engagement

Partners maintain ongoing communication with their assigned student researchers.

## ■ Participation in Key Events

Partners are expected to actively participate in essential program events, including the kick-off event in February 2024, the round-table discussion in April 2024, and the final presentation session in early July 2024. Partners are also encouraged to join other program gatherings and meetings.

## Province of South Holland

The province of South Holland aims towards being a region with a complete circular society in 2050. A society without waste, in which we reduce materials needed with smart circular strategies and reuse existing raw materials and materials for new products. In that way we are less dependent on scarce materials and limit damage to the environment, biodiversity and our own health. The province stimulates collaboration between industry, government, research and citizens.

## InnovationQuarter

InnovationQuarter is the regional economic development agency for the Province of South Holland. Their mission is to strengthen the regional economic structure by stimulating the innovation potential of the unique delta region. In close collaboration with all major corporations and many small medium enterprises, educational and research institutes as well as government organisations, they align the efforts required to design a brighter tomorrow.

## Economic Board South Holland

The Economic Board South Holland (EBZ) consists of the most important actors of the South Holland economy: industries, knowledge institutions and governmental organizations. The board members of the EBZ are committed to renew and strengthen the economy of South Holland, to make the economy more sustainable and stimulate the business climate in the region.



provincie  
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Quarter



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# Thematic Focus

The region of South Holland is an important driver of the Dutch economy. However, it houses a lot of conventional industrial practices. In 2050, these fossil fuel-based practices need to be replaced by circular carbon industrial practices and circular ventures. This new industry needs to fit into a new fully circular value system.

In 2050, 100% of the products that our society needs need to be produced with zero CO2 emissions. To reach this goal a systems change is needed: a shift from a “take, make, waste” system to a circular system. In this system reuse, product sharing, product leasing, repairing and refurbishing will be the new norm to reduce the amount of materials needed. The materials we do use need to be sustainable: industry needs to recycle and reuse circular, biobased and CO2-based materials.

In this thesis lab we explore the chances, opportunities and challenges of a circular carbon industry cluster in South Holland, together with the province of South Holland, InnovationQuarter and the Economic Board South Holland (taskforce Circular Economy).

The main question, central to this lab is: How does the South Holland circular carbon industry cluster look like in 2050, what is its role in the new circular system? And how do we get there?

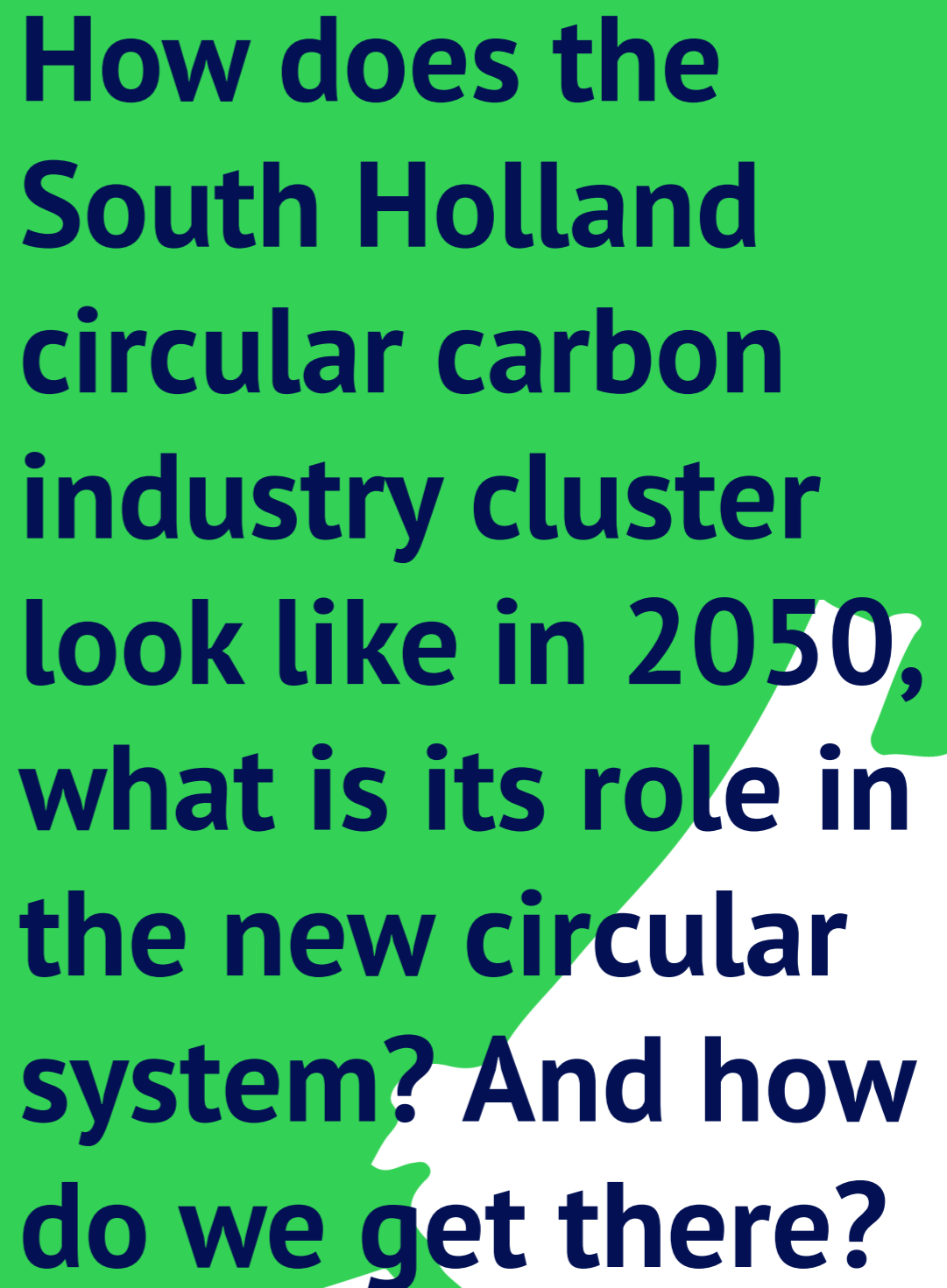
What kind of new circular industrial activities will take place, especially in the Rotterdam harbor complex, to prepare for and take full opportunity of the upcoming systems change? How does this systems shift look like? How can we accelerate this shift?

The Lab invites students to apply for thematic thesis challenges that connect to the overall challenge:

1. Natural sciences (environmental impact, innovative technologies)
2. Social sciences (public attitudes, multi-stakeholder collaboration, governance)
3. Engineering
4. Design
5. Law & regulations
6. Economics
7. Management
8. Humanities and Philosophy

The thesis challenges will be re-formulated by students to make it suitable for a thesis assignment within their specific study programs.

More details on the topics and possible research questions will be provided on the following pages.



# How does the South Holland circular carbon industry cluster look like in 2050, what is its role in the new circular system? And how do we get there?

# Thesis Challenges

## 1. Natural sciences

■ **Assessing the environmental impacts and carbon reduction potential of circular carbon economy practices, with a focus on the Rotterdam harbor industrial complex.**

*This study will explore who is involved, what strategies are being employed, where these practices are being implemented, how they are being carried out, and why they are important for sustainable development. Additionally, it will consider the international aspects of logistics and the role of imports in these practices. How would companies change their techniques, practices, and business models if legislation restricted imported fossil oil/feedstocks? What sectors/companies would be most affected by such legislation?*

■ **Exploring innovative technologies for achieving circularity and reducing carbon emissions in regional industrial processes, including their applicability and effectiveness.**

*This investigation will delve into the 'how' of these technologies and assess how venture building can play a role in their implementation, considering the international context and import factors. How can the (petro)chemical sector transition to circular ecosystems where consumer products are reused, repaired, and recycled? What will be the new role of the sector in these circular ecosystems?*

■ **Analyzing market dynamics, identifying barriers, and exploring opportunities for industry in the future circular ecosystem.**

*This study will address the 'how' and 'why' behind these dynamics, considering international market influences and import/export factors.*

## 2. Social Sciences

■ **Investigating public attitudes, perceptions, and behaviour towards circular carbon economy strategies, considering the socio-economic context of the local community**

**and actively seeking strategies to enhance stakeholder engagement.** *This research will explore the different dimensions of these attitudes, considering international perspectives and the role of imports where applicable. Who are potential thought leaders on the circular transition and how can they accelerate the transition? What people, skills, and attitudes are needed for the industry to transition?*

■ **Analyzing the role of multi-stakeholder collaboration, governance structures, and participatory processes in driving the transition toward a circular carbon economy.**

*This study will examine the mechanics and motivations behind collaboration and governance, with consideration of international partnerships and import/export aspects where relevant. How can the (petro)chemical sector compete on sustainability in the global market and what kind of legislation could facilitate this? What is the contribution of the sector to the Dutch economy from both economic growth and broad welfare perspectives?*

## 3. Engineering

■ **Developing and optimizing engineering solutions for energy and feedstock flows, while considering international logistics as needed for import purposes.**

■ **Designing processes and technologies to enable circular use of carbon resources and waste valorization, focusing on efficiency, scalability, and technical feasibility. Actively explore ways to prevent fixation on existing systems to facilitate innovative solutions, including international collaborations.**

■ **Assessing the techno-economic viability and market potential of circular carbon economy projects in the (petro)chemical industry, considering infrastructure requirements, cost-effectiveness, and potential market**

**transformation, with an active consideration of international import/export dynamics.**

## 4. Design

■ **Integrating sustainable design principles into products, systems, and infrastructures for the circular carbon economy.** *Address the different dimensions of these design principles, considering international aspects and the role of imports where appropriate.*

■ **Developing effective communication and awareness campaigns using design thinking methodologies to promote circular carbon economy concepts among stakeholders.** *Consider the various facets of these campaigns, including international perspectives.*

*Assess the effect of widely applied circular design practices on de vraagmarkt for materials.*

## 5. Law

■ **Analyzing the legal and regulatory frameworks necessary for facilitating and accelerating the circular carbon economy transition, addressing international aspects and the role of imports.** *How can hard/unpopular legislation be passed to reduce production and what can be learned from similar processes?*

■ **Addressing legal challenges and barriers related to carbon capture and utilization technologies and proposing legal solutions to promote their adoption and market transformation, while considering international legal contexts and implications.**

■ **Investigating the international and regional legal frameworks supporting circular**

**carbon economy initiatives and their implications for governance and implementation.**

## 6. Economics

■ **Conducting a comprehensive economic analysis of circular carbon economy strategies (within a company or in a circular value chain of companies), assessing the cost-benefit implications, economic feasibility, and potential for market transformation.** *This research seeks to understand the economic considerations in circular carbon initiatives.*

■ **Evaluating financial mechanisms, incentives, and investment models required to attract capital and stimulate private sector engagement in circular carbon projects.** *This study will delve into the 'how' of financial engagement, considering venture building and international partnership opportunities, to ensure that the transition beyond existing models is embraced.*

■ **Analyzing the economic opportunities arising from the development of circular value chains and new business models, emphasizing market dynamics, job creation, and long-term competitiveness.** *This analysis will address how new models can prevent fixation on existing structures, while also considering the international dimensions of these opportunities.*

*More topics on the next page*

## 7. Management

■ **Identifying and addressing organizational and managerial challenges in the transition to a circular carbon economy.** *This study will actively explore strategies for effective change management, stakeholder engagement, and market transformation while considering international collaborations and import/export dynamics.*

■ **Selecting a few cases of chemical supply chains and investigate the ecosystem supporting these chains. Developing a vision for an alternative ecosystem based on circular economy principles.**

■ **Developing transition strategies to a new circular ecosystem, using the theory on ecosystem change, amongst others through developing minimal viable ecosystems.**

■ **Exploring the pivotal role of corporate sustainability strategies and circular economy principles in driving circular carbon initiatives.**

■ **Assess effective governance models and collaborative platforms that facilitate coordination and cooperation among stakeholders in circular carbon economy.**

## 8. Humanities and Philosophy

■ **Examining the ethical considerations and philosophical underpinnings of the transition to a circular carbon economy, including concepts of sustainability, responsibility, and intergenerational equity.** *This examination addresses the international implications of these ethical considerations and how they can guide innovative thinking beyond established norms.*

■ **Analyzing cultural values, narratives, and discourses that shape attitudes and behaviours towards circular carbon economy prac-**

**tices exploring ways to align these cultural values with sustainable market transformation goals.** *This analysis seeks to bridge international cultural perspectives and leverage them for more effective implementation.*

■ **Investigating the role of humanities and arts in fostering public engagement, and promoting sustainable behaviours.** *Inspire creative solutions during the circular carbon economy transition. Exploring how international artistic collaborations can encourage the emergence of fresh perspectives and innovative ideas, steering clear of fixation on existing paradigms.*

**Excited?**  
**Please contact us**  
**or register online**



