

# Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences



## Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners ([Examencommissie-BK@tudelft.nl](mailto:Examencommissie-BK@tudelft.nl)), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Maximilian Theye
Student number	6067751

Studio		
Name / Theme	Metropolitan Ecologies of Place	
Main mentor	Alexander Wandl	Environmental Technology and Design
Second mentor	Teake Bouma	Urban Design
Argumentation of choice of the studio	<p>For my graduation project, I want to explore how the industrial system of the Wadden Sea Region can transition to circularity and carbon neutrality in response to climate change. The focus lies on its cross-border, semi-peripheral geography as well as its unique landscape including the only tidal flat system of this size and diversity in the world. I use the concept of sustainable spatial circularity to address the ecological, social and political dimensions of this transition.</p> <p>The focus of the MEP studio on large-scale ecological and socio-economic transitions aligns perfectly with my research. Its methods allow me to analyse different flows and bridge scales, from systemic strategies to place-based interventions. This enables me to develop a regional vision and strategy while also refining my small-scale design skills.</p>	

Graduation project	
Title of the graduation project	Where Industry Meets the Tides: Anchoring Sustainable Spatial Circularity in the Wadden Sea Region
Goal	
Location:	Central Wadden Sea Region and hinterlands (Dutch provinces of Groningen, Drenthe; German federal states of Niedersachsen and Bremen)
The posed problem,	<p><i>0 – Defining a lens</i></p> <p>First of all, it is necessary to define a lens to analyse industrial systems comprehensively. Therefore, the industry as viewed as being interconnected with supporting infrastructures,</p>

which together results in specific environmental and societal impacts. These three elements both shape and are shaped by the surrounding landscapes in terms of morphology, functions, society and the ecosystem. This analytical lens is adaptable and can be applied to any industrial context, regardless of specific sectors or models of production. For my study, I apply it to the Wadden Sea region.

### *1 – Systemic Legacies*

The industrial system of the Wadden Sea region has long been defined by a linear production model characterised by "take-make-dispose" processes that generate significant negative externalities. Its high need for (fossil) energy sources further exacerbates ecological and social issues, contributing to pollution and greenhouse gas emissions that impact the unique regional environment. The connection to global trade and production chains positions the "semi-peripheral" region as a "Hinterland of the Capitalocene" (Brenner & Katsikis, 2020) where economic activities are dominated by external dependencies. These systemic legacies, deeply embedded in both industry and the footprint of the supporting infrastructure, result in direct negative effects on the fragile tidal flat ecosystems and landscapes, which are globally significant for their biodiversity (Lotze et al., 2005; Kabat et al., 2012).

### *2 – Current Urgencies*

The systemic vulnerabilities of the industrial system in the Wadden Sea region are heightened by pressing contemporary challenges. The IPCC's Sixth Assessment Report (2023) emphasizes that limiting global temperature rise to 1.5°C requires transformative changes in production and energy systems, particularly in regions heavily reliant on fossil fuels like the study area. Sea level rise and increasingly extreme weather patterns further threaten the sensitive balance of the tidal flats, coastal ecosystems, and protective infrastructure. The energy transition, while presenting opportunities, introduces new dependencies on renewable energy infrastructure and resource flows. Hydrogen production, for instance, is often

cited as a game changer but is still in its infancy. Potentially the region will continue to be reliant on broader European and global energy networks.

Additionally, the Wadden Sea region is caught in the broader European manufacturing crisis. Recent closure threats of major factories, coupled with findings like the Draghi Report (2024), highlight that the European Union lags behind in industrial development. Challenges include decarbonising energy systems, scaling up clean technologies and adapting to shifts in global manufacturing competitiveness. These issues are particularly acute in regions like the Wadden Sea, where economic and industrial infrastructure must adapt to maintain relevance and resilience.

### *3 – A Case for Rethinking*

The adding up of systemic legacies with current urgencies underscores the need for a critical rethinking of the systemic and spatial dynamics in the Wadden Sea region. Its industrial practices, energy dependencies, and socio-ecological impacts must be rethought through a lens that integrates strong sustainability (cf. Dietz & Neumayer, 2007) maintaining our planetary foundation and circular principles that go beyond just resource efficiency. Only by addressing these challenges can the region move toward a sustainable future that balances its industrial roles with the preservation of its unique landscape and ecosystems.

Brenner, N., & Katsikis, N. (2020). Operational Landscapes: Hinterlands of the Capitalocene. *Architectural Design*, 90(1), 22–31.

Dietz, S., & Neumayer, E. (2007). Weak and strong sustainability in the SEEA: Concepts and measurement. *Ecological Economics*, 61(4), 617–626.

Draghi, M. (2024). *The Future of European Competitiveness. Part A: Competitiveness Strategy for Europe*. [https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961\\_en](https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en)

Grasland, C., & van Hamme, G. (2010). La relocalisation des activités industrielles: Une approche centre-périphérie des dynamiques mondiale et européenne. *L'Espace géographique*, 39(1), 1–19.

IPCC (2023): *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland.

	<p>Kabat, P., Bazelmans, J., Van Dijk, J., Herman, P. M., Van Oijen, T., Pejrup, M., Reise, K., Speelman, H., &amp; Wolff, W. J. (2012). The Wadden Sea Region: Towards a science for sustainable development. <i>Ocean &amp; Coastal Management</i>, 68, 4–17.</p> <p>Lotze, H. K., Reise, K., Worm, B., Van Beusekom, J., Busch, M., Ehlers, A., Heinrich, D., Hoffmann, R. C., Holm, P., Jensen, C., Knottnerus, O. S., Langhanki, N., Prummel, W., Vollmer, M., &amp; Wolff, W. J. (2005). Human transformations of the Wadden Sea ecosystem through time: a synthesis. <i>Helgoland Marine Research</i>, 59 (1), 84–95.</p>
research questions and	<p>The research questions address the core issue of transforming the linear and unsustainable industrial system of the Wadden Sea region into a circular and sustainable model. By exploring the historical development of industries and their spatial patterns, the study establishes a foundation for understanding current dynamics. This contextual knowledge, combined with cross-scale analysis examining territory and flows, provides a comprehensive framework for proposing pathways toward the overall aim:</p> <p>Main research question: [RQ] How can the industrial production system in the Wadden Sea region be transformed into a circular and sustainable model, considering functions, morphology, society and ecosystems?</p> <p>Sub-Questions:</p> <p>[SQ1] What spatial patterns and historical developments have defined the evolution of human settlements and industries in the Wadden Sea region, and which factors influenced the localisation of specific industrial activities?</p> <p>[SQ2] How do the territorial and metabolic dynamics of industrial production and supporting infrastructure in the Wadden Sea region have an influence on and integrate with the regional socio-ecological and spatial systems?</p> <p>[SQ3] What pathways can guide the transformation of the industrial system in the Wadden Sea region towards circularity and sustainability, while considering different priorities?</p>

	<p>[SQ4] How can the approaches for a circular and sustainable industrial system in the Wadden Sea region be translated into detailed designs at the local scale and what measures ensure actionable and beneficial outcomes for functions, morphology, society and ecosystems?</p>
<p>design assignment in which these result.</p>	<p>Throughout my research and design process, I aim to develop a variety of outcomes that correspond to distinct stages of my trajectory. These outcomes not only address different facets of the Wadden Sea region's industrial system but also collectively contribute to the overarching aim of achieving a circular and sustainable industrial system in the Wadden Sea region. Below, I outline the key design outcomes in detail:</p> <p>1. Analytical Maps and Graphics A first set of analytical maps and graphics provides an understanding of how human settlements, industrial activities and spatial patterns in the Wadden Sea region have evolved over time. They chronologically illustrate the development of key industries, infrastructure networks, and their interplay with natural and societal systems to establish a foundational narrative by revealing spatial patterns and systemic legacies, which are critical to framing the subsequent stages of analysis and design. A second set of maps and graphics investigates the present-day territorial capital and industrial metabolism of the region to establish a baseline understanding. They illustrate assets such as infrastructure, resource availability, and socio-economic networks. Additionally, they represent industrial flows, such as energy, materials and waste. Systemic Sections showcase flows and interactions between systems. Different scales are used, as I refine my findings in Zoom-Ins, where bird's-eye illustrations merge territorial and flow perspectives. These locations will serve as testbeds for refining designs.</p> <p>2. Vision Graphic A Vision Graphic will provide a conceptual and visual representation of a circular and sustainable industrial system for the Wadden Sea region as the overall aim. I will employ a Collage Illustration</p>

that uses evocative imagery to synthesise and communicate the core principles and aspirations of this overarching vision, because it serves as a guiding framework that anchors the development of scenarios and helps communicate the broader goal.

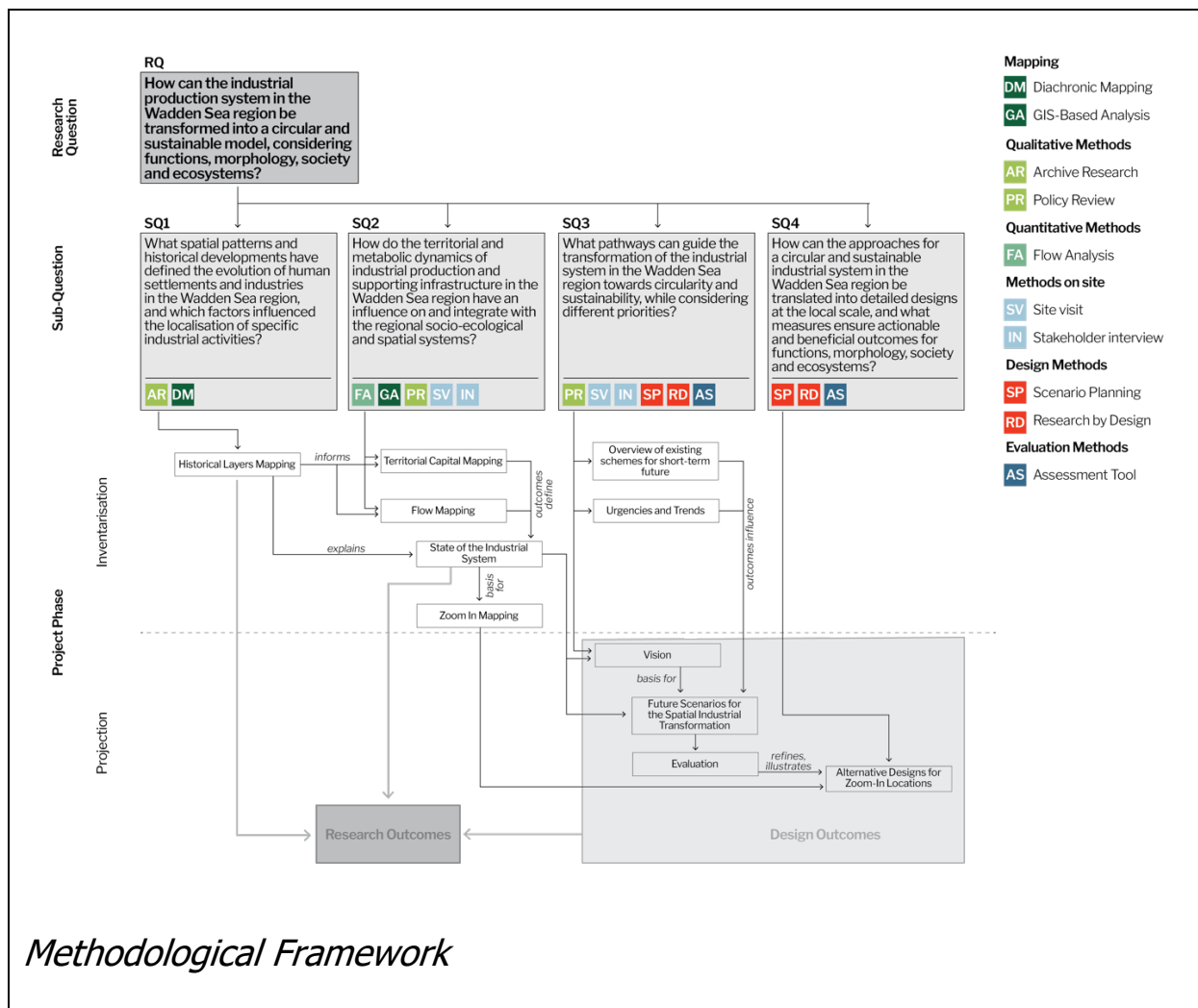
### 3. Scenario Graphics and Maps

Here, I plan to develop and evaluate diverse pathways to achieve a circular and sustainable industrial system using different priorities, emphasising spatial and systemic implications. Multiple design outcomes will be created for each Scenario:

- Illustration of Key Ideas: Each scenario will begin with an evocative visual encapsulating its core principles and priorities.
- Evaluation Framework: The scenarios will be assessed based on their alignment with principles of strong sustainability and the seven circles of circularity.
- Strategic Regional Maps: Maps will illustrate how each scenario might be rolled out spatially across the Wadden Sea region. These maps will highlight changes in infrastructure, resource flows and socio-ecological systems.

### 4. Zoom-In Designs

Zoom-In Designs for Locations deemed interesting / crucial according to the analysis and scenario building phases will be created to explore and illustrate how the scenarios would manifest at the local scale. This can provide detailed insights into spatial and systemic impacts. For these selected zoom-ins, I want to test and refine at least two scenarios per location to compare their implications. The aim is to develop localised designs using site plans, axonometric diagrams, sections and potentially eye-level drawings that highlight key interventions, spatial transformations and main interactions between systems. By testing multiple scenarios at the same location, this phase highlights the tangible impacts of different pathways.



## Methodological Framework

## Process

### Method description

To address the research questions across both my Inventarisation Phase (RQ1 and RQ2) and Projection Phase (RQ3 and RQ4), I apply a combination of methods tailored to achieve the envisioned outcomes. The methods are described below:

#### 1. Mapping (for RQ1, RQ2)

- **Diachronic Mapping (DM):** This method involves comparing developmental stages over time to uncover spatial patterns of industrial/infrastructural evolution and the impact on the Wadden Sea region. It helps frame historical trajectories and contextualise current conditions.
- **GIS-Based Analysis (GA):** Through the use of geographic information systems, I combine, process, interpret, and synthesize data layers, such as those of territorial capital. This approach is the basis for the integration of diverse datasets into cohesive visualisations and analytical outcomes.

#### 2. Qualitative Research (for RQ1, RQ2, RQ3)

- **Archive Research (AR):** Historical processes of development are investigated through archival sources, whereby I will be focusing primarily on historical maps to complement the diachronic mapping. Data availability and relevance will influence the extent of this method.



- Policy Review (PR): Current policies, plans, and strategies from different levels of government (EU, NL, DE and below) are reviewed to identify factors influencing territorial capital and flows as well as their ambitions to create future transformations in the region.

### 3. Quantitative Methods (for RQ2)

- Flow Analysis (FA): While I anticipate highly limited regional data on material flows, I will focus on existing infrastructure and estimate volumes where feasible. For energy flows, slightly better data availability is expected. The emphasis is therefore on applying flow-based thinking to analyse systemic interdependencies.

### 4. Methods on Site (for RQ1, RQ2, RQ3, RQ4)

- Site Visit (SV): Visits to key locations in the Wadden Sea region allow for ground-truthing of data, understanding the context and capturing site-specific dynamics in a multi-sensory manner.
- Stakeholder Interviews (IN): Interviews with relevant stakeholders provide insights into the regional context and inform the feasibility and realism of future pathways. This method bridges the analytical and design phases by incorporating local knowledge and expertise.

### 5. Design Methods (for RQ3, RQ4)

- Scenario Building (SP): Scenarios are developed to test and illustrate different pathways for achieving a circular and sustainable industrial system. These scenarios highlight spatial and systemic implications.
- Research by Design (RD): This iterative and multi-scalar approach explores and refines potential solutions in the Projection phase by combining analytical insights with design thinking, using different ways of representation across scales.

### 6. Evaluation Methods (for RQ3, RQ4)

- Assessment Tool (AS): This tool supports prioritisation and decision-making by evaluating the scenarios (from SP) against criteria derived from strong sustainability principles and the seven circles of circularity. It ensures that proposed solutions align with the overarching aim of a circular and sustainable industrial system.

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## Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

As stated above, I want to explore how the industrial system of the Wadden Sea Region can transition to circularity and carbon neutrality in response to climate change. The emphasis of the MEP studio on large-scale ecological and socio-economic transitions aligns very well with this research topic. Its methods enable the analysis of different flows and bridge scales, moving from systemic strategies to place-based interventions. This provides the tools to create a regional vision and strategy while simultaneously refining my small-scale design skills.

This studio focus falls within the Urbanism master track, which integrates urban design, landscape architecture, spatial planning and engineering. Here, the connection of social, cultural, economic and political perspectives with the natural and man-made conditions of a site play a key role. My graduation project fits within this overall approach of the track because I am looking at my research field through a multidisciplinary lens and I am addressing sustainability through a multiscale approach, from regional systems to localised interventions. Likewise, Design is of fundamental importance in my project, as I analyse the spatial impacts of the production system on the landscape, study industry clusters morphologically, and propose designs for their transformation.

The MSc AUBS programme stands out for its interdisciplinary approach, blending design practices with insights from the physical and social sciences, as well as technology and engineering. My project embodies this integration by combining systemic analysis, design innovation and sustainability-driven strategies. The programme brings together local examples and a global perspective, why a focus on the Wadden Sea Region also fits geographically.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

Societally, this project addresses the profound socio-economic changes needed in the Wadden Sea Region. Here, raising awareness and creating positive visions for sustainable development are crucial. Transformative proposals often face political resistance, a challenge this project seeks to overcome by providing and illustrating optimistic, but also actionable pathways for change. It also responds to broader European industrial challenges that have social implications, as highlighted in the Draghi report and addresses the disparities faced by a semi-peripheral area, which is exemplified by Groningen's struggles with the aftermath of gas extraction. By naming these pressing issues and proposing integrated spatial solutions, the project promotes equitable societal development that can gain public and political support.

From a professional perspective, this work contributes to the field of urbanism by combining systemic industrial/infrastructural strategies with spatial design for sustainable transitions. It applies methodologies for addressing cross-border, large-scale challenges and links them to place-based interventions. The integration of historical and future-oriented components is particularly valuable for professionals working on regional development, governance and infrastructure. By proposing pathways that are both actionable and rooted in local conditions, the project aligns with contemporary professional demands for innovative and context-sensitive approaches to sustainable development, especially because in a region outside of the largest Western European metropolitan regions.

The scientific relevance of this project lies in its application of the concepts of circularity and territorial metabolism to the Wadden Sea Region, which bridges the gap between theoretical concepts and practical implementation, especially concerning the spatialisation. By addressing this semi-peripheral geography, the project tackles a notable research gap, as these principles remain relatively underexplored in such a context. The cross-border focus enhances the significance because they enable comparative analyses of regional dynamics and interdependencies between Germany and the Netherlands. Furthermore, linking historical development patterns with future scenarios offers valuable insights for both policymakers and academics.