CONCLUSIONS

How is the apparatus of energy infrastructure in the North Sea territory changing towards a prosperous low-carbon future?

'The North Sea made us who we are, so she will determine where we go'
Pye, The Edge of the World

The North Sea played an important role for the development of culture and society, starting with the Romans and lasting until today. The sea turned from a crossroad, into a space of extraction and will eventually transform into a space of collaboration. With these conclusions, I want to highlight certain aspects of my thesis: the urgency of the topic, the necessity to tackle the energy transition on the big scale and the idea of a multifunctional energy system that relies on the legacy of the oil- and gas industry and aims to lower the carbon footprint.

The urgency of the topic

The climate change is the most obvious reason to deal with the energy transition in the North Sea territory. While the hazards and consequences of this topic are broadly researched and part of the public awareness, little research is done so far on the question how these transformative processes through the scales will take place.

I am stating that the key parameters to deal with the transformative processes of the energy transition in the North Sea territory are 'population growth' and 'resource management.'
The urgency of the topic is highlighted by the fact, that the territory is facing rapid population growth until 2080. These predications are very problematic, because a growing population demands an increasing amount of resources with the equal footprint. Resources in the North Sea territory are limited, because the energy system is still heavily relying on fossil resources, especially on crude oil and gas.
This leaves the urgent question on how to accomodate the growth in terms of energy and resources in a sustainable way and how to how to ensure the territorial energy supply, social wealth and economic prosperity towards a low-carbon future.

Tackling the energy transition on the big scale

My master thesis is stating that it is necessary to deal with the energy transition on the big scale. According to the reference example of 'An Energetic Odyssey', this topic can just be solved with drastic changes in a whole system (IABR 2016). Small-scale projects, like the intention to make the Dutch island Texel CO2 neutral, will not contribute to the overall European goals in 2020, 2030 and 2050 to reduce carbon significantly and to ensure a high share of renewable resources.

With my thesis I furthermore want to add to the ongoing discussion on how to integrate soft-planning approaches into existing hard-planning structures. There are already existing examples and planning instruments to deal with systems on the big scale. Macro-regional strategies, a planning instrument of the European Union, is a soft-planning approach that is aiming to add on to existing hard-planning institutions.
Soft-planning and hard-planning approaches show apparently big potential to work jointly towards common challenges, since soft planning is building the framework to deal with hazards more flexible while hard planning institutions and stakeholders are needed to legalize the process. The idea of soft-planning is to build a structural vision and to create principles and guidelines through the involvement of private and public stakeholders and research institutions on the big scale. This overall framework is on the hand coordinating interventions on the small scale to work jointly towards one common goals but leaves on the other hand planning freedom to adapt to regional hazards and specific challenges.

The idea of multifunctional energy infrastructure

'Everything Remains Transformed' - I am introducing an approach, which is proposing to transform the current energy system of resource extraction into a space of collaboration among all actors of the North Sea territory. Through collaboration, big parts of the current energetic system can be reused to produce electricity and fuel and to secure the territorial energy supply for all actors in the adjacent countries of the North Sea. The project is introducing a system which is generating social wealth and prosperity through the generation of new jobs and emerging alternative industrial fields that are not relying on fossil resources.
An important point is the focus on R&D intense sectors since knowledge-based economies create furthermore innovation. Innovation is one of the most crucial features of the new energy system, because it is increasing the efficiency of existing technologies, but it also might result into the invention of new technologies. Knowledge can become an important element of trade next to carbon-based products and manufactured renewable technologies. Nevertheless, some of the technologies that are introduced in this thesis are still in the development or test phase. They can be used for speculations and scenarios of application but the evaluation leaves questions of uncertainty and doubt when these technologies can be commonly introduced.

The overall aim of the project is to reduce the carbon footprint in the territory to facilitate the estimated territrial population growth.
Renewable energy is one of the key elements for the development towards a low carbon economy. The second point of equal importance is, how to deal with the carbon emissions. This thesis is stating that the former waste of urban areas, carbon dioxide, is becoming a resource to ensure the territorial energy supply, as well as the economic prosperity and social wealth.
I made first predictions, that carbon could eventually produce enough energy to cover the energy demand of the entire territory. With this fact, I am not aiming to provide a concrete number since I know that I can hardly make accurate predictions due to the complexity and the amount of parameters. I rather want to highlight, that carbon can become one of the biggest potential in the energy transition as soon as it is embedded in circular processes.

REFLECTION

The Ecological Footprint

I want to use the last chapter of my master thesis as a moment, to reflect on the concept of the ecological footprint. This concept is basically giving information about how much capacity a given area has to accomodate growth in a sustainable way.

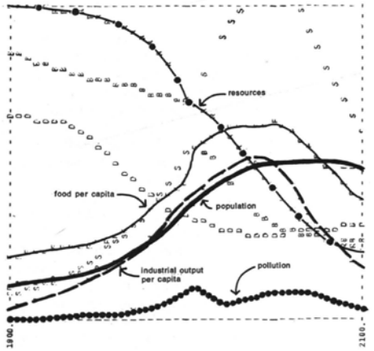
The topic of growth and the limitations of growth were first discussed in *The limitis to growth* by The Club of Rome. In their work, they simulated an extreme economic and population growth with an finite amount of resources. The goal was to get insights into the limits of our world society and to shed some light on the main parameters that influence the long-term behaviour of this society.Two of these elements are population and the consumption of non-renewable resources. This report was furthermore stating, that without changing our behaviour in resource management we would reach the limits of growth in the year 2072.

The ecological footprint is as well taking certain parameters into account to define two key aspects: How fast we consume resources and generate waste and how nature can absorb our waste and generate new resources. As a result, two numbers are directly compared to give insights on the question if one society consumes resources in a sustianable way.
This model is at the same quiet strong as it is very weak. On the positive side, the visualisation and the lvel of reduction makes it very easy to communicate this complex context. Furthermore, you gain insights about the status quo, neither new technologies nor more sustainable ways of consuming resources are consideres.
On the other hand, these strenghts are the same time the weakness of the concept. The level of reduction seems to lead to an incompletness since certain factors and aspects of sustainability are not considered. For example, the global hectar, the unit that measures the ecological footprint, does not take parameters like toxic or non-biologocal waste into account.

Also, not all kind of emissions seems to be consideres in the calculations. The reduction of carbon dioxide played a major role in my thesis in order to lower footprint. But this maked it very hard to compare it to any other project related to the concept of the ecological footprint. While my project lowered the footprint by reducing carbon emissions, projects in other parts of the world migh rather focus on a change in landuse since carbon emissions is in other locations might be of less importance. Comparing these parameters from a methodological point of view is problematic, because carbon emissions as a dominant factor of a calculation can hardly be compared to a project that is based on the transformation of the productivity of a given area. Anyway, comparing the productivity is very difficult because monocultural and intense types of agriculture are more productive by nature than biological types. Therfore, monocultures might score a better result in the calculation even if nobody would consider them more sustainable than biological types of agriculture.

As a summary, I consider the ecological footprint as a way to get an overview on the situation of any region regarding resource exploitation and the capacity for growth. This concept is not made for a detailed evaluation of the status quo of any region.

5 parameters to determine the limits to growth



The limits to growth, Club of Rome, 1972, p. 169

Balancing the natural and the human system

The overall theme of this year's graduation studio Delta Interventions was 'The North Sea - territory as a project', where the students were allowed to choose any architectural or urban project on any scale, I chose to start with the North Sea as a point of departure and to investigate what the role of the marine area is in relation to the terrestrial zone. My P1 group discovered, that two systems exist in the North Sea territory, the human and the natural system. The relation of both machineries changed over time, from an age where both system coexisted in balance to an epoch where humankind manipulated and engineered nature regardless of the outcome. In the light of my project, humans extracted crude oil and gas resources from the basin of the sea accepting the fact, that this system of resource extraction is threatening the marine environment directly as it contributes to climate change.

The group conclusion of P1 questioned the current balance between the human and the marine system and asked for interventions or strategies to rebalance this relation for mutual benefits. I developed my project along the specific studio theme 'Ecologies of power', coordinated by Dr. Hamed Khosravi, focussing on the energy transition at the sea. I propose a multifunctional energy system, which is producing advantages for both the natural and human system through collaboration.
The human system is benefiting from the new energetic system by securing the territorial electricity and fuel demand through the use of renewable energies and carbon dioxide. This system creates furthermore economic prosperity through alternative R&D clusters which are based on renewable technologies or the utilization of carbon. New markets are generated for carbon-based products, manufacturing, and knowledge that ensure social wealth and new jobs.

The natural system is benefiting from the new energety systems, since the future infrastructural machinery will purify sea water and improve the marine biodiversity. First, the engineered marine artefacts form ecological corridors that connected fragmented protected zones through the establishment of artificial reefs and algae production. Second, these objects extract toxic substances from the water by processing sea water into hydrogen and oxygen. If hydrogen is burned at a later stage it releases clean water.

My project is aiming to rebalance the relationship between the human system and marine system by using synergies: energy production through natural forces and enhancing the marine biodiversity through engineered objects. Nevertheless, the technical side of the project is difficult to evaluate out of several reason: Due to the complexity of the project through scales, I focussed on the conceptual and spatial parts of the approach. My methods up to this point were mostly aiming to develop an approach for the macro scale through visioning and scenario-making and literature was used to understand the components and relations between certain technological parts of the project. Data analysis might be a further method to proceed and to evaluate my principles and spatial guidelines referring to the problem statement Resource Management Vs. Growth. The ecological footprint can act as framework for calculations since the numbers of the concept are based on the human footprint and the biodiversity (Global Footprint Network 2018). Nevertheless, data collection will be the most critical part of this calculations because there is no collection of detailed carbon emissions available.

Nevertheless, I intend with this thesis to highlight the following points: (1) Transformative processes regarding the energy transition and the relation between resource management and population growth are an urgent topic and should be part of the European Agenda (2) The energy transition needs to be tackled first on the big scale in order to bring drastic changes to the whole energetic system (3) Beyond the sake of energy production, an energetic system has to bring benefits for the three dimensions: People, Planet, Prosperity.

Group conclusions in P1: The Netherlands and Germany,
in cooperation with Julia Holtland and Deniz Üstem