Re-thinking the Power of Water

integrating sustainable water management and renewable energy systems in a surface water oriented strategy to design future living quality in the Rhine-Meuse delta

graduation plan

Graduation project Delta Interventions

Caspar Lysen

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GRADUATION PLAN

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Graduation Studio
Delta Interventions [DI5]
studio leaders:
Ir. A.L. Nillesen & Dr. F.L. Hooimeijer

First mentor: Dr. F.L. Hooimeijer
Environmental technology & Design

Second mentor: Ir. E. Brandes
Urban Design, Theory and Methods

Committee member: Ir. F.W.A. Koopman

Department of Urbanism
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PERSONAL INFORMATION

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STUDIO

theme: Delta Interventions [DI 5]
teachers: Ir. A.L. Nillesen & dr. F.L. Hooimeijer

argumentation of choice of the studio

In the coming century climate change will cause a threat to most of the urban areas in the world. Since they are mostly situated near a waterfront, these areas will be subject to changing water levels and extreme drought or precipitation. Awareness should be raised and at the same time solutions should be created.
We can no longer fight the water, we need to find a way to live with it and benefiting from its qualities it brings to the living environment (almost everybody enjoys being near water). Here still lies a lot of work; projects scattered all over the world. I would like to study on this topic for a year, so I will have the necessary extra knowledge to be able to work in this field.
My interest goes out to a project on the larger scale in a large city or metropolis. These areas are often situated in delta areas. There are still uncertainties on where to work after my graduation, but working with these regions have my preference. It seems essential to me to have more knowledge on delta interventions. This graduation course will touch the subjects and knowledge needed to be more prepared for any job in urbanism in the twenty-first century.

theme: Climate adaptation, integrating water- and energy management with urban planning and design to face future threats in the Rhine-Meuse delta
first mentor: dr. F.L. Hooimeijer
second mentor: Ir. E. Brandes
committee member: Ir. F.W.A. Koopman

TITLE

Re-thinking the Power of Water
integrating sustainable water management and renewable energy systems in a surface water oriented strategy to design future living quality in the Rhine-Meuse delta

PRODUCT

Problem statement

People have settled themselves in complex areas, namely deltas. These areas are favourable for trade and agriculture, but hostile in water conditions. Urbanized deltas will continue to grow in the coming century. Threats from climate change and energy resource depletion will affect this growth, or even existence in these regions. Adaptation is therefore needed. By adapting the water systems it is possible to store more rainwater and withstand stronger storm surges and rising sea levels. This is what is being done in The Netherlands at the moment with the Deltaplan. To power urban deltas in future, the transition from fossil fuels to renewable sources needs to be made. This is a slow process that gradually starts to take form. By transitioning to renewable energy, CO2-emissions are reduced. This contributes to the reduction of climate change through mitigation.
Although both disciplines are adapting, they are doing this mostly in their own domain. But especially in deltas there are many opportunities to benefit from each other. Water is useful to generate energy, such as waterwheels or (more current) tidal energy plants. The other way round, energy is needed to manage the water on land in deltas. Especially in The Netherlands energy is needed to keep pumps running all day long to prevent the land from flooding. This graduation project will explore the combined possibilities from each discipline and will implement this into the Rhine-Meuse urban delta. An integrated approach of both water management and energy management should lead to a more resilient region.

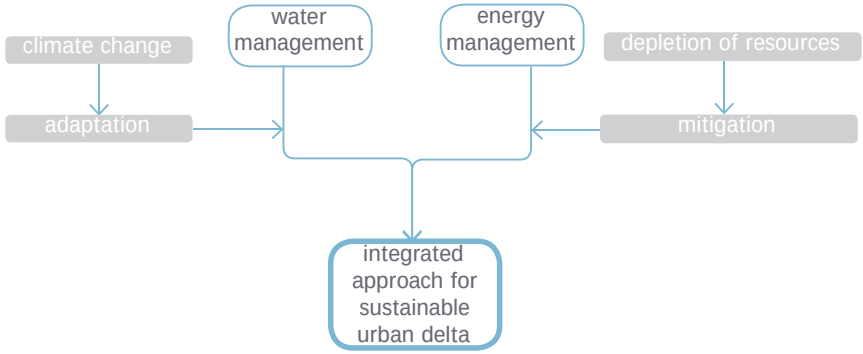
For this graduation project the main research question is therefore as follows:

How to spatially integrate flood resilient urban water management and renewable energy systems in a regional surface water oriented strategy to design a sustainable Rhine-Meuse delta towards the year 2100?

From this main research questions the following sub-research questions are derived to give more detail to the research at hand:

- What threats are facing the Rhine-Meuse delta towards the year 2100?
  What scenario for climate change will occur and with what quantities?
  What will be the energy demand and what will be the availabi lity?
- What historical events, concerning water- and energy management have led to the current situation of the Rhine-Meuse delta?
  How did water management evolve over time until today and how did it affect urban development?
  How did energy management evolve over time until today and how did it affect urban development?
- Where lie the possibilities for creating extra buffer capacity for extre me water levels in the Rhine-Meuse delta?
- Which renewable energy systems related to surface water can be implemented into the Rhine-Meuse delta?
  Which renewable energy systems are most suitable for the region?
  What type of landscape is suitable for what type of energy system?
  Which systems suit a decentralized approach, which favour a centrali zed approach?
- Where can we find strategies, methods and approaches concerning energy cycles that are applicable to the region?
- How do all the suitable elements form an integrated regional strategy?
  How does the strategy match with visions from governmental parties involved in the region?
  How is the strategy translating the theoretical framework on water- and energy management?
  What key intervention areas in this strategy can be distinguished?
- How can the intervention areas be spatially integrated on a local scale?
  What are the issues that need to be analysed in the local area?
- What are the effects of the local intervention on the regional scale?
  What socio-spatial effects could derive from this intervention?
  What socio-economical effects could derive from this intervention?
  What are the environmental impacts of the intervention?
  What changes need to be made to the regional strategy, knowing the effects on a local scale?
- What are the generic qualities of the regional strategy and the local interventions?

Design assignment

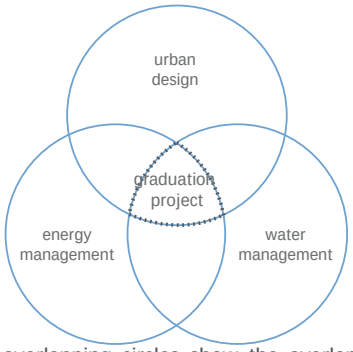


Goal of the graduation project

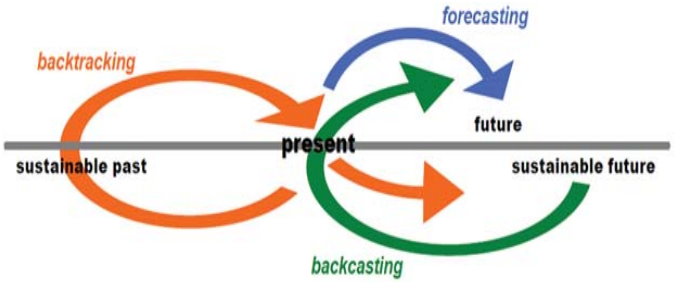
The intention of this graduation project is to develop an integrated approach between water- and energy management that results in a strategy of soluti-ons for a sustainable Rhine-Meuse delta. This strategy should offer solutions for the effects of climate change and the energy transition that threaten the urban delta in the twenty-first century.
A spatial design of a key intervention in the strategy should give a an example of what the changes will look like. It should offer a view on what cities could look like at the end of the twenty first century and through what phases this process will be taken.

PROCESS

method description
The main methodology structure of this project is planned as follows:
I – Theoretical framework
II – Analysis of region and possible implementations
making spatial analyses, scenario assessment, reports, interviews (energy specialists, energy landscape architect, precedents
III – Regional vision and strategy
Design by research, using literature, calculations of demands and yields,
IV – Local spatial design of one key area in regional vision
Research by design, drawing, site visits, interviews (designers/municipality/ water transport companies), precedents, calculations of demands and yields
V – Evaluation
Comparing scales, testing generic quality (implementing solutions in other deltas; only when there is enough time)



overlapping circles show the overlap in disciplines for this graduation project (own work)



A graphic representation to clarify the principles of forecasting, backtracking and backcasting.
Source: Van den Dobbelsteen et al., 2006, p.3

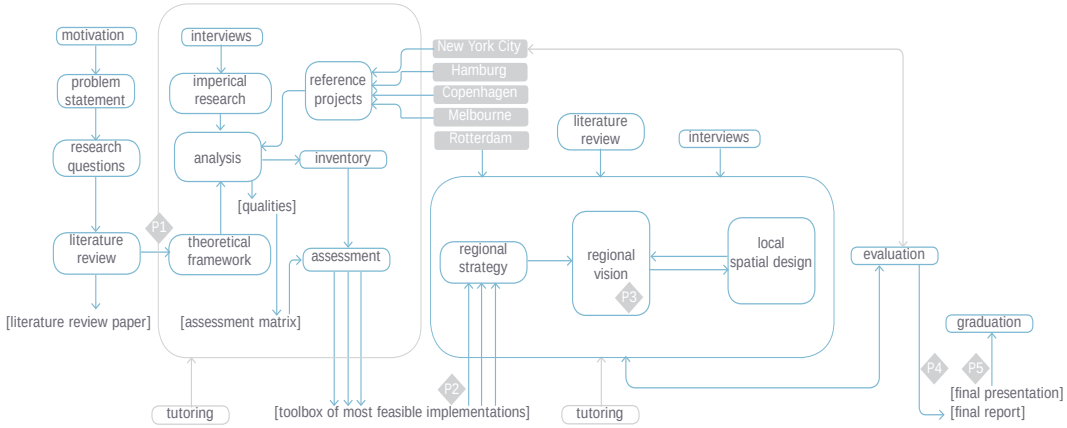
literature and general practical preference

Valuable resources for this project are:

Historical analysis of water management (Hooimeijer, 2011) and energy use (Pasqualetti, 2012) combined with the historical development of Rotterdam (Meyer, 1996)

Theories and new approaches on sustainable energy use presented in various documents by Van den Dobbelsteen, Tillie, Roggema and Stremke. The most important ones that should be mentioned: Energy Potential Mapping (EPM), Rotterdam Energy Approach & Planning (REAP).

New sustainable approaches to water management by Brown and Wong (2008), the concept of water sensitive urban design (WSUD; put in practice



in Melbourne, Australia) and water sensitive cities, but also important information can be extracted from the Water Atlas (2011) and plans and visions made for the region, such as the Waterplan 2, Waterstad 2035, the Delta Programme.

Documents with visions on the regional and the city of Rotterdam, such as Zuidvleugelvisie, Ruimtelijk regioplan Rotterdam 2020, Stadsvisie Rotterdam 2030, visions on the future of the port of Rotterdam.

Precedents in urban design or landscape design dealing with water management and energy management

REFLECTION

Societal relevance

The water management parties are now predominantly focused on water issues that address the climate change (adaptation). The same can be seen with the actors of energy management. These are concerned with the availability of resources and the preconditions to make an energy transition possible (mitigation). These are obviously necessary tasks for these actors, but there is still so much issues to address within their own field, that there is too little scoped on other disciplines, for instance each other.

Scientific relevance

The scientific relevance of this project lies in the new integrated approach for the urban delta between water management and energy management. The project should produce a strategy in which both mitigation and adaptation takes place in the Rotterdam region and addresses them in one spatial interventions. This should be a demonstration of the possibilities in the combined field of both disciplines.

Time planning

The time planning for this graduation project is visualized in the scheme below.

It shows the possibility of an internship at PBL. This is not arranged yet, but there is a change this will work out. It is not essential for the project, but it is a pleasant addition to it. After the P2 further analysis will be shortly followed by an energy potential map. Before P3 the regional strategy will be finished and the local spatial design in the Waalhaven has been started. Since the method of research by design is used, the design process will raise questions that require new analysis.
Due to experiencing too little structure in the first semester of the graduation a periodical personal evaluation of the progress is held. This requires setting more short term goals and therefore more control on the progress.