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), 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:

<table>
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<tr>
<th>Personal information</th>
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<tr>
<td>Name</td>
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<td>Student number</td>
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<td>Telephone number</td>
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<td>Private e-mail address</td>
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<th>Studio</th>
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<td>Name / Theme</td>
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<td>Teachers / tutors</td>
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<td>Argumentation of choice of the studio</td>
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<th>Graduation project</th>
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<th>Goal</th>
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<tr>
<td>Location:</td>
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<td>The posed problem,</td>
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<td>research questions and</td>
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| Design assignment in which these result. | The main objective of this research is to develop a roadmap for the energy transition towards energy neutrality of the built environment for the city Delft, with technical interventions based on the local sustainable energy potentials integrated at all scales and of which the general approach can be applied to other Dutch municipalities. This research objective will lead to the following final product: a roadmap for the city Delft towards a sustainable energy system that optimally uses the local sustainable energy potentials. The roadmap will show the required
Interventions at different scales from now till the energy neutrality in the built environment is reached in 2050. Thereby not only a strategy for the energy transition of the city as a whole is proposed, but a strategy for all scales including the districts, neighbourhoods and buildings. Beside the scale of the interventions the roadmap will also show their implementation moment and location. Finally a general approach for the built environment of the Dutch municipalities is derived from this roadmap that will decrease the complexity of their energy transition.

**Process**

**Method description**

The research objective is to create a roadmap for the energy transition of the city Delft and to define a general approach for the energy transition of Dutch municipalities.

In order to design this roadmap first a literature study is preceded. This literature review gives insight in the basic principles of the energy transition. And includes subjects like the current energetic situation of the Netherlands, sustainable energy sources and technologies and case studies. This knowledge is required to be able to design the roadmap and to define the approach. The applied research method is a combination of design by research and research by design. While the roadmap will largely be based on the literature study and the context analysis including demands, current system, potentials, etc. The approach is based on both the findings of the design process of the roadmap and the analysis of existing energy transition methodologies. Both design processes will be performed simultaneously and thereby findings in both designs will influence each other’s final outcomes. This is visible in the approach scheme below. Finally in the last phase there will be zoomed into two neighbourhoods to define the interventions at this scale.
The report research has a clear division between three substantial parts; the first part consists of the required basic knowledge to be able to create the approach and understand the principles of the energy transition. The second part is the approach for the energy transition of Dutch cities. The last part will be the roadmap for the energy transition of Delft. In the following overview, the most important literature per part is summed. For each source, a very short description is given:

**Part I: The Basics of the energy transition**


This report gives insight into the basics of the energy transition and methodologies.


Literature concerning the energy transition and technologies.


A (more technical) Explanation of energy transition applied to England. Concerning demands, potentials and technologies towards a fully renewable energy system.


Focussing on energy transition of thermal energy: creating of thermal energy networks in the Netherlands.
Different possibilities and applications of sustainable thermal energy.


Case study with various scenarios and possibilities for a sustainable energy system for Duindorp.


Case study for energy transition of Buiksloterham area.

Part II: A methodology for the energy transition of Dutch cities


Describes a methodology for the energy transition

Other methodologies that will be studied are the City-Zen approach for Urban energy master plans, REAP and 7 steps Urban Transform (EU).

Part III: The energy transition of Delft

Centraal Bureau voor de Statistiek, Statline. [Data files] www.statline.cbs.nl

Data files consisting different energy statistics of the Netherlands.


Report consisting information about the energy demands and supplies (system) in the Netherlands.


The energy Agenda of the Dutch government.


Data files/program consisting the energy demands of Delft per neighbourhood and district. Divided in total, business sector and private sector. In total and per real estate asset.


Report with different strategies towards energy neutral Delft.


A report consisting integrated solutions for making the city future ready on different sustainable topics like energy.

> Initiatives and goals by the municipality of Delft towards energy neutrality in 2050.


> Data about the potential for thermal energy storage in the Netherlands/Delft.


> Data about the potential for Geothermal energy in the Netherlands/Delft.

**Reflection**

**Relevance**

With the energy transition to a sustainable energy system the energy goals of the Paris Climate agreements of 2015 can be achieved, this will limit the global warming to 2 degrees Celsius and will make sure the that energy can still be provided to our future generations as well as a healthy environment. Thereby the transition will also lead to a self-sustaining energy system for the Netherlands, which means independency from the (fossil) energy supplies of other countries. This will make sure that conflicts with, between or inside these countries won’t lead to an energy shortage or high energy prices. This thesis will result in a roadmap for the energy transition of the city Delft and an approach for the energy transition of Dutch municipalities. The energy transition to an energy neutral municipality can stimulate the transitions of other cities, transition related policies by the national government and above that it can increase the awareness of the urgency of the energy transition by citizens, companies and institutions. And will thereby become a bottom-up movement in the energy transition of the Netherlands.

For Delft specific the energy transition will lead result in an energy system based on renewables. This will increase that status of Delfts as well-known innovative city even more. By positive publicity about the city and the knowledge institutes in the city, like the TU Delft.

**Time planning**

The graduation period is divided into 5 reflection points: the P1-5 presentations. In the period until P2 the literature study was done (part I of the thesis). After the P2 the literature study results were implemented into the roadmap and approach design. At the same time the analysis of the context/starting point for the roadmap for Delft was performed. After the P3 the design of the roadmap resulted in resulted into a first version of the approach. Both roadmap and approach where optimized until the P4 presentation. Finally the complete thesis (including the literature study, approach and roadmap) was improved to the final version that is presented during the P5 presentation. See planning on the next page.
| Week | 15| 16| 17| 18| 19| 20| 21| 22| 23| 24| 25| 26-35| 36| 37| 38| 39| 40| 41| 42| 43| 44| 45| 46| 47| 48| 49| 50| 51| 52| 1| 2| 3| 4 |
| Event | P1| P2| Summer holiday | P3| P3| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Research Framework**
- **PART I Literature study**
  - Background
  - Basics energy transition
  - Renewable energy
  - Energy system Netherlands
  - Dutch energy System
  - Demands and supplies
  - Role municipality
- Technologies matching
  - Energy savings
  - Conversion
  - Storage
  - Transportation
- Case Studies
  - Technology combinations
  - Energy systems / situation

**Stakeholders & problems**
- Stakeholder analysis
- Problems during transition

**Literature -> Methodology**
- Technology combinations
- Energy systems / situation
- Guidelines general

**PART II Methodology**
- Analysis existing methodologies
- Demands
- Potential mapping
- Problems and stakeholders
- KPI's
- Define methodology

**PART III Roadmap**
- Context/starting point
  - Characteristics
  - Energy goals and status
  - Current energy system
  - Current Demands
  - Stakeholder analysis
- Define KPI's
- Energy potential mapping
- Create roadmap
- Technical measures 2-4 districts
  - Districts
  - Building blocks
- Report finalisation (check/layout)
- Prepare presentation

**Holiday**