DELFT IN TRANSITION
Towards a Sustainable Energy System for Dutch Municipalities

P5 Presentation
Tess Blom
25.01.2018
It’s time to make the transition to a more sustainable world
It’s time to make the transition to a more sustainable world
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Paris Climate Agreements 2015
Limit the global warming with 2ºC
2050
\( \text{CO}_2 \)-emissions: -80/95%
100% renewables
The Netherlands is still far from reaching the transition goals as stated in February last year:

Europees rapport: Nederland gaat energiedoelstellingen niet halen

(www.nos.nl)
Fossil energy is highly interwoven with the Dutch economy.

(Weterings et al., 2013, p. 20).
Bottom up movement by Dutch municipalities how often transition mostly to complex to make a difference. (. later I will more deeply explain the role of the municipality)
'How should the roadmap for the energy transition of the built environment towards energy neutrality for the city Delft look like, with technical interventions based on local sustainable energy potentials integrated at different scales and what is the general approach for the energy transition of Dutch municipalities?'
Research Framework
Research Approach

LITERATURE STUDY
- Transition NL
- Technologies
- Case Studies
- Existing Approaches
Research Approach

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- Transition NL
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- Case Studies
- Existing Approaches

APPROACH

- Steps
- Systems
- Technologies
ROADMAP

LITERATURE STUDY

Transition NL
Technologies
Case Studies
Existing Approaches

CONTEXT ANALYSIS

Demands
Existing systems
Potentials & supplies
Characteristics

ROADMAP

APPROACH

Steps
Systems
Technologies
ROADMAP

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APPROACH
- Steps
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INTERVENTIONS NEIGHBOURHOODS

Research Framework
Research Approach
2
The Basics
Basics of the energy transition
Primary Energy Sources

- Solar Energy
- Biomass
- Currents
- Wind
- Geothermal
Basics of the energy transition
Conversion Primary Sources

- Solar Collector
- Solar Energy
- Currents
- Biomass
- Wind
- Pellet Boiler
- Geothermal
Basics of the energy transition
Conversion Primary Sources

Solar Energy → PV

Currents → Turbine

Wind → Turbine

Biomass

Geothermal
Basics of the energy transition
Conversion Primary Sources

- Solar Energy
- Currents
- Geothermal
- Biomass
- Wind
- Biogas
Basics of the energy transition
Secondary Energy Sources

BIOGAS
HEAT
ELECTRICITY
Basics of the energy transition
Conversion Secondary Sources

- Biogas
- Heat
- Electricity
Basics of the energy transition
4 heat systems

INDIVIDUAL

BIOMASS
Pellet boiler

BIOGAS
Boiler

ALL-ELECTRIC
Heat Pump

HEAT GRID
Heat exchanger

COLLECTIVE
Basics of the energy transition
4 heat systems

INDIVIDUAL

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COLLECTIVE
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Basics of the energy transition
4 heat systems

INDIVIDUAL

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Heat Pump

COLECTIVE

HEAT GRID
Heat exchanger
Limit the energy demands
Basics of the energy transition
Collective savings
Industrial waste heat
Residual heat, small scale
Basics of the energy transition
Collective savings

Cascade
Basics of the energy transition
Variant New Stepped Strategy

1. Reduce the energy demands
2. Re-use (energy) waste streams
3. Renewables
Basics of the energy transition

Variant New Stepped Strategy

1. Reduce the energy demands
2. Re-use (energy) waste streams
3. Renewables
Basics of the energy transition

Variant New Stepped Strategy

1. Reduce the energy demands

2. Re-use (energy) waste streams

3. Renewables
Basics of the energy transition
Sustainable heat systems tool
Basics of the energy transition
Sustainable heat systems tool

Individual systems
Building (block)

Collective systems
Urban-district-neighbourhood scale

HEAT SYSTEMS
Basics of the energy transition
Sustainable heat systems tool
Basics of the energy transition
Sustainable heat systems tool

Individual systems
Building (block)

Collective systems
Urban-district-neighbourhood scale

HT heat

MT heat

LT heat

VLT heat

REQUIRED RENOVATION
Basics of the energy transition

Example

Aquifer 250m

PVT

Residual heat

Datacentre

ATES

25°C

5°C

40°C
Basics of the energy transition

Electricity storage

Seasonal electricity storage no option: The Netherlands is too flat
Basics of the energy transition
Thermal energy storage

Aqueous layer (aquifer)
Heat exchanger
ELECTRICITY = GOVERNMENT

International network

THERMAL = MUNICIPALITY

Local energy potentials

Windparks North Sea

Local characteristics & building stock

Basics of the energy transition
Role municipality
Guidelines

Heat supplies
• self-sufficient
Guidelines

Heat supplies
• self-sufficient
• Decrease demands by energy retrofitting buildings
Guidelines

Heat supplies
  • self-sufficient
  • Decrease demands by energy retrofitting buildings
  • Optimally implement the local potentials
    - Never use HT heat for LT purposes
Guidelines

Heat supplies
- self-sufficient
- Decrease demands by energy retrofitting buildings
- Optimally implement the local potentials
  - Never use HT heat for LT purposes
  - Only construct/expand heatnetworks in high density area
Guidelines

Heat supplies

- Self-sufficient
- Decrease demands by energy retrofitting buildings
- Optimally implement the local potentials
  - Never use HT heat for LT purposes
  - Only construct/expand heatnetworks in high density area
  - All-electric only for LT heating
Guidelines

Heat supplies
- self-sufficient
- Decrease demands by energy retrofitting buildings
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Electricity
- Minimize the demands, maximize generation
Guidelines

Heat supplies
- self-sufficient
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Electricity
- Minimize the demands, maximize generation
  - To optimize generation 70% available roof surface PV
Guidelines

Heat supplies
• self-sufficient
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  - Never use HT heat for LT purposes
  - Only construct/expand heatnetworks in high density area
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Electricity
• Minimize the demands, maximize generation
  - To optimize generation 70% available roof surface PV
  - To limit peak demands: max. 10-15% heated all-electric
3
The Approach
The Approach
Research Approach

ROADMAP

LITERATURE STUDY
- Transition NL
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APPROACH
- Steps
- Systems
- Technologies
The approach

Step 1

Analysis
- Demands
- E-System
- Stakeholders
- Status Quo
- Vision & Targets

Roadmap
- Urban Strategy
- Interventions
- Sustainability

Steps
1. Demand
2. E-System
3. Stakeholders
4. Vision & Targets
5. Status Quo
6. EPM
7. Urban Strategy
8. Interventions
9. Sustainability
10. Roadmap

Transition Goals
- 2020
- 2030
- 2040
- 2050
The approach

Step 2

Analysis

Roadmap

VISION & TARGETS

EPM

URBAN STRATEGY

INTERVENTIONS

DEMANDS

E-SYSTEM

STAKEHOLDERS

STATUS QUO

Sustainability

ROADMAP

transition goals

2020 2030 2040 2050

STEPS

1 2 3 4 5 6 7 8
Step 3

The approach

Analysis

- Demands
- E-System
- Stakeholders
- Status Quo
- Vision & Targets
- EPM

Roadmap

- URBAN STRATEGY
- INTERVENTIONS
- EPM

Roadmap

- Sustainability
- Transition Goals

Steps

1 2 3 4 5 6 7 8
Step 4

The approach

Reduce the energy demands
1

Use existing systems
2

Re-use (energy) waste streams
3

Renewables
4a

Technologies
4b
The approach

Step 5

Analysis

- Status Quo
- Demand
- E-System
- Stakeholders

Vision & Targets

EPM

Roadmap

Urban Strategy

Interventions

Roadmap

Steps

1 2 3 4 5 6 7 8
The approach

Step 6

Analysis

1. Demands
2. E-system
3. Stakeholders

Status Quo

Vision & Targets

EPM

Roadmap

Urban Strategy

Interventions

Transition Goals

Roadmap

Steps

1 2 3 4 5 6 7 8

Demand?

E-system

Status Quo

Vision & Targets

EPM

Interventions

A B C D E F G H

2020 2030 2040 2050

Transition Goals

Sustainability

Steps

1 2 3 4 5 6 7 8
The approach

Step 7

Analysis

- Demands
- E-system
- Stakeholders

Vision & Targets

- Status quo
- EPM

Roadmap

- Urban Strategy
- Interventions

Roadmap

- Transition goals
- Sustainability

Steps

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

DEMANDS

E-SYSTEM

STAKEHOLDERS

VISION & TARGETS

STATUS QUO

EPM

URBAN STRATEGY

INTERVENTIONS

ROADMAP

RM

2020 2030 2040 2050

2050 transition goals

2040

2030

2020
The approach

Step 8
Energy neutral city

“Only energy of renewable sources will be used for heating, cooling, illumination and other processes of all buildings and for all the traffic and transport in between the city boundaries of Delft.”
(Leguit, 2011)
Energy neutral city

“Only energy of renewable sources will be used for heating, cooling, illumination and other processes of all buildings and for all the traffic and transport in between the city boundaries of Delft.”

(Leguit, 2011)
CITY OF TECHNOLOGY
Collaboration TU-TIC-Delft
Mobilize & Implement their knowledge

COHERENT CITY

CORPORATIONS
Feel connected & contribute to the cities developments & transition
CITY OF TECHNOLOGY

COHERENT CITY

CORPORATIONS

47% property of corporations
Upgrade to label B/A
(E-Deals)
2015 Heat demands: 2.2 PJ
2015 Electricity demands: 1.3 PJ
2015 Total demands: 3.5 PJ

(CBS, Klimaatmonitor)
Heat demands

2015: 2.2 PJ
2050: 1.7 PJ

Electricity demands

2015: 1.3 PJ
2050: 1.1 PJ

Total demands

2015: 3.5 PJ
2050: 2.8 PJ

Energy savings

Roadmap for Delft

(PICO Webtool)
### Roadmap for Delft

**Urban scale strategy**

<table>
<thead>
<tr>
<th>Typology</th>
<th>Retrofitting</th>
<th>°C</th>
<th>Energy potentials</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1900 Residences &amp; offices</td>
<td>HT</td>
<td>I</td>
<td>G F E D C B A A A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>by 100% of the Private house-owners</td>
</tr>
<tr>
<td>1900-1945 Single-family housing</td>
<td>MT</td>
<td>IV</td>
<td>G F E D C B A A A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>by 55% of the Private house-owners</td>
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<tr>
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<td></td>
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<td>G F E D C B A A A</td>
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</tr>
<tr>
<td>50-60’s Single-family housing</td>
<td>MT</td>
<td>IV</td>
<td>G F E D C B A A A</td>
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<tr>
<td></td>
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<td></td>
<td>by 50% of the Corporation</td>
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<tr>
<td></td>
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<td></td>
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</tr>
<tr>
<td>50-60’s Multi-family 3-dayers</td>
<td>MT</td>
<td>IV</td>
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</tr>
<tr>
<td>50-60’s Multi-family High-rise</td>
<td>MT</td>
<td>IV</td>
<td>G F E D C B A A A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>by 20% of the Private house-owners</td>
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<td></td>
<td>G F E D C B A A A</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>by 60% of the Private house-owners</td>
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<td>G F E D C B A A A</td>
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<td>70-80’s Single-family housing</td>
<td>LT</td>
<td>V</td>
<td>G F E D C B A A A</td>
</tr>
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<td></td>
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<td>90-00’s Single-family housing</td>
<td>LT</td>
<td>V</td>
<td>G F E D C B A A A</td>
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<td>V</td>
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<td></td>
<td></td>
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<td>by 100% of the Private house-owners</td>
</tr>
<tr>
<td>&gt;2010</td>
<td>LT</td>
<td>V</td>
<td>G F E D C B A A A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>by 100% of the Private house-owners</td>
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<tr>
<td>Farm &amp; low density</td>
<td>HT</td>
<td>I</td>
<td>G F E D C B A A A</td>
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### Notes

- **Indus. waste heat**
- **ATES/BTES**
- **Heat Pump**
- **Small/Moderate renovations**
- **Moderate/Deep renovations**
- **Deep renovations**
- **Residual heat**
- **Biogas**
- **CHP**
- **PV**
- **PVT**
- **Solar collectors**
- **Air-source Heat Pump**
- **Cascade**
- **District heating**
- **Retrofitting**
- **Renovations**
Residual heat

Energy sources
Roadmap for Delft
Energy sources
Intervention Schie-area
Source HT Network
Source HT Network
Roadmap for Delft
Intervention: Schie-area

- Residual heat
- Cascade
- Solar collectors
- ATES/BTES
- Biogas
- CHP
- Wood
- AVALEX
Roadmap for Delft
Intervention: Schie-area
Roadmap for Delft

Energy balance

- **Import electricity (HP comp)**
- **Natural gas**
- **City centre & Hof v. Delft**
- **Residual heat small scale**
- **Biomass/Biogas(CHP)**
- **Effluent**
- **All-electric**
- **ATES/BTES &Solar coll./PVT**
- **Geothermal TU**
- **Existing**
- **Savings**

Energy balance:

- 2015: 3.5 PJ
- 2020: 31%
- 2030: 15%
- 2040: 11%
- 2050: 7%
Conclusions
Conclusions
By following the steps & guidelines a roadmap for Delft is designed, showing that:

- Multiple outcomes can result in the same goal: energy neutral Delft; The design differs per designer. While sometimes multiple potentials are possible, it’s important to match these as much as possible with the characteristic of the district/neighbourhood.

- The energy transition is achievable; however it requires active participation by the citizens and companies. They should become aware of urgency of the energy transition and actively be stimulated to energy retrofit their property.

- Also municipality should become aware of both the urgency of the transition and the enormous size of the assignment. They should no longer wait, start now; create a bottom-up movement for the energy transition of the Netherlands.
Recommendations for further research
- A business case of the proposed roadmap should be created: including stakeholders, financial models and risks.
- Included the demands and supplies for traffic and transporation and at which scale should be looked to this?
- The created roadmap will be outdated relatively fast due to the fast developments in the energy (generation) technologies. A roadmap should be analysed and updated on regular basis.
Thank you!