Iterations for heat savings, electrification, and district heating.

Susana Paardekooper and Rasmus Lund
Heat Roadmap Europe projects

• Study 1 (2012): will district heating play a role in the decarbonisation of the European energy system?

• Study 2 (2013): what is the balance between heat savings and heat supply at an EU level?

• Study 3 (2015, STRATEGO WP2): low-carbon heating and cooling strategies for 5 member states

• Study 4 (2016-2019): integrated low-carbon heating and cooling strategies for 14 member states
Motivation

Move from **balance** to **interplay**

- Does it make a difference?
- Is it possible to use the resulting trends to understand the scenarios better?
- Treating them sequentially in the context of a Roadmap can be a confusing message.
- Represents a less exploratory approach

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#SES4DH2018
Methodology

• Repetitive simulation of systems with different levels (5 and 10% increases) in EnergyPLAN
• Transport and electricity; taken from Conventionally Decarbonised scenario
• Heuristics: merit order
  – Boiler capacity to cover peak + 10%
  – Excess heat; maximum
  – PP/CHP to cover that demand +10%
• 700 combinations with corresponding scenarios

• Heat Roadmap Europe: background reports on website
Methodology: heuristics

Ceteris paribus approach over trying to achieve a certain objective.

- Boiler capacity to cover peak + 10%
- Excess heat; maximum based
  - Spatial constraints, temporal constraints (baseload), temp.
- Geothermal: maximum based on spatial constraints
- Solar thermal: capped at 5% of the DH production
- CHPth capacity: average hour demand
- LSHPth: low peak demand
- PP: peak demand (incl. demand for small and large HPs) +10%
## Results: Matrices

### Costs and PES: Netherlands

<table>
<thead>
<tr>
<th>Percentage of market share covered by DH</th>
<th>Total energy system costs (M€/year)</th>
<th>Residential sector savings additional to the Baseline</th>
<th>0%</th>
<th>5%</th>
<th>10%</th>
<th>15%</th>
<th>20%</th>
<th>25%</th>
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<tbody>
<tr>
<td>0%</td>
<td>55251</td>
<td>55230</td>
<td>55237</td>
<td>55207</td>
<td>55267</td>
<td>55275</td>
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<tr>
<td>5%</td>
<td>55178</td>
<td>55153</td>
<td>55156</td>
<td>55121</td>
<td>55176</td>
<td>55180</td>
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<tr>
<td>11%</td>
<td>55069</td>
<td>55040</td>
<td>55038</td>
<td>55001</td>
<td>55050</td>
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<tr>
<td>19%</td>
<td>54896</td>
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<td>54816</td>
<td>54860</td>
<td>54864</td>
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<tr>
<td>28%</td>
<td>54702</td>
<td>54665</td>
<td>54655</td>
<td>54609</td>
<td>54649</td>
<td>54653</td>
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<td>54514</td>
<td>54473</td>
<td>54458</td>
<td>54408</td>
<td>54444</td>
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<tr>
<td>47%</td>
<td>54362</td>
<td>54318</td>
<td>54298</td>
<td>54245</td>
<td>54276</td>
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<tr>
<td>56%</td>
<td>54286</td>
<td>54236</td>
<td>54212</td>
<td>54154</td>
<td>54180</td>
<td>54184</td>
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<tr>
<td>66%</td>
<td>54242</td>
<td>54188</td>
<td>54159</td>
<td>54097</td>
<td>54117</td>
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<tr>
<td>76%</td>
<td>54302</td>
<td>54244</td>
<td>54210</td>
<td>54142</td>
<td>54158</td>
<td>54162</td>
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<tr>
<td>86%</td>
<td>55865</td>
<td>55802</td>
<td>55764</td>
<td>55691</td>
<td>55702</td>
<td>56151</td>
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</tbody>
</table>

**NL: Costs as DH penetration increases**

![Graph showing costs as DH penetration increases](image1)

**NL: Costs as savings increase**

![Graph showing costs as savings increase](image2)
## Results: where do costs change?

<table>
<thead>
<tr>
<th></th>
<th>S0 DH0</th>
<th>S20 D90</th>
<th>Difference</th>
</tr>
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<tr>
<td>Savings</td>
<td>9260</td>
<td>10040</td>
<td>780</td>
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<td>Indiv. HP</td>
<td>5094</td>
<td>532</td>
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<tr>
<td>PP and CHP</td>
<td>3330</td>
<td>2885</td>
<td>-445</td>
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<td>Electric grid costs</td>
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<td>37023</td>
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<td>RES electricity</td>
<td>1531</td>
<td>1531</td>
<td>0</td>
</tr>
<tr>
<td>DH infrastructure</td>
<td>0</td>
<td>1816</td>
<td>1816</td>
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<tr>
<td>Boilers</td>
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<td>1297</td>
<td>1297</td>
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<tr>
<td>Heat pumps</td>
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<tr>
<td>Solar thermal</td>
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<tr>
<td>Geothermal</td>
<td>0</td>
<td>21</td>
<td>21</td>
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<tr>
<td>Excess heat</td>
<td>0</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Other</td>
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<td>1499</td>
<td>-31</td>
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<tr>
<td>Coal</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Oil</td>
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<td>511</td>
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<tr>
<td>Gas</td>
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<td>9675</td>
<td>-1029</td>
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<tr>
<td>Biomass</td>
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<td>12754</td>
<td>-58</td>
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<tr>
<td>O&amp;M</td>
<td>6075</td>
<td>5137</td>
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<tr>
<td>Balance</td>
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<td></td>
<td>-3112</td>
</tr>
<tr>
<td>Total</td>
<td>91674</td>
<td>88562</td>
<td>97%</td>
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</table>
Next steps

1. Describe scenarios more precisely
2. Extract heat/cooling costs from total system costs
3. Exemplify/explain the trends better (what kind of investment costs rise, etc)
4. Discuss country variations
5. (minimising cost and PES here – but no hard biomass constraint)
Conclusions

• The balance is more complex than the traditional positive exponential curve visualisation.
  – There are almost always cut-off points, also for DH
  – Fuel savings and economic savings do not always run hand in hand

• The results differ per country, but there are trends
  – Eastern Europe: more savings than within the scope
  – DH: much more driven by urban/rural nexus than climate or current level of DH

• What are the implications if we achieve more or less of this efficiency?
Thank you!

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Heat Roadmap Europe: www.heatroadmap.eu

Pan-European Thermal Atlas: www.heatroadmap.eu/maps

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