Heat pumps on a city scale – assessing optimal scales of implementation

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Aims and objectives

• Work with Stratego results
  • Peta and EnergyPLAN models
  • Moving from country to local
• The role of networks in urban areas, especially in the context of heat pumps
• Overall aim:
  • To develop national low-carbon heating and cooling strategies (Heat Roadmaps)
  • To quantify the impact of implementing them at national level
  • For CZ, HR, IT, RO, UK

www.stratego-project.eu

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Stratego: Heating Options

Everywhere

- Heat Savings
- Balance Savings vs. Supply
- 30-50% Total Reduction

Urban Areas

- (District) Heating Networks
- High Population and Heat Density Areas
- Supply ~50% of the Heat Demand

Rural Areas

- Primarily Electric Heat Pumps
- Smaller Shares of Solar Thermal & Biomass Boilers
- Remaining ~50% of the Heat Demand

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Stratego: Individual Heating Options

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<tr>
<th>Heating Unit</th>
<th>Sustainable Resources</th>
<th>Efficient</th>
<th>Cost</th>
<th>Cost Sensitivity</th>
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<td>Electric Heating</td>
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Objective

- To use a local case study using (mainly) Stratego resources.
- To understand how to best employ heat pumps in cities
  - On a large scale, with a DH network for distribution
  - In each building, individually
  - Control: gas network
Applicability of heat pumps

• What seemed reasonable based on other examples
  • Stockholm – 250 MWth
  • Helsinki – 90 MWth

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www.heatroadmap.eu
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Methodology: local cases based on Stratego resources

- Use Peta3 to identify areas
  - Bristol – looked promising by waterway
  - York – no immediate sources for large heat pumps
  - Dundee – located by the sea
Dundee

Prospective DH system ID: 3,395
Annual Heat Demand [TJ]: 4,460
Annual Cooling Demand [TJ]: 63
DH system size: 3-10 PJ/a
Geothermal area [yes/no]: No
Annual mean solar irradiation [kWh/m²]: 1,031
Area of DH system [km²]: 40.52
Population in DH area: 149,078
Availability of surface water [1-5]: 5
Available heat from sewage water [TJ/a]: 223
Available wood < 30km [TJ/a]: 115
Available straw < 30km [TJ/a]: 3,650

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Building the scenarios

- What is EnergyPLAN?
- Hourly distributions— UK Energy Model (http://heatroadmap.eu)
- Electricity: all imported, with UK average CO\textsubscript{2} content
- Technology data & costs: Danish Energy Agency database (updated)
How it works

Both individual and large scale heat pumps have the same COP ~3.3

Prove the principle rather than having an optimized model

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Results

• Energy efficiency (fuels used)
• CO$_2$
• Costs
Results

- Efficiency of heat pumps
- CO$_2$: Dependent on the carbon content of the electricity system
Results

- (variable) Fuel costs
- Network costs: 5% of total
  - Substations
- Investment costs for HPs
Discussion

Objective: use Stratego resources for a city case

- Delineating boundaries
  - Urban agglomerations; can be organisational, physical
- Integrating the electricity sector
  - Local forms of electricity generation

Objective: understand the best employ of heat pumps

- Network solution is preferred
- LS heat pumps can provide heating at higher efficiency and similar cost to gas boilers, if sources are available.
Next steps

• SES: integrate storage, assess effects on integrating RES
• Optimise other heat sources for DH
• Local planning processes: use of results (HRE4)
• Heat pumps: continue survey
• Consider variations and intermediaries
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Questions/suggestions?

THANK YOU!

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