Heat pumps in the UK’s district heating: individual, district level, both or neither?

Zhikun Wang
PhD student
UCL Energy Institute
University College London
Outline

• UK’s heat demand and market

• Options to decarbonise the UK’s heating sector
  – Repurposing the gas grid
  – District heating networks
  – Individual heating technologies

• Heat pumps in district heating
Today

45% of final energy demand is consumed to supply heat

78% houses are heated by natural gas

- Natural gas: 78%
- Electricity: 7%
- Oil: 8%
- Bioenergy and waste: 5%
- Solid fuel: 2%

Transport, 846 TWh, 36%

Electricity, 438 TWh, 19%

Heating (non-electric), 890 TWh, 38%

Heating (electric), 155 TWh, 7%

Decarbonising the heating sector

Improve efficiency and reduce heat demand

Decarbonising fuel supply

Deploying low-carbon heat technologies
Repurposing the gas grid

Natural gas
Syngas
Biogas/
Gasified biomass
Hydrogen

Gas grid

Boilers in buildings
District heating

- Power plants
- Renewables
- Gas and electric boilers
- Industry waste
- Incineration plants
- Hydrogen plants
- Large heat pumps

Heat

Individual low-carbon heat technologies

<table>
<thead>
<tr>
<th>Renewable Heat Incentives</th>
<th>ASHP</th>
<th>GSHP</th>
<th>Biomass</th>
<th>Solar thermal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tariffs (p/kWh)</td>
<td>7.63</td>
<td>19.64</td>
<td>4.28</td>
<td>20.06</td>
</tr>
</tbody>
</table>

(Offgém, 2017)
Current costs comparison

<table>
<thead>
<tr>
<th>Heating System</th>
<th>LCOH (£/MWh)</th>
<th>Total (£/MWh)</th>
<th>Total without RHI (£/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas boiler</td>
<td>78.52</td>
<td>78.52</td>
<td>78.52</td>
</tr>
<tr>
<td>Ground source heat pump</td>
<td>61.98</td>
<td>161.89</td>
<td>161.89</td>
</tr>
<tr>
<td>Air source heat pump</td>
<td>99.92</td>
<td>138.73</td>
<td>138.73</td>
</tr>
<tr>
<td>Biomass heating</td>
<td>103.75</td>
<td>129.08</td>
<td>129.08</td>
</tr>
<tr>
<td>Solar thermal system + Gas boiler</td>
<td>85.44</td>
<td>102.77</td>
<td>102.77</td>
</tr>
</tbody>
</table>
Average annual carbon saving compared to gas boilers

- Solar thermal system + Gas boiler: 14.6%
- Biomass heating: 71.6%
- Air source heat pump: 71.0%
- Ground source heat pump: 78.2%
Heat pumps in Europe

(Hannon, 2015)
What are the economic and environmental advantages of deploying heat pumps at different scales?
Individual heat pump vs. heat pumps in DH

Same amounts of heat pumps and houses, no DH

District heating

Heat pumps in DH, less amount of heat pumps than houses

Individual heat pumps with houses which are connected to DH

Individual heat pump vs. heat pumps in DH

Economies of scale? or Diseconomies of scale?
Thank you!

zhikun.wang.10@ucl.ac.uk
References

• Northern Gas Networks. 2016. The H21 Leeds City gate project.
Power demand under 0% and 20% heat pump deployment

(Love, et al., 2017)
After Diversity Maximum Demand per heat pump

(Love, et al., 2017)