SECONDARY HEATING AND COOLING OPPORTUNITIES IN URBAN AREAS

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http://www.lsbu.ac.uk/research/research-interests/sites/centre-air-conditioning-refrigeration-research
Heating challenge in the UK

Climate Change Act 2008
What is the plan?
# Secondary heat sources

<table>
<thead>
<tr>
<th>Heat Source</th>
<th>Proximity to heat demand</th>
<th>Available year round</th>
<th>Typical source temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power station rejection</td>
<td>✗</td>
<td>✓</td>
<td>35°C</td>
</tr>
<tr>
<td>Buildings</td>
<td>✓</td>
<td>✗</td>
<td>28°C</td>
</tr>
<tr>
<td>Industrial heat</td>
<td>✗</td>
<td>✓</td>
<td>35-70°C</td>
</tr>
<tr>
<td>Underground Railways</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>32°C</td>
</tr>
<tr>
<td>Electricity substations</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>50°C</td>
</tr>
<tr>
<td>Sewer heat mining</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>14-22°C</td>
</tr>
<tr>
<td>Data centres</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>35°C</td>
</tr>
<tr>
<td>Cable tunnels</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>Up to 40°C</td>
</tr>
<tr>
<td>Roads / Car parks</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>25°C</td>
</tr>
</tbody>
</table>
UNDERGROUND RAILWAYS
Heat on underground railways

- It is cooler below
- Comparison of temperature in 1900, 1940, and 2018
- Temperatures: 1900, 1940, and 2018
- London South Bank University
Ground heat exchangers

Heat extraction rates of GSHPs installed near UR tunnels can be significantly improved by up to ~ 43%
Ventilation shaft waste heat recovery and cooling - MICAH
Ventilation shaft waste heat recovery and cooling - MICAH
Sewers
Map of interceptor sewers and underground rivers

Many hundreds of km of sewage network in London
Waste heat recovery from sewers - options

(a) Integrated heat exchangers

(b) External heat exchangers
Waste heat recovery from sewers – Integrated heat exchangers

“Walk-in channel” heat exchanger

Integrated in the concrete pipe

~ 2.5 kW/m² of heat exchanger surface can be achieved
Waste heat recovery from sewers – External heat exchangers

- Scottish Borders Campus in Galashiels
- 400 kW system
- Energy centre houses the heat recovery equipment along with the heat pumps, all associated pipework, vessels and the control systems
- HP CoP~4
CABLE TUNNELS AND SUBSTATIONS
Cable tunnels
Waste heat recovery from cable tunnels - options

1. Cooling of air supplied to tunnel with waste heat recovery
2. Waste heat recovery from air exiting tunnel
3. Cooling of air in tunnels using water pipes, with waste heat recovery
Waste heat recovery from transformers

- Tate Modern case study
- UKPN transformer
- 1 MW of waste heat recovery system
- 7000 MWh per year
- Saving 1400 tonnes of CO2e
DATA CENTRES
Waste heat recovery from data centres

Total heat output of the sector in London is $\sim 86$ MW
Waste heat recovery from data centres - options

(a) Recovery of heat from air in data centre room

(b) Recovery of heat from chiller condenser
Waste heat recovery from data centres - Example

Mäntsälä, Finland

- Using six heat pumps
- Total capacity 4 MW
- Supply enough heat for 1500 homes
Mapping of Secondary Heat Sources
London Urban Sub-Terrain Energy Recovery

LUSTER

2017
3D Stock Model - UCL
CHALLENGES AND TASKS

- Develop fit for purpose technical solutions
- Optimise complex energy system of multiple renewable and secondary energy sources
- Develop new business models which will allow optimal operation / potential revenue streams
- Disseminate findings and results
**SUMMARY**

- Large quantity of secondary heat available in cities
- Already some great examples
- Important to establish new commercial models
THANK YOU

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