Improving the energy efficiency of district heating systems

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District heating in Europe

How does a district heating system work?

Source: European Commission, https://www.power-eng.com/topics/d/district-heating-and-cooling.html#gref
District heating in Europe

- District heating provides **9% of heating in the residential sector**, 10% in the service sector and 8% of industry's heat needs.

- There are **more than 10,000 district heating (DH) systems in EU-28** which supply around 8% of the Europe's total demand for heat. Today, **approximately 70 million EU citizens are served by DH systems.**

EU climate and energy targets

- Making use of **existing district heating** to supply heat can be an **efficient way of providing affordable heat, improving flexibility, and reducing greenhouse gas emissions**.

- They can have advantages over the use of individual heating, **if they are based on sustainable sources of heat**, such as RES or recovered industrial waste heat and/or CHP.

- **Thus key to providing grants to district heating systems are the requirements set out in EU Directive 2012/27/EU:**

(41) ‘efficient district heating and cooling’ means a district heating or cooling system using at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat;

(42) ‘efficient heating and cooling’ means a heating and cooling option that, compared to a baseline scenario reflecting a business-as-usual situation, measurably reduces the input of primary energy needed to supply one unit of delivered energy within a relevant system boundary in a cost-effective way, as assessed in the cost-benefit analysis referred to in this Directive, taking into account the energy required for extraction, conversion, transport and distribution;
The district heating projects JASPERS has worked on are mainly existing systems in Central and South East Europe.

Although most systems have converted from coal to less carbon intensive fuels, they all suffer from high heat losses and water losses due to poor insulation and highly corroded transmission pipes.

The district heating systems projects we have been working on date back to the 1950s-1970s. Between 10,000 - 1.2m people are connected to them.

We only assisted systems that had a heat density of at least 2.0 MWh/m, a standard rule of thumb for being considered an economically viable system.
JASPERS assistance

- The latest projects involved replacing corroded transmission networks with appropriately sized and insulated pipes.

- **Average heat losses** in the EU-28 networks are estimated at 12.3%, but we have seen losses as high as 50% (transmission & distribution level).

- **Modernisation** translates into lower opex (fuel and maintenance costs), lower carbon dioxide emissions and air pollution and improved quality of service.

- After the intervention, heat losses typically fell by 9-1.5 %pts, while water losses and emergency repairs fell between 50%-80%.

- Primary energy savings ranged between 0.02 - 2.6 PJ.
Challenges and issues

- Climate change
- Old and oversized DH networks
- Heat tariffs being politicized and being set below cost-recovery.
- Operator in financial difficulty
- Price regulation
- Maintenance backlogs, low-efficiency heat production and bad water management.
- High heat and water losses
- Consumers disconnecting and/or high level of non-payment due to poor quality of service.
- Lack of metering and control technology
<table>
<thead>
<tr>
<th>Scope of support</th>
<th>Impact of support</th>
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<tbody>
<tr>
<td>Mapping of energy flows…</td>
<td>…to fully understand the DH system.</td>
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<tr>
<td>Scrutinising the <strong>heat demand and supply analysis</strong> of the DH system…</td>
<td>… to understand the heat demand (climate change assumptions, EE measures) and head load.</td>
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## Scope of support

<table>
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<tr>
<th>Scope of support</th>
<th>Impact of support</th>
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<tbody>
<tr>
<td>Reviewing the <strong>investment plan</strong> to replace the oldest and worst pipelines first.</td>
<td>Through reviewing the <strong>KPIs focused investment on the areas most in need of replacement</strong>, thereby having an impact on the achieved heat and water savings.</td>
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<td><strong>Coordinating between different owners of the network and substations to establish a joint investment plan.</strong></td>
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<td>Reviewing the <strong>option analysis</strong>.</td>
<td>Through expanding option analysis, made it credible and found a <strong>justifiable least cost option</strong>.</td>
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<td>Reviewing the <strong>financial and economic analysis</strong> of the beneficiary.</td>
<td>Through reviewing and amending the input assumptions achieving more <strong>favourable financial and economic indicators</strong>.</td>
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<td>Carrying out the <strong>calculation of the funding gap and level of EU grant</strong>.</td>
<td>Through reviewing the eligible costs and FGR calculation, managed to <strong>increase</strong> FGR (80-100%) and thereby <strong>higher level of EU grant</strong>.</td>
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Scope of support

<table>
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<tr>
<td>Reviewing the <strong>financial sustainability of the business</strong> and advice on providing letters of support from the energy regulator and parent company.</td>
<td>Spotted issue with heat tariffs being set below cost recovery and financial ratios being too low which would be an issue for the European Commission. Thus initiated <strong>letter of support from energy regulator and parent company</strong> to support major project application.</td>
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<td>Providing advice on <strong>state aid</strong>.</td>
<td><strong>Provided initial advice and initiated early informal talks with DG COMP</strong> to clear swifter path to (pre-) notification stage.</td>
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<td><strong>Water management day</strong> and water investment plan.</td>
<td>Spotted issue with high oxygen content in the circulation water / substations and <strong>worked with beneficiary to additional develop investment plan.</strong> Good quality of circulation water is vital to the long technical lifetime and reliable operation of the pipelines and to a successful major project application!</td>
</tr>
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</table>
Conclusions and outlook

• Refurbishment of networks for existing DH networks is a sound economic investment, where there this is a high heat density.

• To maximize energy efficiency & sustainability of a DH system ones needs to: take a full network view:

  1. **Assess long term demand developments**, taking into account climate change and EE measures to reduce consumption;

  2. **Identify measures to reduce high level losses in the transmission/distribution system** as well as improving the water quality;

  3. Based on the above, **consider investment in the production system and take account of alternatives**, such as heat pumps.

• There are institutional, regulatory and political issues which need to be jointly solved in the medium-run (institutional set-up and capacity, regulatory framework, heat tariffs, phasing out of subsidies…).
Conclusions and outlook

Outlook

• In February 2016, the Commission proposed an **EU Strategy on Heating and Cooling strategy** as a first step in exploring the issues and challenges in this sector, and solving them with EU energy policies.

• In particular the Strategy calls for:
  
  • **development of sustainable heating and cooling strategies** at national level, with special attention to *combined heat and power, cogeneration, district heating and cooling, preferably based on renewables, as is stated in Article 14 of the Energy Efficiency Directive*;

  • replacement of unsustainable and old individual or district heating/cooling technologies with efficient district heating/cooling systems;

  • the **phasing-out of subsidies** for heating and cooling fuelled by fossil fuels in order to gradually decarbonise the sector;

  • measures to **secure access to finance for investment** in modernising the heating and cooling sector.

Definition of ‘**efficient district heating and cooling**’ in Article 2 of the Energy Efficiency Directive (2012/27/EU):
“a district heating or cooling system using at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat”
More information:

http://jaspers.eib.org/
EU climate and energy targets

• In May 2019 the EU approved a comprehensive legal framework to deliver EU climate and energy targets, summarised in the table below.

<table>
<thead>
<tr>
<th>EU targets</th>
<th>Greenhouse gas emissions</th>
<th>Renewable energy</th>
<th>Energy efficiency</th>
<th>Interconnection</th>
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<tr>
<td>2020</td>
<td>-20%</td>
<td>20%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>2030</td>
<td>&lt;40%</td>
<td>&gt;32%</td>
<td>&gt;32.5%</td>
<td>15%</td>
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• The new legal framework includes an EU Governance Regulation to ensure that the Union and its Member States collectively achieve these targets.

• A core element of this new regulatory framework is the requirement for Member States to prepare integrated National Energy and Climate Plans, or NECPs.

• The EC has assessed in the summer of 2019 the collective impact of the draft NECPs on EU-wide targets. The draft plans show a substantial gap with respect to energy efficiency, amounting to 26-30% under current plans compared to the 32.5% EU target.
The gross real investment required to deliver the 2030 targets is estimated by the EC at around EUR 400 billion per year over the decade.

Figure 1: Gross and additional investment required to meet 2030 targets
EU 28, EUR billion per year over decade 2021-2030

Source: EC Communication
District heating in the EU 28

- Heating and cooling accounts for 50% (546 Mtoe) of final energy consumption in 2012 and is projected to remain the largest energy sector even in the long-term under both business-as-usual and decarbonisation scenarios by 2030 and 2050.

More Information

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