Case study for district heating in Genk area

DHC+ Summer School Group Project
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Goals

1. Minimize use of non-renewable primary energy sources:
   - Elimination of CO$_2$ emissions
   - Integration of waste heat

2. Establish an anchor location for DHC in Genk area:
   - “First” grid from which extensions can grow
   - Raising awareness and acceptance in the local community for future DHC projects

3. Plan for economic and societal feasibility within the Belgian context
   - “It’s a small step for mankind, but a big step for Belgians” ☺
Genk-South

1. Use excess heat that is currently wasted
2. Connect new development areas to DH from the start
3. Integrate existing buildings and/or plan for future transition
4. Integrate long-term thermal storage

Genk city center: commercial, residential
Sledderlo: residential
Nieuw-Sledderlo (new development area): residential
Aperam: Industrial (steel manufacturing)
Langerlo power plant: electricity generation [closed]
Ford Genk: Industrial [closed]
Current situation in Sledderloo/Genk-South

- Residential housing district built in 50’s
- New-Sledderloo: social district built in the 70’s
- Groot-Sledderlo: new residential area in 2010
- New area will be built: LO2020
Heat demand analysis

TOTAL DH demand - duration curve [MW]

Annual heat demand: 23.9 GWh
Peak heat demand: 6.9 MW
DHC network planning

• Heat sources:

  TOTAL DH demand - duration curve [MW]
Seasonal heat storage assessment

- 0.3 km² lake area
- Necessary storage volume: 150,000 m³
- Depth needed ~5 m
- Current depth of lake est. 3 m → can be increased by digging deeper and use it to build a dam around the lake

- Reference project: Vojens (Denmark) → 200,000 m³
Network layout

- Total trench length: 8.1 km
- Linear heat density: 2.9 MWh/m/y
- Linear heat power density: 0.85 kW/m
- Network temperatures: 70°C/50°C
Accompanying measures

1. Consumer incentivation to reduce heat demand and supply temperature:
   - Subsidize investments in insulation improvements and heating system replacements
   - Neighbourhood competitions
   - Provide real-time monitoring applications
## Cost analysis

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Fixed cost</th>
<th>Variable cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste heat - HEX</td>
<td>4 MW</td>
<td>60.000</td>
<td>3.000</td>
</tr>
<tr>
<td>Natural gas boiler</td>
<td>8 MW</td>
<td>800.000</td>
<td>12.000</td>
</tr>
<tr>
<td>Thermal storage capacity - HEX</td>
<td>4 MW</td>
<td>60.000</td>
<td>3.000</td>
</tr>
<tr>
<td>Thermal storage size</td>
<td>150.000</td>
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<td>84.000</td>
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<tr>
<td>Grid</td>
<td>16.323 m</td>
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<tr>
<td>NG boiler specific price - investment</td>
<td>100.000</td>
<td>€/MW</td>
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<tr>
<td>NG boiler specific price - variable</td>
<td>1.500</td>
<td>€/MW</td>
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<tr>
<td>HEX investment cost</td>
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<td>€/MW</td>
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<td>HEX variable cost</td>
<td>5% of investment</td>
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<tr>
<td>TES investment</td>
<td>80</td>
<td>€/m³</td>
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<tr>
<td>TES variable</td>
<td>0.70% of investment</td>
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<tr>
<td>NG price</td>
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<td>€/MWh</td>
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<td>Heat price</td>
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<td>€/MWh</td>
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<td>Total yearly revenue</td>
<td>1.062.427</td>
<td>€</td>
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<tr>
<td>Payback period</td>
<td>30.45 years</td>
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</tbody>
</table>
Future expansion

Kolderbos: residential

Ziekenhuis Oost-Limburg: regional hospital

Industrial area
Conclusions

• Primary energy savings: 20.4 GWh

• CO₂ emission savings: 0.0024 t-CO₂/MWh (90% reduction)

• Pay-back time: ~30 years