Klimaschonende Nahwärmeversorgung durch Abwasserwärmenutzung im Projekt Celsius, Standort Köln

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Department for Social Affairs,
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3. BMUB-Fachtagung Klimaschutz durch Abwärmenutzung,

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Agenda

CELSIUS – Brief description

Cologne Demonstrators

KPIs

Wastewater Heat Potential

Lessons Learned
CELSIUS – Brief Description

- EU Project with 4 Years of Experience
- 10 New Demonstration Plants
- Waste Heat Recovery & more

http://celsiuscity.eu/
CELSIUS – Brief Description

Fig. 1 CELSIUS Wiki Internet Page [1]
Cologne Demonstrators

Fig. 2 Cologne Demonstrator Plants [2]

Fig. 4 Heat Exchanger Wahn @Rheinenergie

Fig. 5 Control Room Nippes @Rheinenergie
# Cologne Demonstrators

## Requirements for wastewater heat recovery

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Size</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry weather flow rate (daily average) [l/s]</td>
<td>&gt; 15 l/s</td>
<td>Mixed and dirty water sewage</td>
</tr>
<tr>
<td>Size of the channel [mm]</td>
<td>&gt; DN 800</td>
<td></td>
</tr>
<tr>
<td>Heat power [kW]</td>
<td>&gt; 150</td>
<td>&gt; 1000 Central heating system</td>
</tr>
<tr>
<td>Distance from the channel [m]</td>
<td>100-200</td>
<td>&lt; 300 Dense house construction in the city</td>
</tr>
<tr>
<td>Heat source temperature</td>
<td>&gt; 12 °C</td>
<td></td>
</tr>
<tr>
<td>Supply temperature</td>
<td>40 °C</td>
<td>70 °C COP &gt;3, COP 5.6</td>
</tr>
</tbody>
</table>

Table 1. Requirements for wastewater heat recovery [3]
Cologne Demonstrators - Wahn

- Heat exchanger long: 40m
- Water Temp.: 10/22°C
- Flow rate: 220 l/s
- Area Covered: 22000 m²

- Heat Demand: 1220 MWh/year
- Gas Boiler Heating Power: 1MW
- HP Heating Power: 200 kW
Cologne Demonstrators-Mülheim

- **Buildings:** 1 School, 1 Sport hall
- **Water Temp.:** 12/22°C
- **Flow rate:** 100 l/s
- **Area Covered:** 13000 m2.

- **Heat Demand:** 750 MWh/year
- **Gas Boiler Heating Power:** 860 kW
- **HP Heating Power:** 150 kW
Cologne Demonstrators-Nippes

- **Buildings:** 3 Schools 1 Sport hall
- **Water Temp.:** 12/22°C
- **Flow rate:** 30 l/s
- **Area Covered:** 28000 m².

- **Heat Demand:** 2130 MWh/year
- **Gas Boiler Heating Power:**
  - 760 kW
  - 880 kW
  - 720 kW
- **HP Heating Power (x3):**
  - 150 kW

Fig. 12 CO1-Nippes Layout [3]
Key Performance Indicators

**Energetic**
- Energy produced
- Energy recovered
- Primary energy saved

**Environmental**
- CO₂ emissions
- CO₂ savings
- Emissions (SO₂, NOₓ, PM)
- Emissions savings (SO₂, NOₓ, PM)

**Economic**
- Cost per kWh of saved PE
- Cost per ton of saved CO₂

**Social**
- Surface area m²
- # of residents clients benefitting from the project
- Reduction/increase of complaints
Key Performance Indicators

Fig. 13 Primary Energy Savings CO1-Wahn and Muelheim KPIs diagram 2015-2016 [3,6,7]
Fig. 14 CO2 Savings CO1-Wahn and Mülheim KPIs diagram 2015-2016 [3,6,7]
Key Performance Indicators

2015-Wahn Heat Supply

- HP: 63%
- Boiler: 37%

2016-Wahn Heat Supply

- HP: 48%
- Boiler: 52%

2015-Muelheim Heat Supply

- HP: 53%
- Boiler: 47%

2016-Muelheim Heat Supply

- HP: 50%
- Boiler: 50%

Fig. 15 Heat Supply Share CO1-Wahn and Muelheim 2015-2016 [6,7]
Wastewater Heat Potential

Capacity of large-scale heat pumps (LSHP) in Europe = 1423MW *

Capacity of large-scale HP (sewage) in Europe = 742MW *

* According to Own Research
Wastewater Heat Potential

Methodology based on 5 Cities: Copenhaguen, Cologne, Hamburg, Gothenburg & Turku

Input Data for 135 Cities:
Population, heat sold, electricity and District heating energy mix, Investment costs, etc

Upload into personal server:
Wastewater heating potential App.

Fig.17 Wastewater Treatment Plants in Cologne [9]
Waste Water Heat Potential

Towards a 100% Sustainable World in collaboration with CELSIUS

Wastewater heating potential Web-Application

The heating sector has been receiving more attention in the last years, as Europe's decarbonisation plans cannot succeed without focusing on the sector that represents almost half of its energy demand. Read more.

The tool estimates the heating potential of sewage water as a heat source for large-scale heat pumps in a given city. It shows the district heating annual sales of the selected city as well as the environmental benefits that the recovery of this heat source could provide. The tool was designed in such a way so that the user only needs to give a few input data for the calculation. The results are shown in a interactive map and with a graphs that allow a faster comprehension of the results.

Select the city you are interested and introduce the requested input parameters. Note: If you are not familiarized with the requested data, please look at the suggested values in the help section (?) at the top right corner of the input panels.

Input data

Dusseldorf

Full Operation Hours [hrs]

5137

Delta T [°C]

7

COP [ ]

3.5

Choose the type of DH system

- Low intensive CO2 DH network
- Medium intensive CO2 DH network
- High intensive CO2 DH network

Results

Heating Potential [MW]

42.2

Total Annual Heat Supplied by DH [GWh]

358

DH Heat Supplied by Heat Pump [GWh]

219.3

Share of Potential DH Demand to be Covered [%]

22.9

Fig. 18 Wastewater Heating Potential Web-Application Part 1 [10]
Wastewater Heat Potential

Fig. 7 Wastewater Heating Potential Web-Application Part 2 [10]
Lessons Learned

- Prioritize objectives to design a good control system
- Establish a **good partnership** with stakeholders, learn from other experiences
- Look for **experienced companies**
- **Trust campaigns** with clients
- **Key relationship** - City Gov. & drainage utility
- Involvement of local **specialist in WW**
Conclusions

• Significant **heat potential** for DH systems
• The use of wastewater makes sense from the **energy efficiency** and **environmental** point of view
• **Control system** is very important
• Define in a **smart** way the **objectives** of the plant
• We need the right **policies** to support heat pumps
Thank you for your attention!

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Sources