EUROPEAN HEAT PUMP SUMMIT
POWERED BY CHILLVENTA

CONGRESS + EXPO
NUREMBERG, 22–23.10.2019
Industrial | Commercial | Residential
Heating & Cooling | Components & Equipment

hp-summit.de
120°C HEAT PUMP INTEGRATION
IN GHENT HEATING DISTRICT NETWORK

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District Heating Ghent

North Grid

Central production

South grid
DH NETWORK GHENT

PROJECTS District Heating Ghent

Tondelier
3.5 MW
530 units
2017-2022
+ 3.3 GWh/y

Rabotterors (Renovation)
2.8 MW
320 units
2017-2022
+ 2.3 GWh/y

Academiestraat
1.7 MW
120 units
2018-2019
+ 1.4 GWh/y

Voortuin (secondary grid)
2.2 MW
2017-2019
+ 2 GWh/y

Dokseide gardens
600 kW
50 units
2018-2019
+ 0.4 GWh/y

Stapelplein - Dok West
1 MW
125 units
2019-2022
+ 0.7 GWh/y

Sint Pietersabdij
2.2 MW
2018
+ 2 GWh/y

Sint Pieters Nieuwstraat
450 kW
2018
+ 0.4 GWh/y

IVW Sint Vincentius
600 kW
2018
+ 0.5 GWh/y

Leopoldskazerne
Potential for CHP unit
2020-2022
+ 1 GWh/y

+13 GWh/y + 1 GWh/y

EDF luminus

Volume (MWH) simulatie
<table>
<thead>
<tr>
<th>Year</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWh</td>
<td>68.434</td>
<td>73.929</td>
<td>76.437</td>
<td>78.472</td>
<td>81.370</td>
</tr>
</tbody>
</table>
DH NETWORK GHENT SOURCES

CHP

Sustainable energy but not RENEWABLE

CCGT : 12 MWt

Closed 1/11/2017

Boiler : 5 MWt

Steam boiler : 50 MWt
HEATPUMP WHY?

HEATPUMP OFFERS ENERGY EFFICIENT SOLUTION TO FEED THE DISTRICT HEATING NETWORK

1 gaz @ 105% → 1,05 heat

1 gaz @ 53% (*) → 0,53 electricity

0,53 electricity @ COP3 → HP

1,59 heat

= Sustainable solution (→ Energy Efficient)

(*) EU geharmoniseerde referentierendement voor gescheiden opwekking van elektriciteit (d.m.v. gas) ((EU) 2015/2402 – (BS) 17.06.2016)
HEATPUMP THE ULTIMATE GOAL = CARBON FREE

1 gaz @ 105% → 1,05 heat
1 gaz @ 53% (*) → 0,53 electricity
0,53 electricity HP @ COP3 → 1,59 heat

0 gaz ≈1 electricity @ COP3 → 3,00 heat

= 100% Carbon free energy
HEATPUMP THE ULTIMATE GOAL = CARBON FREE

Thermal storage

District Heating

CGO’s

HEATPUMP
HEATPUMP: THE ULTIMATE GOAL = CARBON FREE

Waste heat source

BIO GAZ

CHP

Thermal storage

District Heating

Pilot

CGO’s

HEATPUMP

Waste heat source
HP – A NICE SYNERGY WITH EDF R&D & VMI

- Offer received from EDF R&D to buy the HP
- First Idea during site visit at EDF R&D for Floating PV project
- FAT at EDF R&D
- Arrival at Ghent
- Sept ‘18
- June ‘18
- Nov ‘17
- Installation & commissioning
- Nov ‘18

Jan ‘17

Sept ‘18

Installation & commissioning

Nov ‘18

First Idea during site visit at EDF R&D for Floating PV project
About the 120ºC Heat Pump by EDF R&D

■ **2009** : Start of the EDF R&D High Temperature Heat Pump project

■ **2010** : Base design of Johnson Controls heat pump **75ºC**
  - refrigerant R134a (HFO)
  - Double screw compressor

■ **2011** : Modifications to reach **100ºC** at condensor

■ **2014** : Major changes to reach **120ºC**
  - Refrigerant R245fa (HFO, lower Global Warming Potential)
  - New lubricant
  - New condensor

■ **2015-2016** : Mapping of performances, long term testing
Heat Pump Compressor

Compressed refrigerant toward condensor

Refrigerant R245fa succion

Double Screw Compressor

Electric motor

Oil separator
EDF R&D Lab facilities for Heat Pumps testing

The **cold** water loop can simulate the heat source (from 40°C to 90°C)

The **hot** water loop can simulate the heat source (from 80°C to 150°C)
120°C Heat Pump Performances

- Mapping of performances

**Chart Description:**
- **HP Performance (COP) Vs. Condensation and Evaporation Temperature**
- **Condensation Temperature**
- **Evaporation Temperature**
- **Out of operating range**

Legend:
- 1-2
- 2-3
- 3-4
- 4-5
- 5-6
- 6-7
- 7-8
EDF Luminus case among other networks
From a study on 80 networks in 11 EU countries

Source: Heat Roadmap Europe: Large-Scale Electric Heat Pumps in District Heating Systems, Andrei David et al., Energies 2017, 10, 578
120°C Heat Pump leaving the lab to work at Luminus

- World first heat pump on a district heating network at 120°C

- EDF R&D will provide a 2 years remote collection of the heat pump operation data
## EFFICIENCY IMPROVEMENT WITH HP

<table>
<thead>
<tr>
<th>No tolerances: data on heat balans sheet (flue gas recuperation calculated to 131°C)</th>
<th>Zonder Wp</th>
<th>Met WP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasconsumption motor</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Electrical production at generator</td>
<td>9.805</td>
<td>9.805 kW</td>
</tr>
<tr>
<td>Electrical consumption of perimeter equipment</td>
<td>4.404</td>
<td>4.404 kW</td>
</tr>
<tr>
<td>Electrical consumption of perimeter equipment</td>
<td>111,2</td>
<td>111,2 kW</td>
</tr>
<tr>
<td>Electrical consumption of Heat Pump</td>
<td>0,0</td>
<td>73,8</td>
</tr>
<tr>
<td>Netto Electrical production</td>
<td>4.292,8</td>
<td>4.219,0 kW</td>
</tr>
<tr>
<td>Electrical efficiency</td>
<td>43,70%</td>
<td>42,95%</td>
</tr>
<tr>
<td>Heat recovery on motor (70-99°C)</td>
<td>2.583</td>
<td>2.522 kW</td>
</tr>
<tr>
<td>Flue gasses entering flue gas cooler1</td>
<td>24.371</td>
<td>24.371 kg/h</td>
</tr>
<tr>
<td>Flue gasses entering flue gas cooler (condensor)</td>
<td>131</td>
<td>131 °C</td>
</tr>
<tr>
<td>Flue gasses cooled down to</td>
<td>80</td>
<td>80 °C</td>
</tr>
<tr>
<td>Heat recovery on flue gasses in cooler (condensor)</td>
<td>360</td>
<td>360 kW</td>
</tr>
<tr>
<td>LT heat (40-45 heat range)</td>
<td>0</td>
<td>264 kW</td>
</tr>
<tr>
<td>Dump Heat from HT to Hpump</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Radiant heat</td>
<td>0</td>
<td>0 kW</td>
</tr>
<tr>
<td>Heat recovery with Heat pump</td>
<td>0</td>
<td>398,8 kW</td>
</tr>
<tr>
<td>Total heat recovered on HT and flue gasses and HP</td>
<td>4.640</td>
<td>4.978 kW</td>
</tr>
<tr>
<td>Netto Heat efficiency</td>
<td>47,24%</td>
<td>50,68%</td>
</tr>
<tr>
<td>Total netto efficiency</td>
<td>90,94%</td>
<td>93,63%</td>
</tr>
</tbody>
</table>
INTEGRATION IN CHP3 PROJECT

RECOVERY OF 264 KW OF WASTE HEAT
A FIRST STEP TOWARDS A GREENER DH

- The Heat Pump gives a green and innovative twist to the CHP3 project
- But it is more than that
- CHP is a bridging technology towards a greener District Heating
- Heat pumps can make the DH nearly totally green when waste heat and green electricity are used
- This first HP of 400kW will help us to demonstrate the technology and increase our experience for the installation and operations of bigger Heat Pumps in the future
HEAT PUMP FUTURE APPLICATION FOR DH

- **Demonstration of Technology in 2019**
  - Demo case Ham will be running
  - Proof of concept for reuse of waste heat
  - Proof of concept of High Temperature DH

- **What is missing for an economical Business Plan is the governmental support mechanism**
  - Green heat certification
  - No grid cost allocation if green electricity is allocated to drive heat pumps for DH production

- **Lobbying needed!**
Thank you for your kind attention.