Near future challenges for R&D in the District heating and Cooling sector

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AGFW - Who we are

» AGFW is the independent and impartial association promoting energy efficiency, (district) heating, cooling and CHP at national and international levels

» AGFW reunites round about 500 (regional und municipal) district energy suppliers and industrial operators of this industry in Germany and Europe

» AGFW represents over 95 % of the heat load connected to German district heating systems – the largest scale in Western Europe (The district heating connected load in Germany is approximately 57.000 MWth).

» AGFW means over 40 years of experience in this field
CHP-unit Berlin Mitte

» Elektric performance: 460 MW
» Thermal performance: 670 MW
» Primary energy efficiency: 90%

Cogeneration copes with mutual dependency on the electricity and the heat market.

» **Memberstates have to achieve targets for energy saving.** The EED requires annual energy savings of 1.5% of the total distributed energy in the EU-member states in the period of the first of January 2014 until 31st of December 2020. According to this legislation energy shall not be wasted and efficient technologies must be supported.

» **This target may be reached partially by primary energy savings** e.g. using district heating

» The member states have to analyse their heat market

» The potential for high efficient chp and DH must be evaluated by the member states.

» Measures to use this potential have to be taken.

» ...
**ENERGY TURNAROUND in Germany**

**Political targets in Germany (energy conception)**

<table>
<thead>
<tr>
<th>Target</th>
<th>Today</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut in greenhouse gas emissions (against 1990)</td>
<td>-27 %</td>
<td>-40 %</td>
<td>-55 %</td>
<td>-70 %</td>
<td>-80 %</td>
</tr>
<tr>
<td>Proportion of renewable energy in gross final energy consumption</td>
<td>10 %</td>
<td>18 %</td>
<td>30 %</td>
<td>45 %</td>
<td>60 %</td>
</tr>
<tr>
<td>Share of renewables in electricity consumption</td>
<td>16 %</td>
<td>35 %</td>
<td>50 %</td>
<td>65 %</td>
<td>80 %</td>
</tr>
<tr>
<td>Cut in primary energy consumption (against 2008)</td>
<td>-6 %</td>
<td>-20 %</td>
<td></td>
<td>-50 %</td>
<td></td>
</tr>
<tr>
<td>Cut in electricity consumption (against 2008)</td>
<td>-7 %</td>
<td>-10 %</td>
<td></td>
<td>-25 %</td>
<td></td>
</tr>
<tr>
<td>Cut in energy consumption in transport sector (against 2008)</td>
<td>-10 %</td>
<td></td>
<td></td>
<td></td>
<td>-40 %</td>
</tr>
</tbody>
</table>

*source: BMWi*
Vision: Hybrid ring-storages?

Reality: Primary energy consumption in the EU 2010.

- Transport: 31%
- Heat: 49%
- Electricity: 20%

455 Million customers

Heat distribution is a major key for the energy turnaround!

Source: Popp
- 55% of the German primary energy consumption is covered by oil and gas
- 9.4% RE (1320 PJ) bzw. 370 TWh primary energy consumption

Increased exploitation of the renewable energy resources is necessary!
Expansion of renewable energies

The installed capacity of RE in Germany must increase rapidly

Expansion of RE according to the German pilot study 2010 in GW

- Geothermics
- Import RE
- Biomass
- Wind energy offshore
- Wind energy onshore
- Photovoltaics
- Hydropower

Source: Prognos
CHALLENGES FOR THE ELECTRICITY GRID

Target: 80% renewable electricity generation by 2050

Balancing power from +35GW to -24GW is necessary (peak load management) (Storages) (import of renewable electricity) (customer behaviour)

Grid expansion is necessary for transmission and distribution

Smart market and smart grid shall be started up.

Source: Prof. Rehtanz, Technical University Dortmund, 2013
CHALLENGES FOR THE ELECTRICITY GRID

Estimated costs for grid expansion:

- Transmission grid: 20 Billion EUR
- Distribution grid: 27-42 Billion EUR

Optimisation of grid engineering is necessary.

Source: Prof. Rehtanz, Technical University Dortmund, 2013
The renewable energy feed-in reaches up to 40 GW for a few hours a year.
» 60 GW are reached on a regular basis
» In hours with high wind and solar feed-in the peak reaches up to 70 GW
Except for the winter time renewable feed-in has peaks around 70 GW to 90 GW.
CHALLENGES FOR THE ELECTRICITY GRID

» Overcome challenges of high investments for grid expansion.
» Stable and save operation.
» Security of supply.
» Electricity storage.
» Interaction with different technologies, markets and solutions.

Remember: High efficient cogeneration copes with mutual dependency on the electricity and the heat market.
Barriers for accelerated development of DHC and CHP

» Market situation for CHP installations is deteriorating
» The base load is slowly deteriorating
» Installations reach lower full load hours
» Higher flexibility (at higher costs) is necessary

Base load disappears (residual load 2030 in GW)

CHP installations are pushed out of the market because of Merit Order in Germany
... in comparison to the electric grid – every production facility is systemic.
The district heating connected load in Germany is approximately 57,000 MWth.

13% CHP share in electricity production

The district heating customers are: 46% private homes, 36% public buildings, commercial and trade sector and 18% industry.

The total length of the district heating grid in Germany is approximately 100,000 km.

Over 84% of District Heating is generated in high efficient cogeneration (CHP) plants.
District heating market share / target by the German government 25%

- Gas: 48%
- Oil: 32%
- Electricity: 4%
- Coal: 2%
- Others: 1%

Target expansion of the district heating market share to 25 - 40%
Potential for DH by 2050 is high. It can only be used by network expansion.
OPPORTUNITIES FOR DISTRICT HEATING

District heating production including storage and electric boiler

Low proportion pv and/or wind

Diagram showing heat production and storage systems, including CHP plant, heat storage, and electric boiler.
OPPORTUNITIES FOR DISTRICT HEATING

District heating production including storage and electric boiler

Medium proportion pv and/or wind
OPPORTUNITIES FOR DISTRICT HEATING

District heating production including accumulator and electric boiler

High proportion pv and/or wind (renewable)
Flexibility Potential of Public CHP Plants

» Load and production management potential of CHP with thermal storage is very high

» A potential of 3.6 GW positive and 6.7 GW negative balancing power can be provided

» With auxiliary electric heating systems an additional potential of 11.7 GW renewable energy can be utilized

» The necessary total investment cost for heat storage facilities in public district heating ranges from 1.4 to 2.2 billion Euro

» The comparison with alternative options for integrating renewable energies shows significant advantages for thermal storage systems
OPPORTUNITIES FOR DISTRICT HEATING

Source: AGFW/Solites
Hot water-storage
(60 - 80 kWh/m³)

Geothermal heat storage
(15 bis 30 kWh/m³)

Pit storage
(60 - 80 kWh/m³)

Aquifer-heat storage
(30 - 40 kWh/m³)

Quelle: AGFW/Solites
Integration of Renewable heat sources

» Biomass in CHP unit.

» Geothermal sources.

» Solarthermal sources.
OPPORTUNITIES FOR DISTRICT HEATING

COOLING

1. Free Cooling = ambient Cooling
2. Absorption Chillers = absorption from liquids
3. Adsorption Chillers = adsorption to solids
4. Compression Chillers = conventional cooling

Waste, Biomass

CHP plant

Electricity

District heating

River, Sea, Lake

Building with space cooling

District Cooling distribution system

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District Cooling in Europe - capacity

- Green bars represent District Cooling capacity 2009.
- Brown bars represent District Cooling capacity 2005 (if not available 2007).

Source: Euroheat&Power
CHALLENGES FOR CHP AND DH

» Make use of the great potential.
» Cost efficient network expansion.
» Combining different RE heat sources.
» Combining different technologies.
» Heat storage and flexibility.
» Expansion of the cooling grid.
MULTI TECHNOLOGICAL SOLUTIONS
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Many thanks for your attention!