TS3 Webinar on “Hybrid Energy Networks”

Integrating district heating and cooling networks with the electricity and gas grid
Tuesday, 27th April 2021, 9:00 to 17:00 (CET)
A side event of the Mission Innovation Austria Online Conference
https://missioninnovationaustriaweek.at/
Contact: Ralf-Roman Schmidt (AIT); ralf-roman.schmidt@ait.ac.at

This Webinar is held in the framework of the international cooperation program IEA DHC Annex TS3 „Hybrid Energy Networks“. More information at http://www.iea-dhc.org/the-research/annexes/2017-2020-annex-ts3-draft.html. The Austrian participation in the IEA DHC Annex TS3 is financed by the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK).
TS3 Webinar on “Hybrid Energy Networks”

Block III: country-based constraints and synergies on a national level

This Webinar is held in the framework of the international cooperation program IEA DHC Annex TS3 „Hybrid Energy Networks“. More information at http://www.iea-dhc.org/the-research/annexes/2017-2020-annex-ts3-draft.html. The Austrian participation in the IEA DHC Annex TS3 is financed by the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK).
Webinar Etiquette

- The **microphone should be muted** by default
- Requests to speak are reported via the **hand symbol**
- Please **state your name** and institution before you speak
- Please **turn off your webcam**! The camera can be used at short notice for spoken contributions.
- We will make a “**group-photo**” at the end of each block
IEA DHC Annex TS3: Hybrid Energy Networks

• **Aim:** To promote the opportunities and to overcome the challenges for district heating and cooling networks in an integrated energy system context

• **Funded** through a task-sharing approach (the participants contribute resources in-kind for connecting existing national and international projects)

• **Lead:** Ralf-Roman Schmidt (AIT); ralf-roman.schmidt@ait.ac.at

• **Runtime:** Fall 2017 – March 2022

• **Expected results:** An assessment of suitable technologies and concepts; country reports; collection and assessment of international case studies; a review of existing methods and tools; best practice guidelines; a final guidebook

• **More information** at [https://www.iea-dhc.org/the-research/annexes/2017-2021-annex-ts3-draft](https://www.iea-dhc.org/the-research/annexes/2017-2021-annex-ts3-draft)
## Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:15 – 11:00 CET</td>
<td><strong>Block I</strong> – Integrated district heating and cooling networks: introduction and best practices</td>
</tr>
<tr>
<td>11:15 – 12:45 CET</td>
<td><strong>Block II</strong> – Barriers, trends and solutions for the creation of an integrated energy market</td>
</tr>
<tr>
<td>13:30 – 15:00 CET</td>
<td><strong>Block III</strong> – country-based constraints and synergies on a national level</td>
</tr>
<tr>
<td>15:30 – 17:00 CET</td>
<td><strong>Block IV</strong> – handling the complexity: Advanced tools and methods for planning and operation</td>
</tr>
</tbody>
</table>
## Agenda Block III - country-based constraints and synergies on a national level

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:15</td>
<td>Testing of technical connections</td>
</tr>
<tr>
<td>13:30</td>
<td>Welcome and introduction into the webinar (Ralf-Roman Schmidt, AIT)</td>
</tr>
</tbody>
</table>

**Overview of concepts and technologies** for hybrid energy networks (Peter Sorknæs, Aalborg University)

**Discussion of country-based constraints and synergies** in parallel groups – main language will be English, but some discussion in the native language are possible
- **Austria** (hosted by Ralf-Roman Schmidt, AIT) including presentations on the flexibility demand of the Austria electricity system (Demet Suna, AIT) and the evaluation of efficient heat supply options for Austria (Lukas Kranzl, TU Wien)
- **Denmark** (hosted by Peter Sorknæs, Aalborg University)
- **Germany** (hosted by Dennis Cronbach, Fraunhofer IEE)
- **Sweden** (hosted by Inger-Lise Svensson, RISE)
- **United Kingdom** (hosted by Anton Ianakiev NTU)
- **European and international rooms** (no moderation)

**Summary** of country-based discussion (each group moderator)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:00</td>
<td>End of Block III</td>
</tr>
</tbody>
</table>
Overview of concepts and technologies for hybrid energy networks
(Peter Sorknæs, Aalborg University)
OVERVIEW OF CONCEPTS AND TECHNOLOGIES FOR HYBRID ENERGY NETWORKS

PETER SORKNÆS
Principle scheme of a possible hybrid energy network
Networks

- Electricity
- Gas
- Heating and Cooling
Combined heat and power (CHP) and gas-fired power stations

• CHP interconnects the electricity and heating networks
• When gas is used, also connects to the gas network

• Gas-fired power plants connect the gas and electricity networks
Boilers

Gas boilers

- Allows for connection from gas networks to heating networks

Electric boilers

- Allows for connection from electricity to heating networks.
- High flexibility in operation allows for participation in (most) electricity system balancing
Heat pumps (electric and gas)

• Can be operated using e.g. electricity or gas  
  • Studies favor electricity for renewable energy systems
• Allow for the utilization of low temperature heat sources in heating networks.
• Energy efficient conversion from power to heat (COP).
• Heat pumps can also be used for interconnecting district heating and district cooling networks.

For more on heat pumps follow IEA HPT Annex 57 (https://heatpumpingtechnologies.org/annex57/)
Electrolysis

- Allows for connection of electricity and gas networks. Either:
  - Directly, in case of possibility for direct $\text{H}_2$ injection into a grid, or
  - Indirectly where electrolysis is used as part of a process to produce gaseous products (electrofuels).

- Potential excess heat from the production of $\text{H}_2$ and/or electrofuels can be used for heating networks.
Examples of electrofuel pathways

Energy storages

- Allows for flexible operation of technologies. E.g.:
  - Heat and cold storages
  - Gas storages
  - H\textsubscript{2} storages
- Power-to-power storages with potential HEN capability
  - Compressed air energy storage (CAES)
  - Carnot batteries

Indirect connections between the networks

- Gas use in industries with excess heat to heating networks
- Electrified industries with excess heat to heating networks
  - Can also be industries with cooling demands, e.g. datacenters and supermarkets.
- Electrofuel production for liquid fuels can also be an indirect connection between electricity and heating networks
Smart grids

- **Smart Electricity Grids**
  Connecting flexible electricity demands, heat pumps and EV to the intermittent renewable resources such as wind and solar power.

- **Smart Thermal Grids** (District Heating and Cooling)
  Connecting the electricity and heating sectors, thermal storage to be utilised for creating additional flexibility and heat losses in the energy system to be recycled.

- **Smart Gas Grids**
  Connecting the electricity, heating, and transport sectors, enabling gas storage to be utilised for creating additional flexibility. If the gas is refined to a liquid fuel, then liquid fuel storages can also be utilised.

For more on Smart Energy Systems:
http://www.energyplan.eu/smartenergysystems/
Heat Roadmap Europe 4 – District heating

Purpose of Heat Roadmap Europe 4:
• Creating scientific evidence to support long-term energy strategies at local, national, and EU level for the transition to a low-carbon energy system
• Quantifying the impact of various alternatives for addressing the heating and cooling sectors
• 14 countries with largest heating demands in EU

Some results related to DHC:
• Use electrification of key sectors
  • Heat pumps and chillers are key!
• Use flexibility and synergies to enable further decarbonisation
  • Better use of variable RES
  • Better use of grid capacity
  • Avoid peak capacity
• CHPs operate to the electricity markets and ‘pair’ with large heat pumps

District heating source shares in HRE 2050

- CHP plants: 38%
- Geothermal: 4%
- Heat pumps: 25%
- Solar thermal: 9%
- Industrial excess: 4%
- Electric boilers: 2%
- Fuel boilers: 1%
- Waste incineration: 2%
- Fuel production heat recovery: 14%
Danish energy system in 2020 (simulated)
"IDAs Klimasvar" – Reduction of the Danish energy sector’s CO₂-emissions in 2030 by ~80% compared with 1990-levels

https://vbn.aau.dk/da/publications/idas-klimasvar-transport-og-energi%C3%B8sninger-2030
"IDAs Klimasvar 2045" – 100% renewable energy in Denmark in 2045 (DRAFT)
Potential national constraints and synergies as inspiration for discussions

• Network availability
  • Are the different networks widely available locally in the country?

• Economic incentives
  • Do tax and tariff structures allow or limit the interconnection of the networks?

• Rules and legislation
  • Do rules and legislations limit the possibility for usage of hybrid energy networks?

• Organizational
  • Are there organizations/actors that can make the investments and operate the units?

• Awareness about the technologies and possibilities?
country-based discussion in Wonder.me

As soon as you are in a circle, you can discuss with the others in the same circle.

Your “avatar” can move freely to the different rooms (use your mouse).

Two or more people will build a circle.

INTERATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON DISTRICT HEATING AND COOLING INCLUDING COMBINED HEAT AND POWER
country-based discussion in Wonder.me

- Austria
- Denmark
- Germany
- Sweden
- United Kingdom
country-based discussion in Wonder.me

- Wonder is optimized for Google Chrome and Edge
- Make sure your browser is allowed to access your camera and microphone
- Make sure Wonder is the only conference/communication tool you have open (Zoom, Microsoft teams, …)
- Make sure no other applications or websites are making use of your camera or microphone

https://www.wonder.me/r?id=ca563bf3-e107-45c5-8ea3-1e120600cfe6

- For any problems, go to https://help.wonder.me/en/
country-based discussion in Wonder.me
Summary of country-based

- Austria
- Denmark
- Germany
- Sweden
- United Kingdom
- European and international rooms
- Any other comments?
note on other events

http://dhc2021.uk/

https://www.nefi.at/new-energy-for-industry-2021/

https://missioninnovationaustriaweek.at/events/industry-dhc-symbiosis-a-systemic-approach-for-highly-integrated-industrial-and-thermal-energy-systems/
Thanks for your active participation!

- The slides will be available at [http://www.iea-dhc.org/the-research/annexes/2017-2020-annex-ts3-draft.html](http://www.iea-dhc.org/the-research/annexes/2017-2020-annex-ts3-draft.html)
- Contact: Ralf-Roman Schmidt (AIT); [ralf-roman.schmidt@ait.ac.at](mailto:ralf-roman.schmidt@ait.ac.at)