District Heating and Cooling Networks in an Integrated Energy System Context – approaches within the IEA DHC Annex TS3

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The IEA technology cooperation program (TCP) on district heating and cooling (DHC)

• a platform for international experts
  – dedicated to helping to make DHC and CHP powerful tools for energy conservation and the reduction of environmental impacts of supplying heat
  – Current members: Austria, Canada, China, Denmark, Finland, France, Germany, Korea, Norway, Sweden, United Kingdom, United States of America.

• The projects within the IEA DHC TCP are either
  – Funded through a cost-sharing approach (by the member states), e.g. MEMPHIS
  – Funded through a task-sharing approach (the participants contribute resources in-kind for connecting existing national and international projects), e.g. Annex TS3

• More information: http://www.iea-dhc.org/home.html
IEA DHC Annex TS3: Hybrid Energy Networks - Background

• The integration of the electricity/gas grids and heating/cooling networks is considered as one of the key measures for decarbonizing the energy system (aka “sector coupling”). This

  – triggers important synergies, that couldn’t be realised by optimizing the sectors individually.

  – is connected to several challenges, such as an increasing competition between the energy domains and a higher complexity.
Aim

- to **promote the opportunities** and to **overcome the challenges** for district heating and cooling networks in an integrated energy system context.
  - provides a **holistic approach** for assessing, planning and operating hybrid energy networks,
  - considers both **technical** (system configuration, operational strategy) and **strategic** aspects (business model, regulatory frame).
Expected results

• The primary result: a **guidebook** highlighting the relevant results of the different subtasks
  – application areas and synergy potentials,
  – Comparison of international case studies,
  – methodological approaches and tools,
  – Recommended business models, market design and regulations

• The Annex TS3 offers an **unique opportunity** for
  – networking between experts from academia and industry,
  – dedicated **know-how exchange** at industry workshops and
  – special sessions at key conferences as well as an
  – intensive **cooperation** with the International Smart Grids Action Network (and others)
Schedule and status

• **Definition workshop**, 21.09.2017 bmvit (Vienna/Austria) with 28 participants

• **1st preparation workshop**, 25/26.04.2017 RISE (Gothenburg/ Sweden) with 26 participants

• **2nd preparation workshop**, 10/11.10.2018; GEIRI (Berlin/ Germany) with 29 participants

• → Start of the working phase beginning of 2019
  • **1st working phase WS**: spring 2019 (tbd)

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<thead>
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<th>2017</th>
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cooperation with other initiatives

- **International Smart Grid Action Network (IEA ISGAN)**
  - Official cooperation with Joni Rossi (RISE, OA of Annex 6) on
    - regular bilateral **communication**;
    - **shared networking activities** (e.g. common workshops, participation in conferences) and the
    - development of **fact sheets for policy makers**

- **Energy in Buildings and Communities (IEA EBC)**
  - Possible cooperation with a new Annex initiative from Canada, details tbd

- **Energy Conservation through Energy Storage (IEA ECES)**
  - Possible cooperation with the new Annex initiative "Flexible Sector Coupling" – details tbd
Structure

Subtask A: Assessment of the **technologies** and **synergy** potentials

Subtask B: **Tools and methodologies** to assess, plan, design and operate hybrid energy networks

Subtask C: analysis and comparison of different **case studies**

Subtask D: recommendations for a suitable **framework** (business models, legal aspects, policy instruments)

Subtask E: **Dissemination** and Guidelines
Structure

Subtask A: Assessment of the technologies and synergy potentials

Subtask B: Tools and methodologies to assess, plan, design and operate hybrid energy networks

Subtask C: Analysis and comparison of different case studies

Subtask D: Recommendations for a suitable framework (business models, legal aspects, policy instruments)

Subtask E: Dissemination and Guidelines
**Example Subtask A: Identifying the Potential of Decentralised Energy Storages for Integrating Fluctuating Sources**

**Results: suggested energy system redesign measures**
- DH → inexpensive storages
- Electric vehicles with smart charging → cost-effective distributed electrical storage.
- Electrical interconnections to island systems (where possible)

**Recommendations for distributed energy storage and conversion**
- Flexible sector coupling
- Individual heat pumps
- Flexible electricity demand
- Thermal energy storage
- Reduction of electrical energy storage investment costs is very important!

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**Energy system configurations**

<table>
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<tr>
<th>Energy system configurations</th>
<th>Baseline system, based on Germany</th>
<th>Island mode</th>
<th>More district heating</th>
<th>More electric vehicles</th>
<th>More nuclear power</th>
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<tr>
<td>Alternative methods of balancing supply &amp; demand</td>
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<td>Energy conversion technologies</td>
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<td>Distributed electrical energy storage</td>
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<td>Distributed thermal energy storage</td>
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<td>Combinations of multiple technologies</td>
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63 scenarios in total.

Simulation using EnergyPLAN

Dadi Sveinbjörnsson, results from IEA ECES Annex 28
Example Subtask B: assessment of modeling and optimization tools for integrated energy systems

Multi-domain modeling languages
- closed representation of the overall system with the help of one consistent language
- simulation of the system is done using a dedicated simulation tool

Simulation coupling (co-simulation)
- modeling of subsystems with the help of domain-specific languages and tools
- dynamic coupling (data exchange) of the individual tools at runtime
- e.g., Pitch pRTI (HLA), FUMOLA, mosaik, …
Example Subtask C: Johanneberg Science Park and the FED Project (Fossil-free Energy Districts)

- FED develops a local marketplace for electricity, heating and cooling.
- FED uses energy efficiently and avoids fossil fuel peaks on the grid.
- FED optimizes use of energy storage

www.johannebergsciencepark.com/fed
Example Subtask D: Market and regulation barriers for sector coupling in Germany

- DSOs are not always allowed to invest in sector coupling. Service / contracting models?
- Taxes / tariffs are charged when different actors interact. Autonomy / policy changes?
- Regulations and documentation form a hurdle for small energy producers. Bundling into communities?
- Changes in subsidies and policies can make or break business models. Focus on flexibility and robustness?
- Multi-energy networks operate in a highly heterogeneous field of markets and regulations.
How do you get involved?

- The project is open to new participants during its whole runtime, however, an early involvement enables a deep interaction with the other participants.
  - To join the project participants need to bring completed, ongoing or upcoming projects that address hybrid energy networks with a focus on DHC in the participants own country.
  - Furthermore resources for processing the project results (e.g. translation) and participating in the workshops as well as special secessions are required.
Thank you for your attention!

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