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

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Andrej David[2], Jay Hennessy[7], Anton Ianakiev[6], Tanja Kneiske[5], Ingo Leusbrock[3], Daniel Muschick[4], Dietrich Schmidt[5], Ralf-Roman Schmidt[1], Olatz Terreros[1], Edmund Widl[1]

[1]AIT Austrian Institute of Technology GmbH, 1210 Vienna, Austria
[2]Aalborg University, 2450 Copenhagen, Denmark
[3]AEE - Institut für Nachhaltige Technologien, 8200 Gleisdorf, Austria
[4]BIOENERGY 2020+ GmbH, 8010 Graz, Austria
[5]Fraunhofer-Institut für Energiewirtschaft und Energiesystemtechnik IEE, 34119 Kassel, Germany
[6]NTU Nottingham Trent University, Nottingham, NG1 4FQ, UK
[7]RISE Research Institutes of Sweden, 114 27 Stockholm, Sweden

Fraunhofer IEE

4DH 4th Generation District Heating Technologies and Systems

AALBORG UNIVERSITY DENMARK

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IEA DHC|CHP

INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON
District Heating and Cooling including Combined Heat and Power

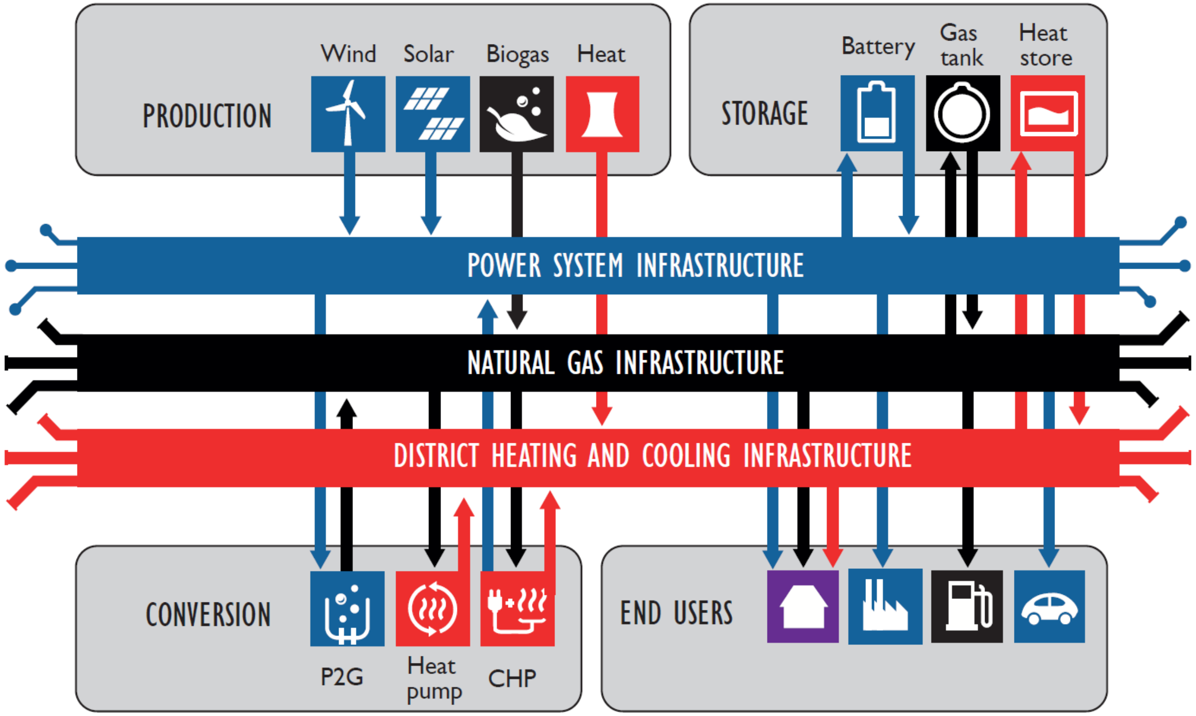
iea Energy Technology Network

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

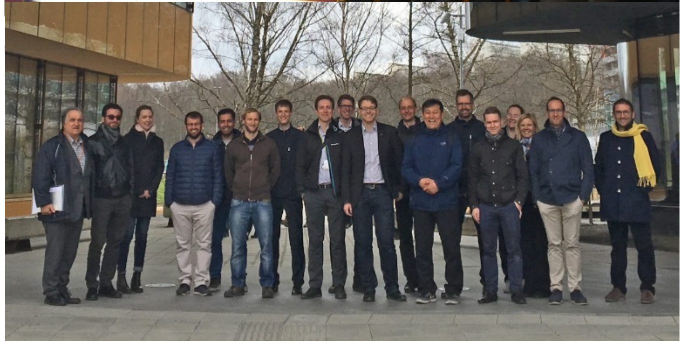
- The primary result: a **guidebook** highlighting the relevant results of the different subtasks
  - application areas and synergy potentials,
  - Comparison of international case studies,
  - methodological approaches and tools,
  - Recommended business models, market design and regulations

- 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)**

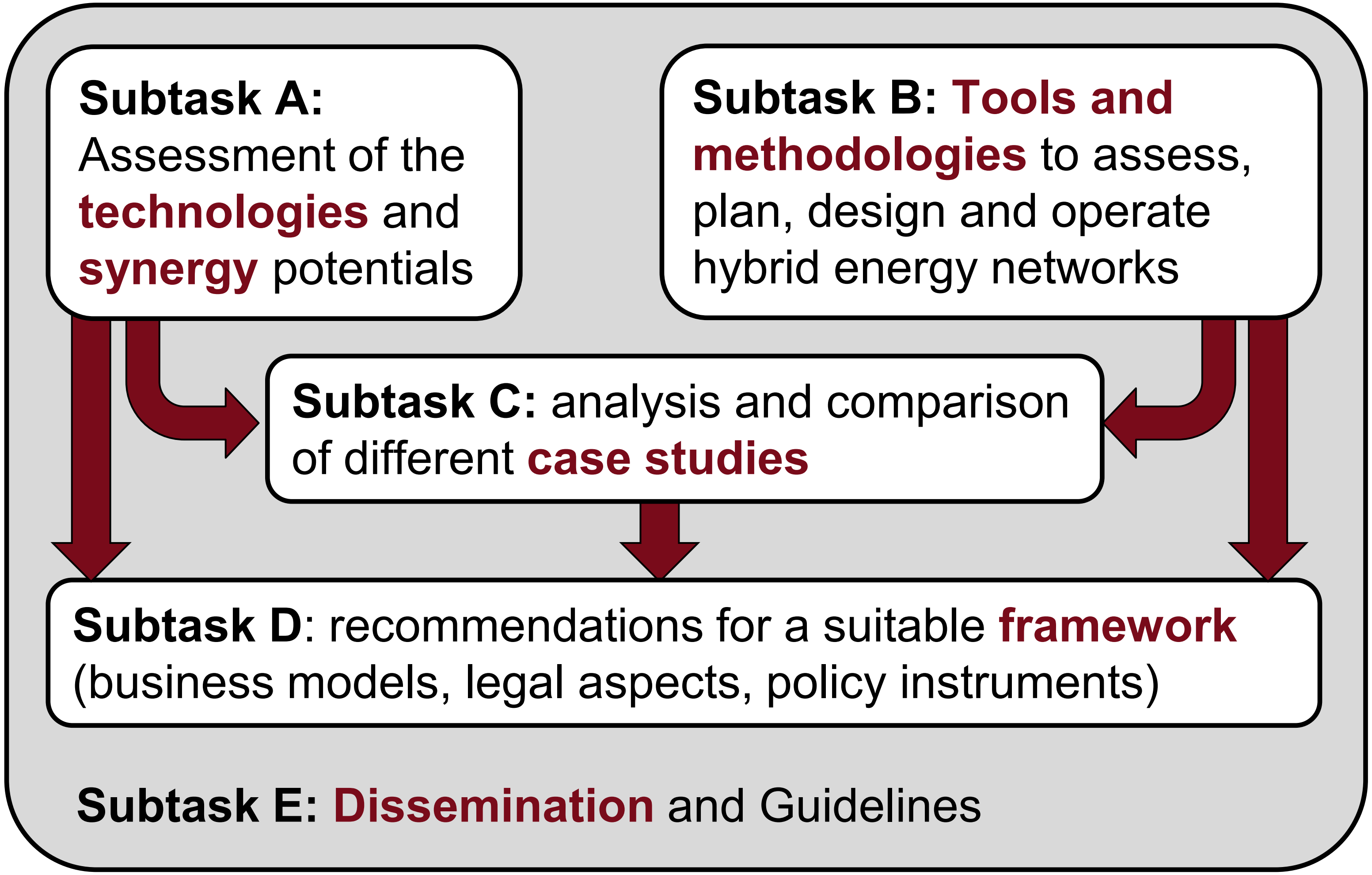
2017		2018		2019		2020		2021		22
	x	x	x	X	X	X	X	X	X	X
Definition		Preparation		Working Phase						Rep.



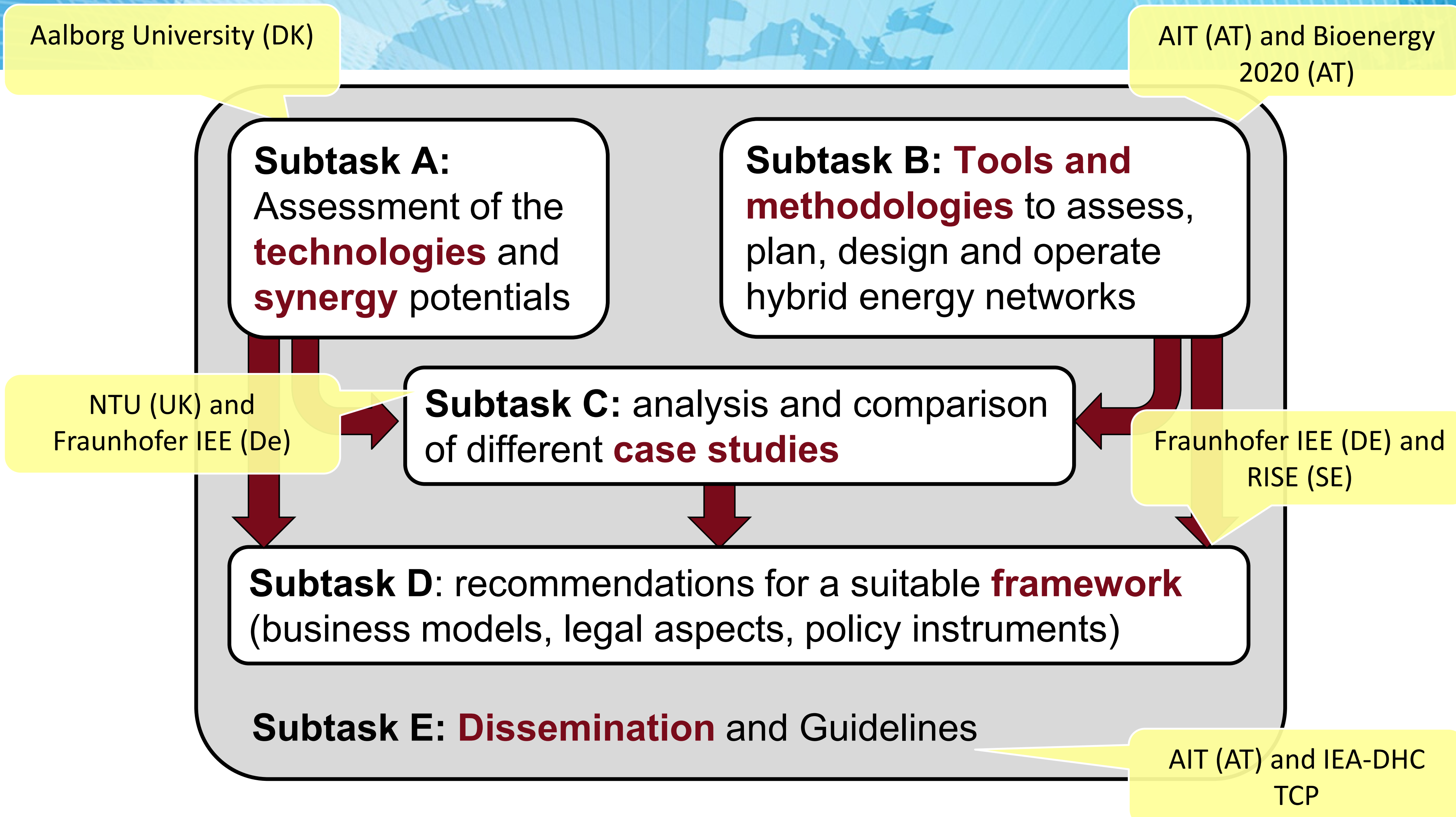
cooperation with other initiatives

- **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

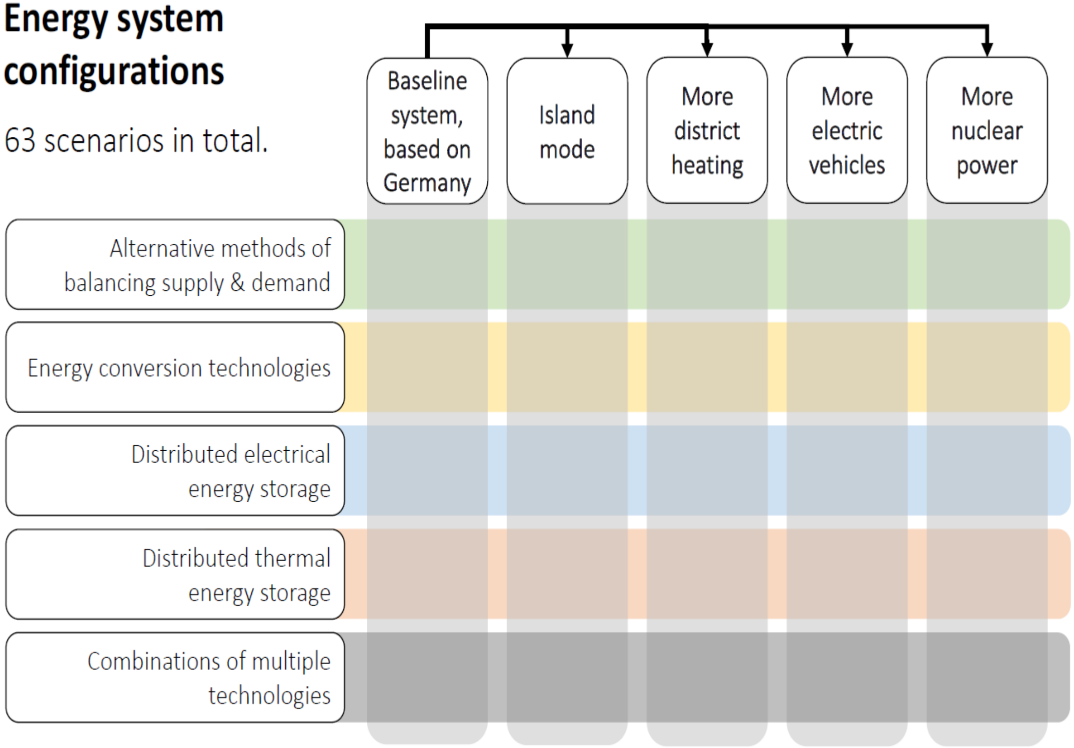
Structure


Aalborg University (DK)
AIT (AT) and Bioenergy 2020 (AT)
Subtask A: Assessment of the technologies and synergy potentials
Subtask B: Tools and methodologies to assess, plan, design and operate hybrid energy networks
NTU (UK) and Fraunhofer IEE (De)
Subtask C: analysis and comparison of different case studies
Fraunhofer IEE (DE) and RISE (SE)
Subtask D: recommendations for a suitable framework (business models, legal aspects, policy instruments)
Subtask E: Dissemination and Guidelines
AIT (AT) and IEA-DHC TCP

Example Subtask A: Identifying the Potential of Decentralised Energy Storages for Integrating Fluctuating Sources

Energy system configurations

63 scenarios in total.



→ Simulation using EnergyPLAN

Dadi Sveinbjörnsson, results from IEA ECES Annex 28

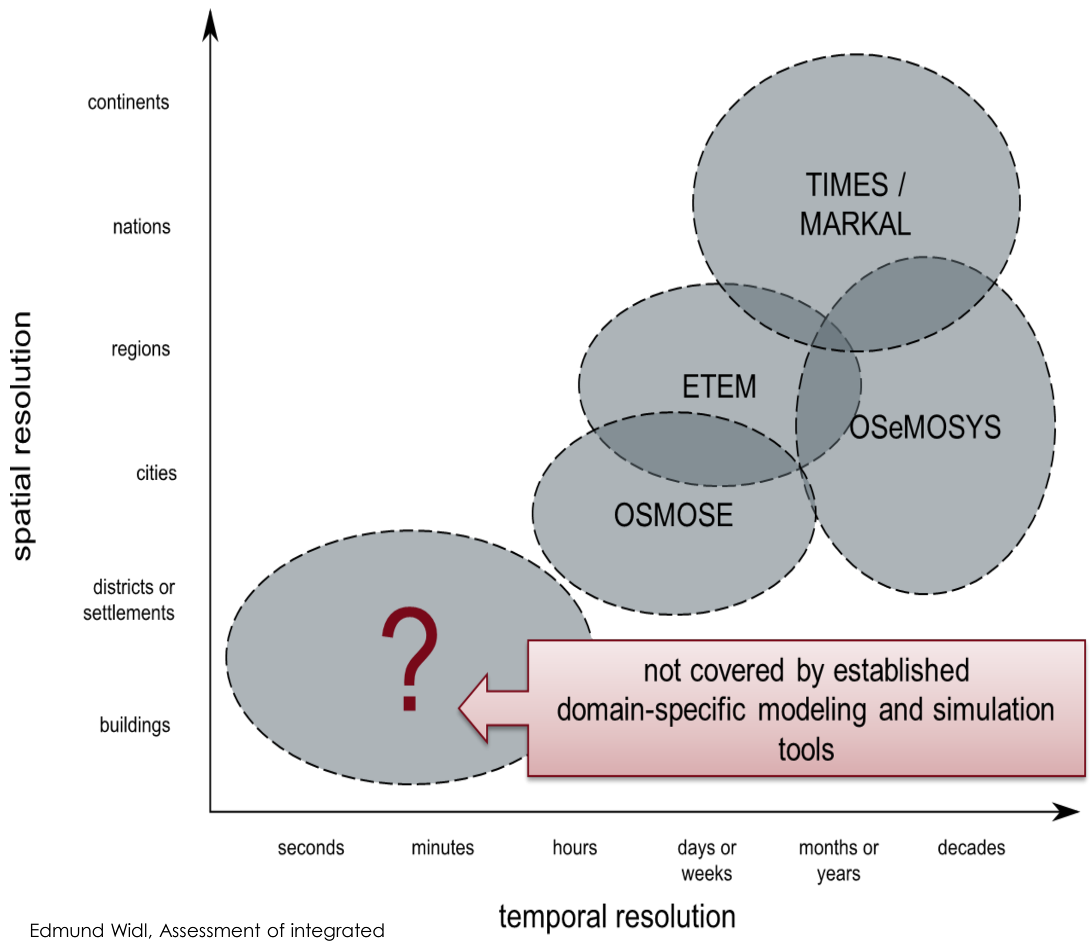
Results: suggested energy system redesign measures

- 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!

Example Subtask B: assessment of modeling and optimization tools for integrated energy systems



Edmund Widl, Assessment of integrated MULTI-Carrier distribution networks

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)

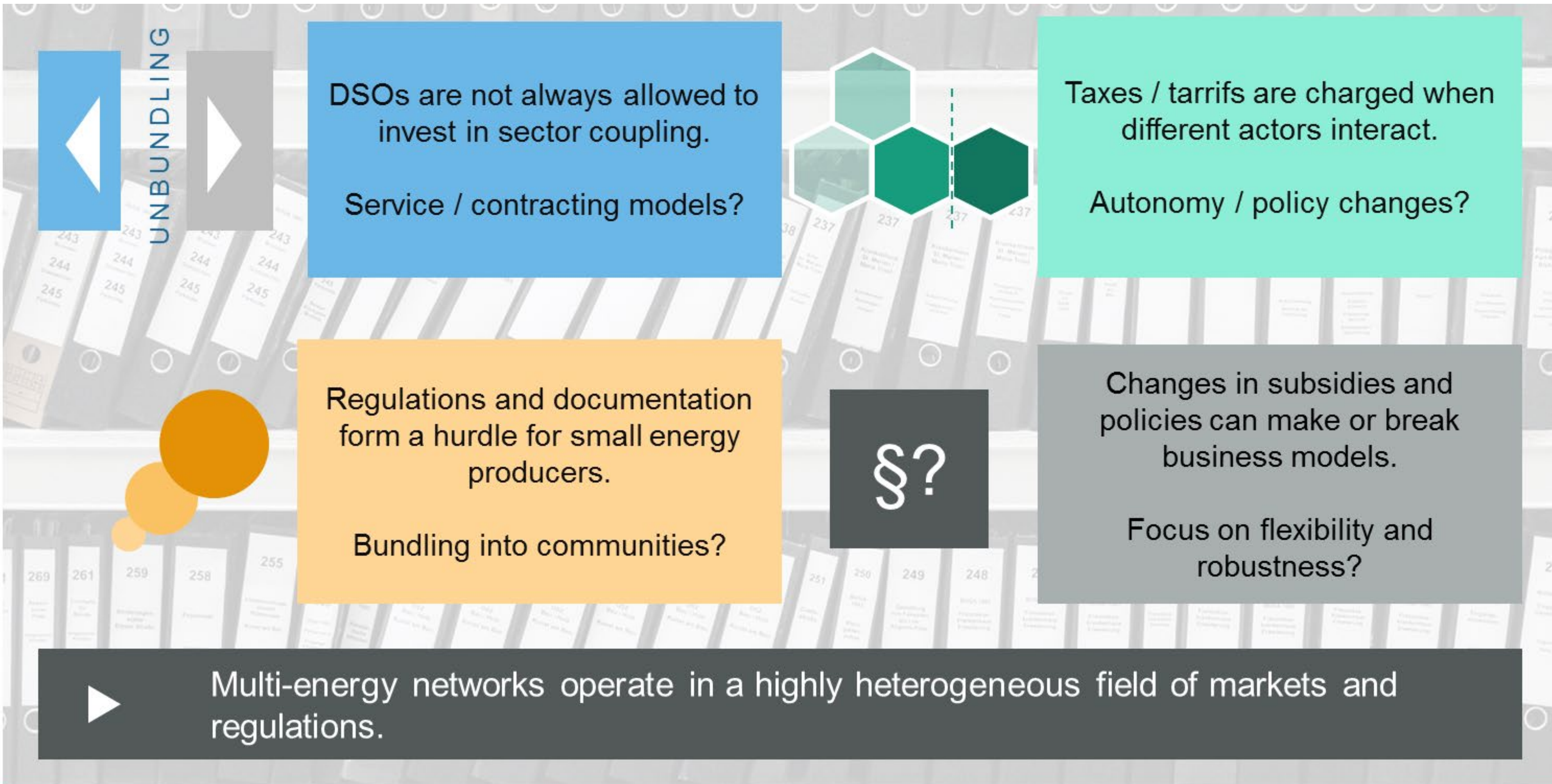
- modeling of subsystems with the help of domain-specific languages and tools
- dynamic coupling (data exchange) of the individual tools at runtime
- e.g., Pitch pRTI (HLA), FUMOLA, mosaik, …

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



Christian Spalthoff, Fraunhofer IEE, Economic aspects of energy grid interaction

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!

Contact:

Ralf-Roman Schmidt (Operating Agent)

AIT Austrian Institute of Technology GmbH

M +43(0) 664 235 19 01, e-mail: Ralf-Roman.Schmidt@ait.ac.at

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