Technology Collaboration Programme
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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)

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

IEA Research Cooperation
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TS3 Webinar on “Hybrid Energy Networks”

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

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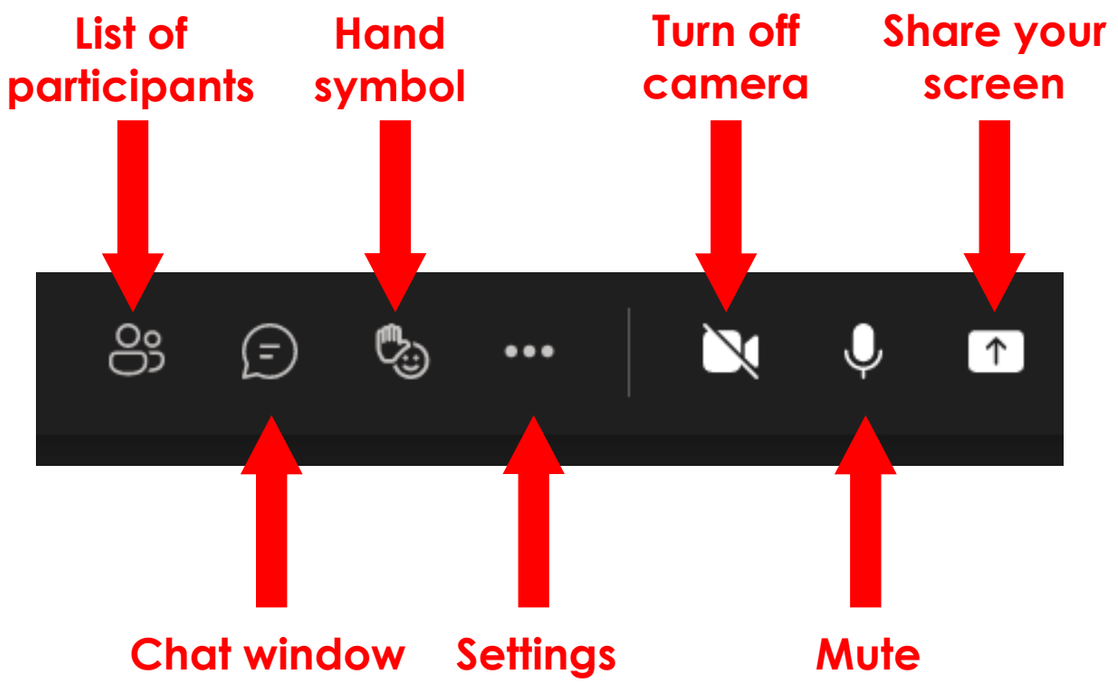
Webinar Etiquette

- 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

Agenda

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

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

13:15	***Testing of technical connections***
13:30	Welcome and introduction into the webinar (Ralf-Roman Schmidt, AIT)
	Overview of concepts and technologies for hybrid energy networks (Peter Sorknæs, Aalborg University)
	Discussion of country-based constraints and synergies in <u>parallel</u> 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)
15:00	***End of Block III***

Overview of concepts and technologies for hybrid energy networks

(Peter Sorknæs, Aalborg University)

OVERVIEW OF CONCEPTS AND TECHNOLOGIES FOR HYBRID ENERGY NETWORKS

PETER SORKNÆS

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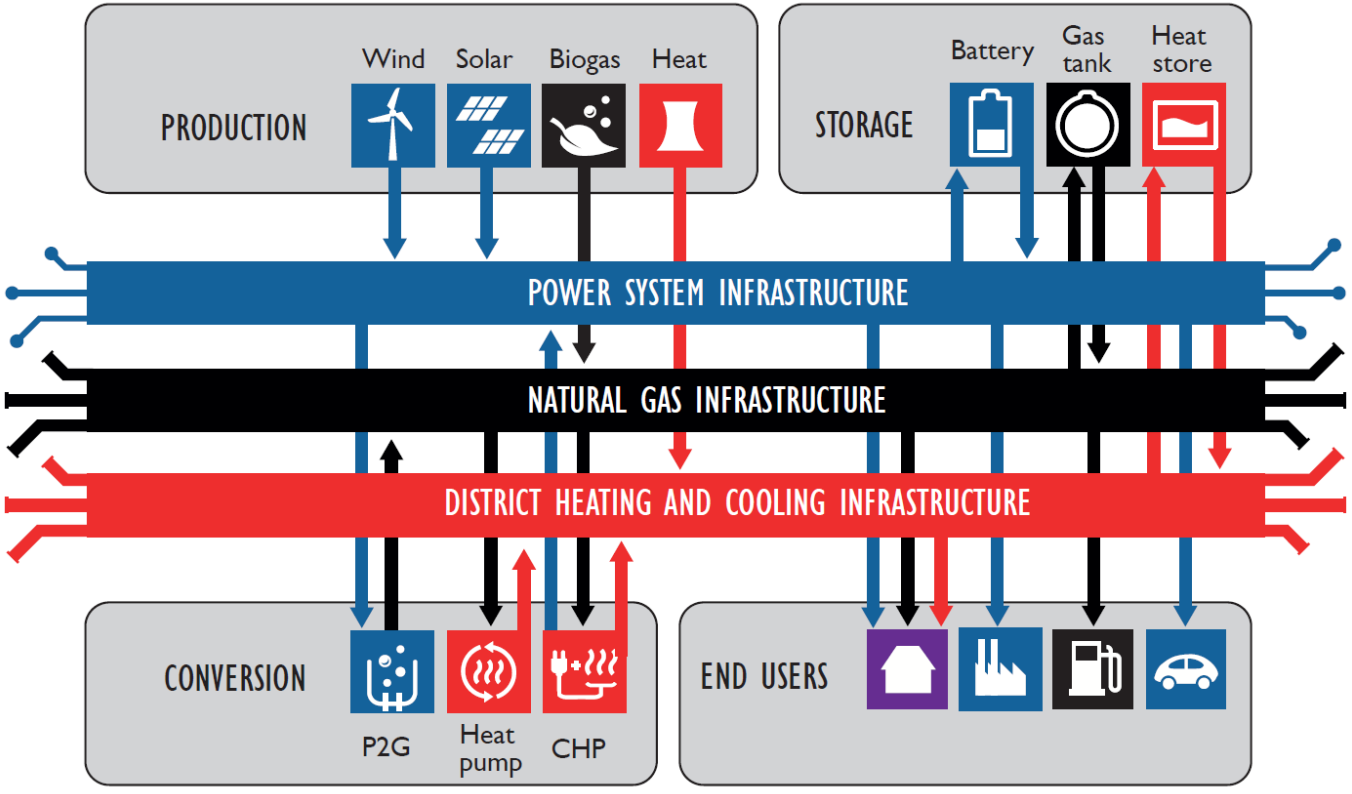
DENMARK

Principle scheme of a possible hybrid energy network



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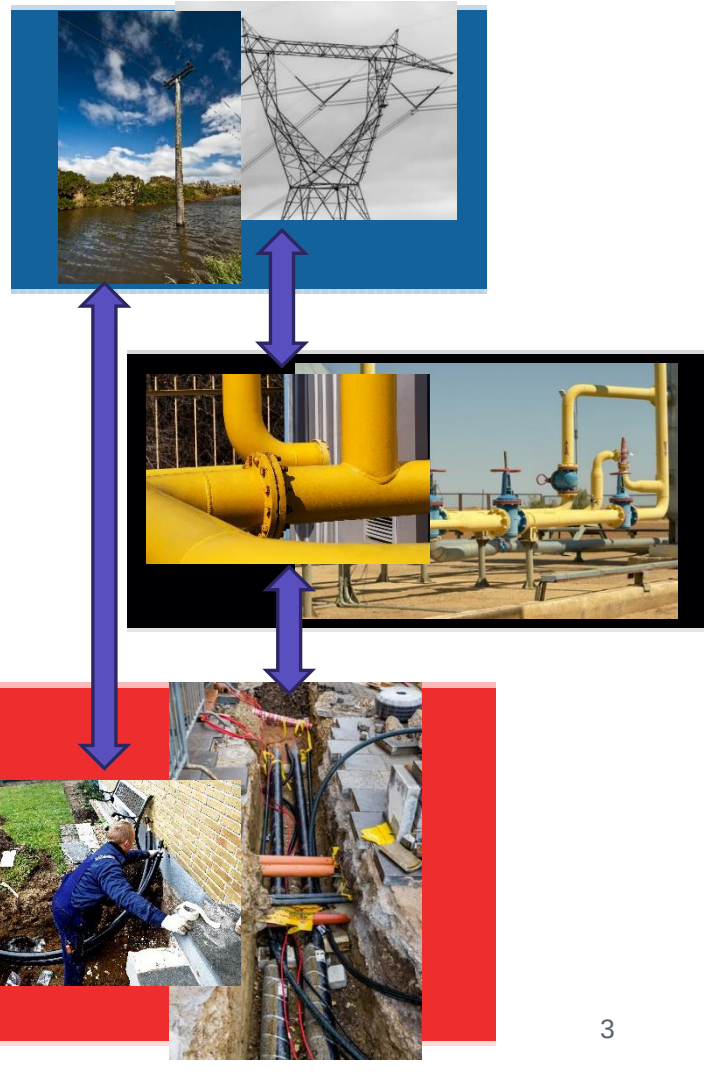
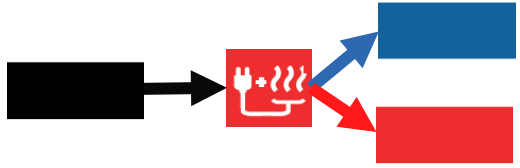
Networks

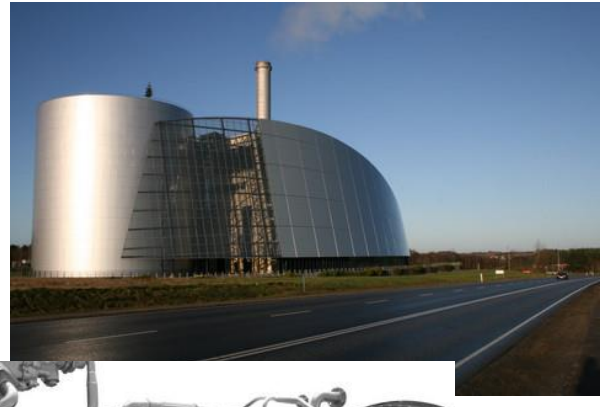
- Electricity
- Gas
- Heating and Cooling



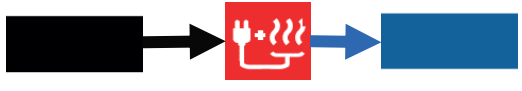
Combined heat and power (CHP) and gas-fired power stations

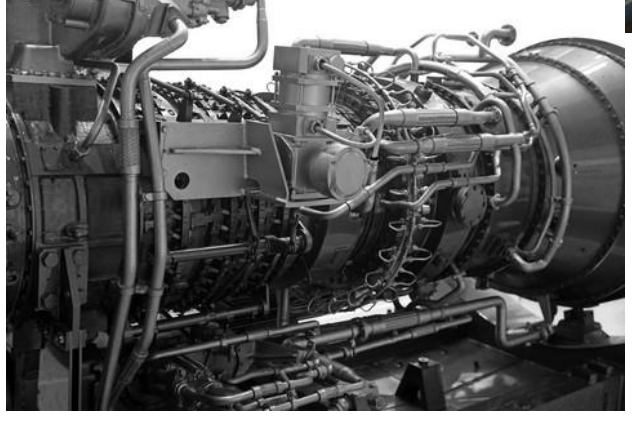


- CHP interconnects the electricity and heating networks
- When gas is used, also connects to the gas network



- 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

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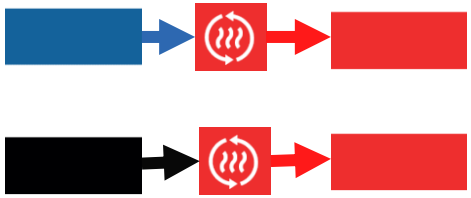
Heat pumps (electric and gas)



- 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.

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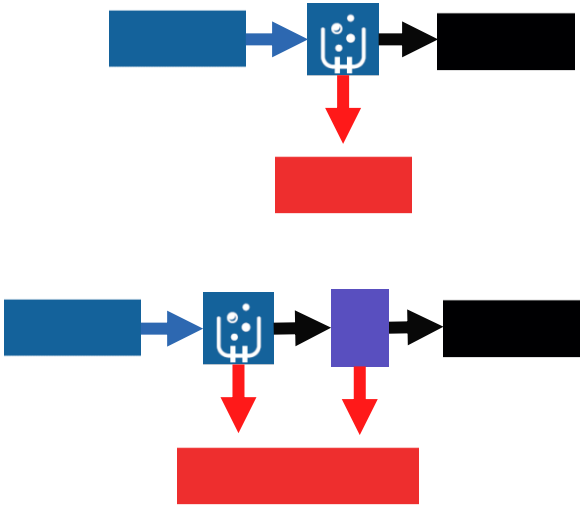
For more on heat pumps follow IEA HPT Annex 57 (https://heatpumpingtechnologies.org/annex57/)

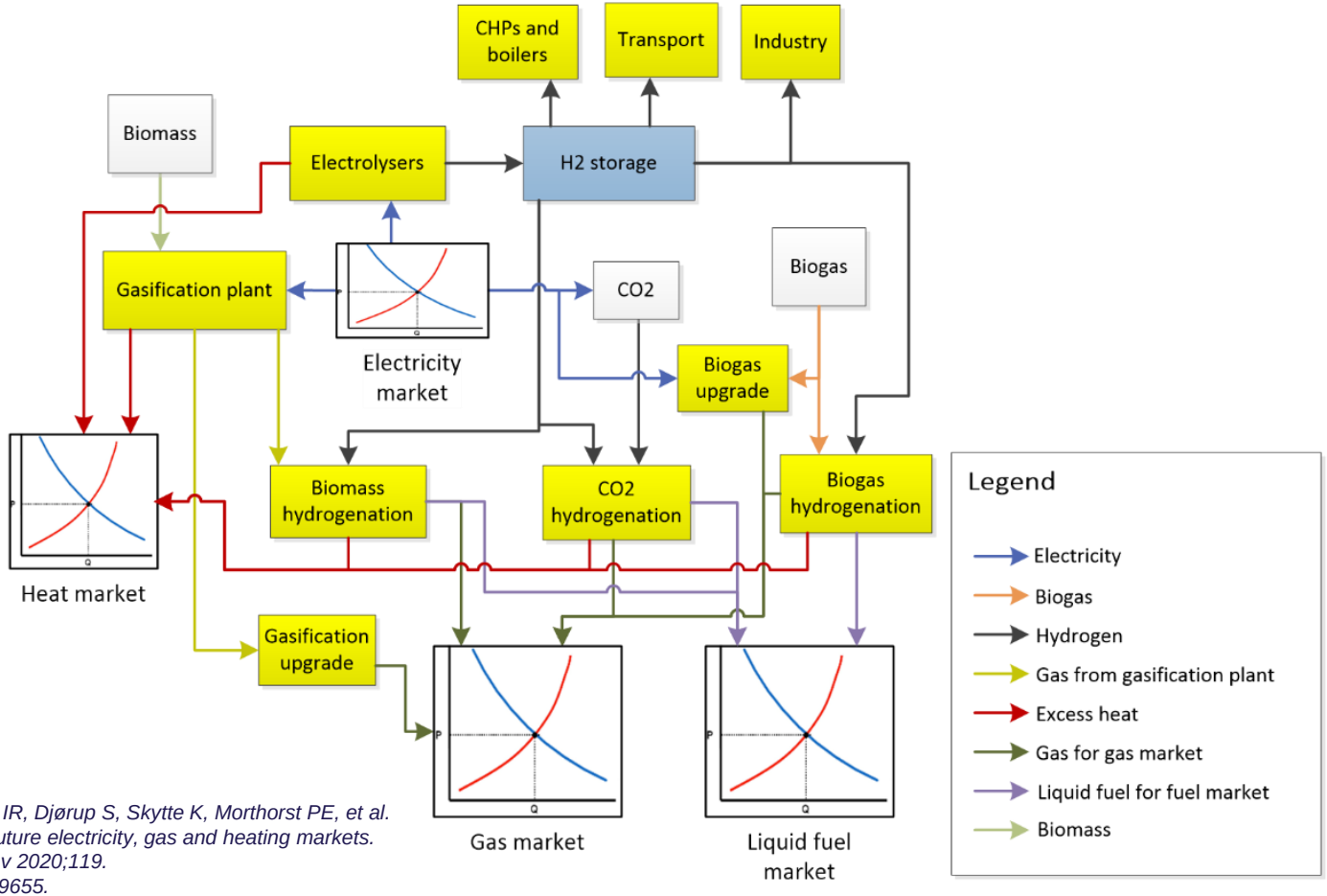
Electrolysis

- Allows for connection of electricity and gas networks. Either:
  - Directly, in case of possibility for direct 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 H_2 and/or electrofuels can be used for heating networks.

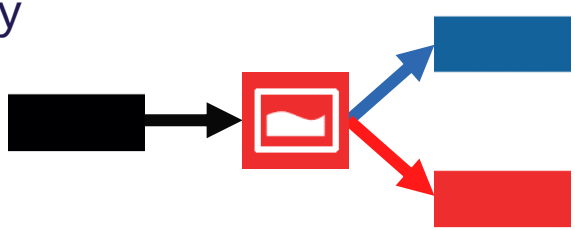
Examples of electrofuel pathways

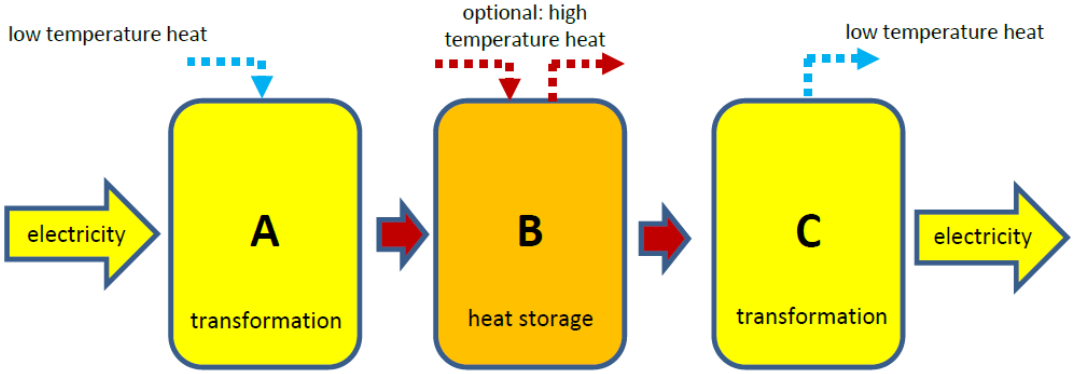


Sorknæs P, Lund H, Skov IR, Djørup S, Skytte K, Morthorst PE, et al. Smart Energy Markets - Future electricity, gas and heating markets. Renew Sustain Energy Rev 2020;119. doi:10.1016/j.rser.2019.109655.

Energy storages

- Allows for flexible operation of technologies. E.g.:
  - Heat and cold storages
  - Gas storages
  - H_2 storages
- Power-to-power storages with potential HEN capability
  - Compressed air energy storage (CAES)
  - Carnot batteries

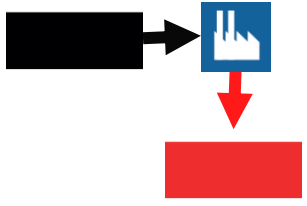




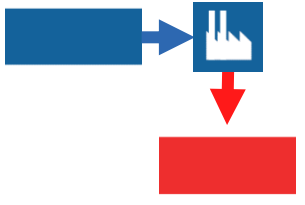
More on Carnot batteries in IEA ECES Annex 36 https://iea-eces.org/annex-36/

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

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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/

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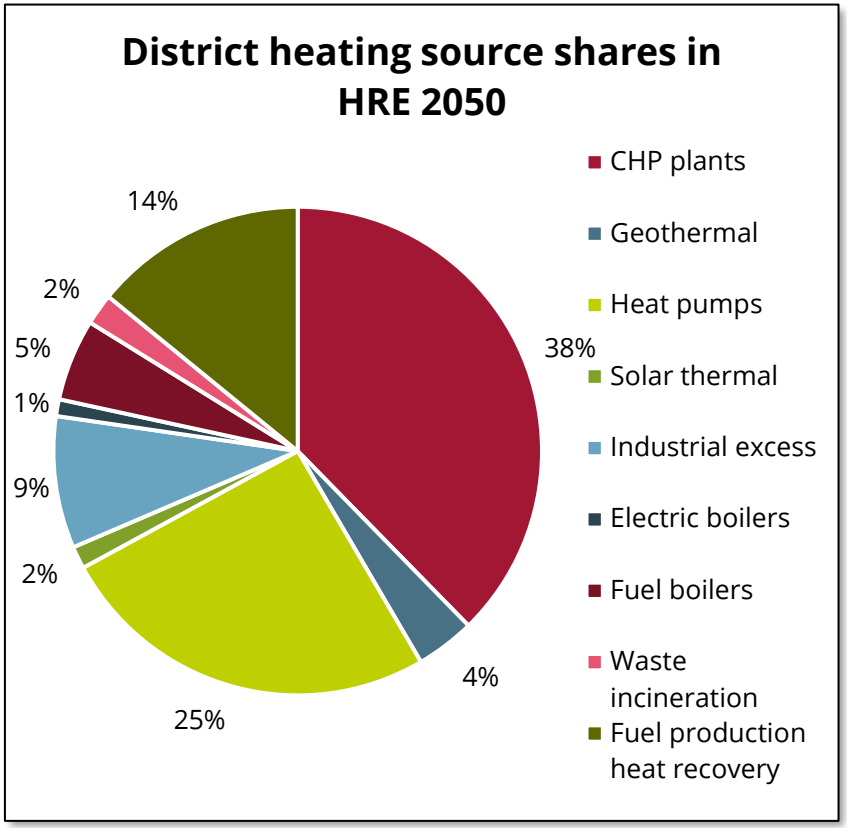
Heat Roadmap Europe 4 – District heating

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



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 695989.

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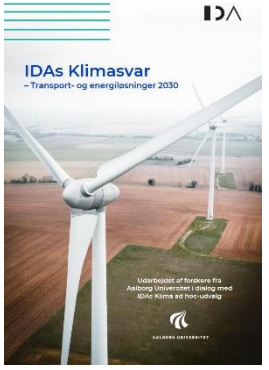
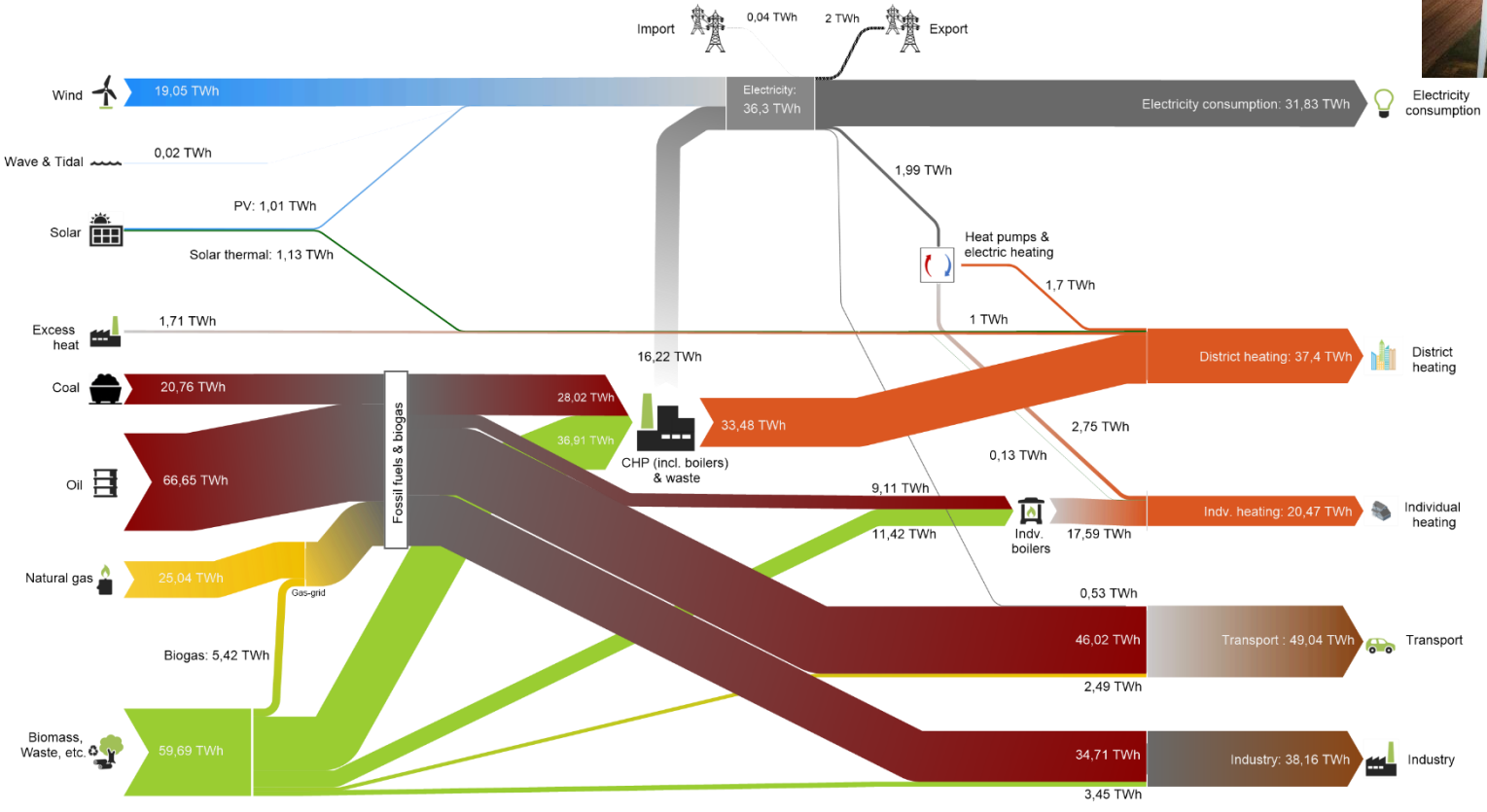
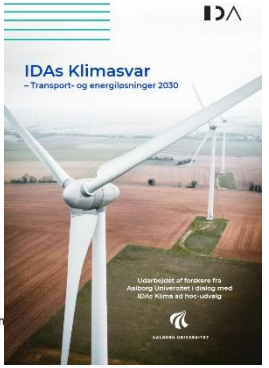
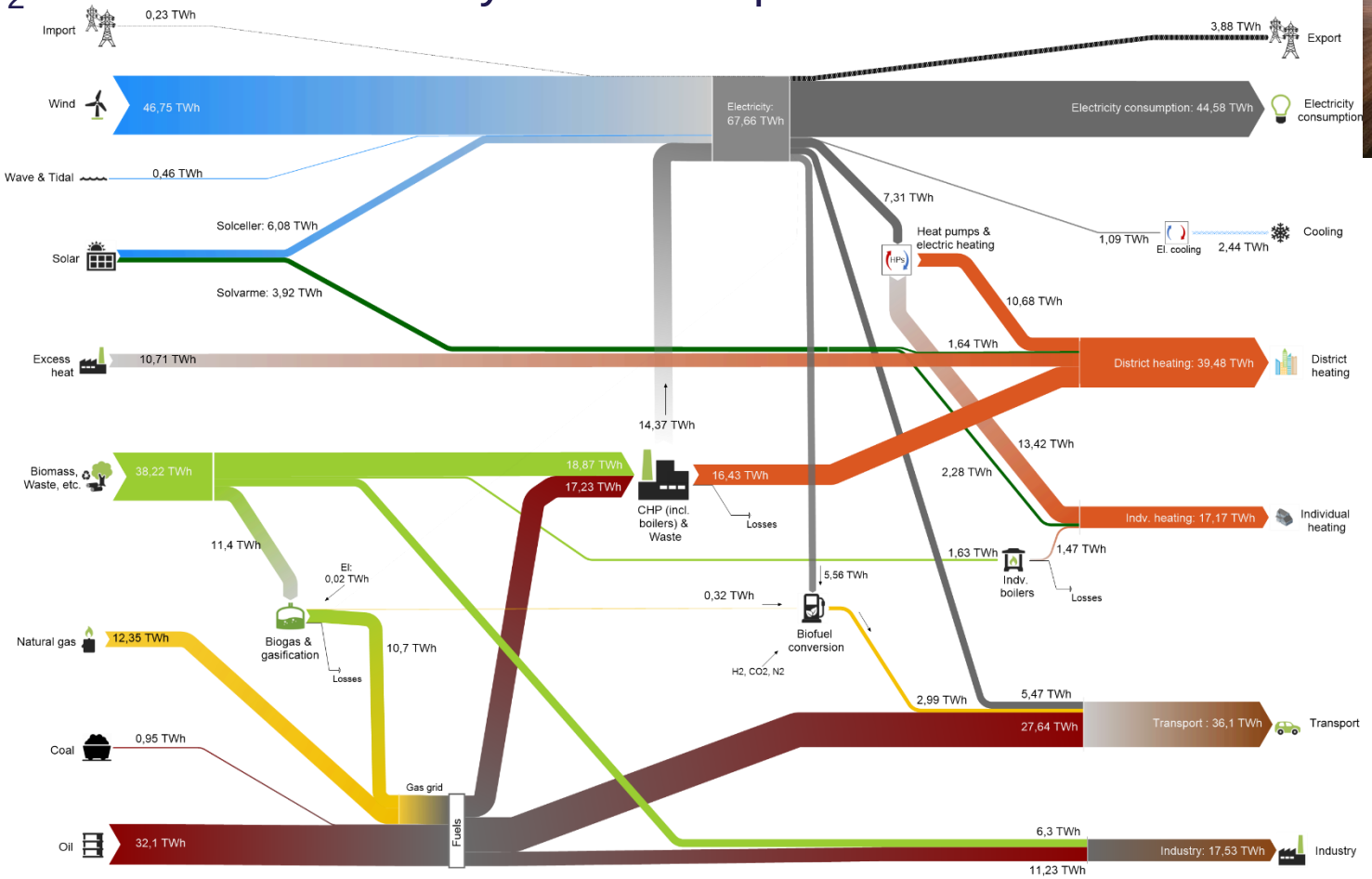
Danish energy system in 2020 (simulated)





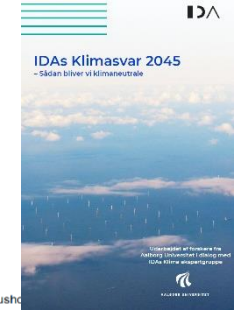
”IDAs Klimasvar” – Reduction of the Danish energy sector’s CO_2-emissions in 2030 by ~80% compared with 1990-levels

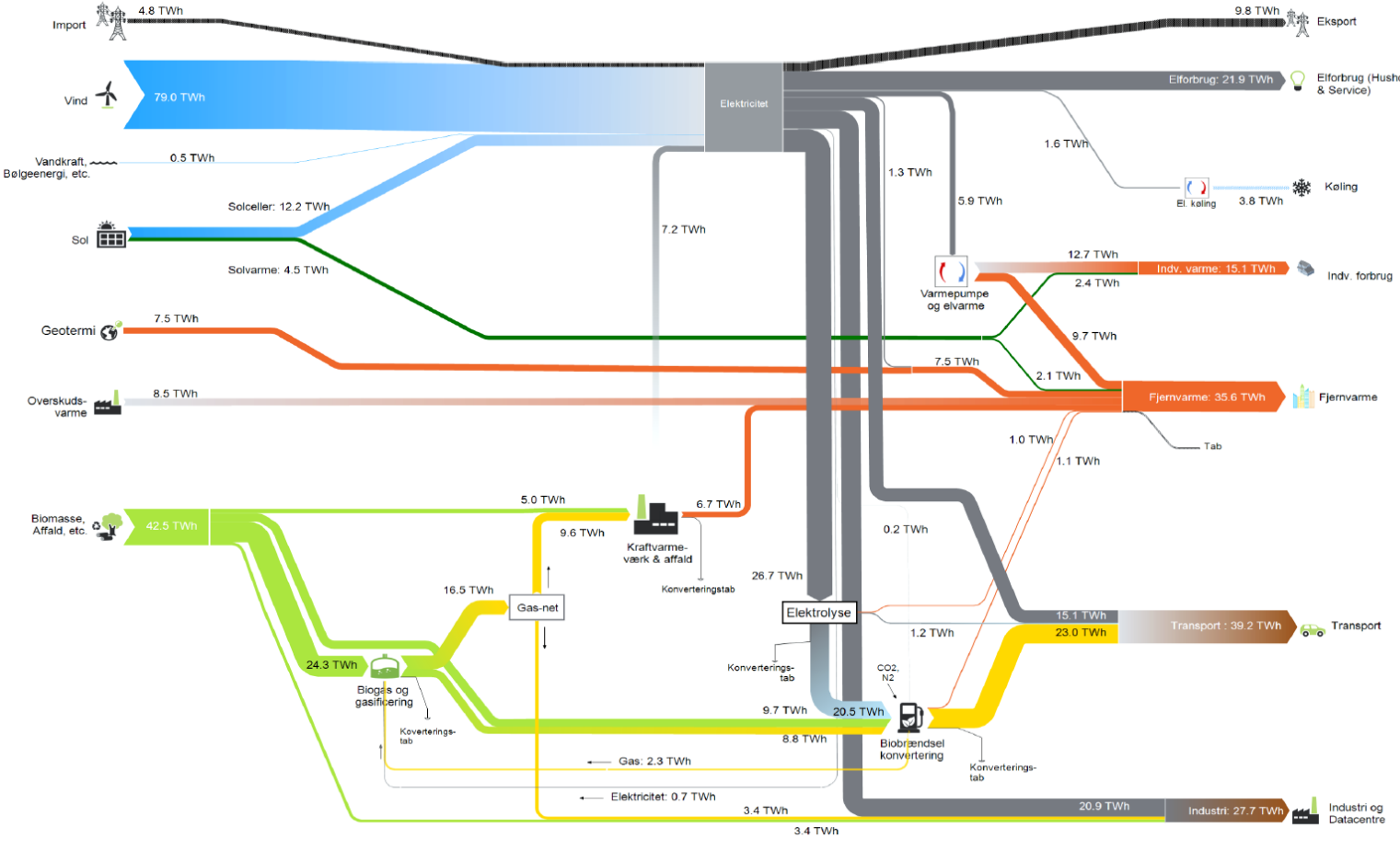




https://vbn.aau.dk/da/publications/idas-klimasvar-transport-og-energil%C3%B8sninger-2030

”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?

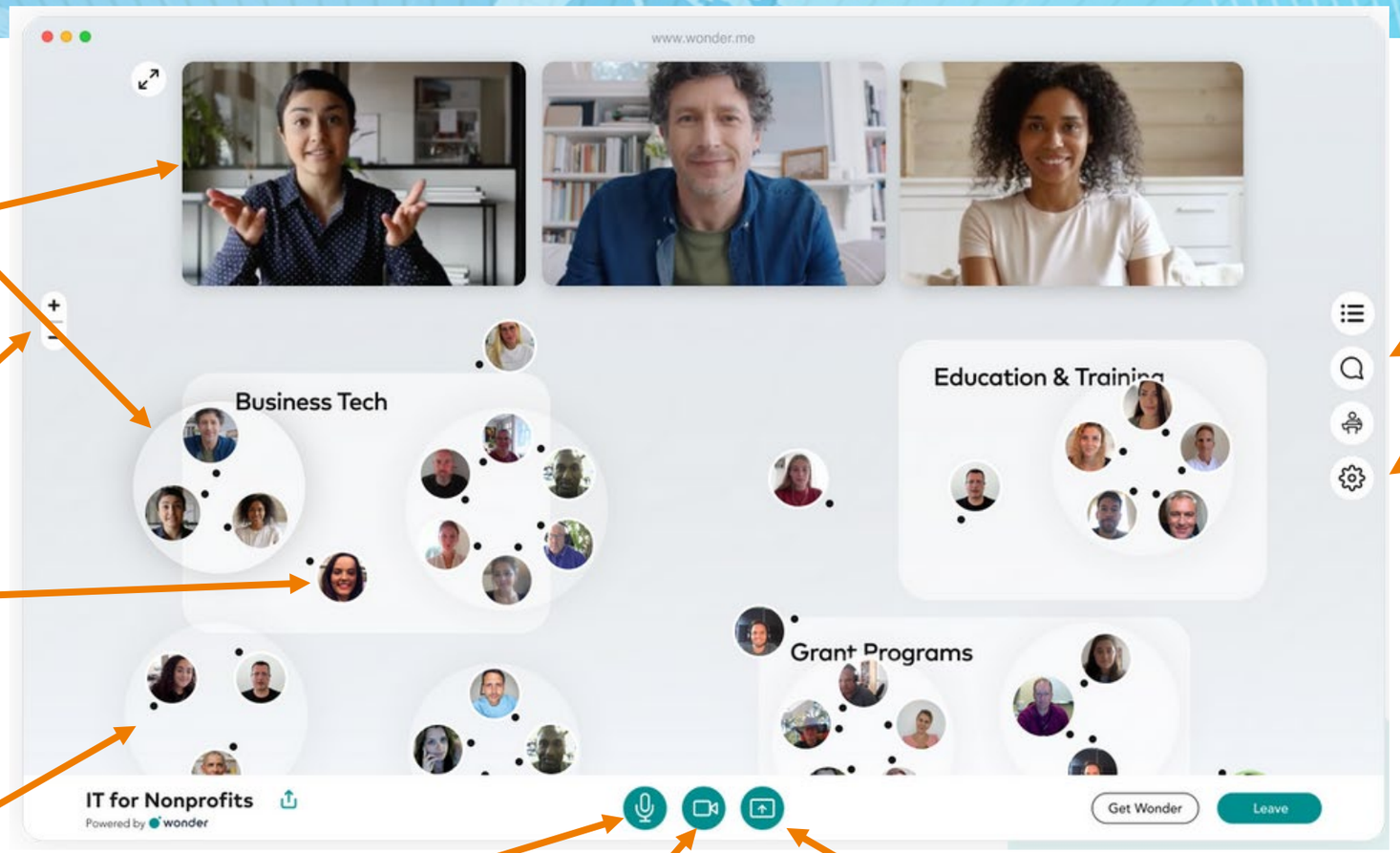
country-based discussion in Wonder.me

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

zoom

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

Two or more people will build a **circle**



Chat

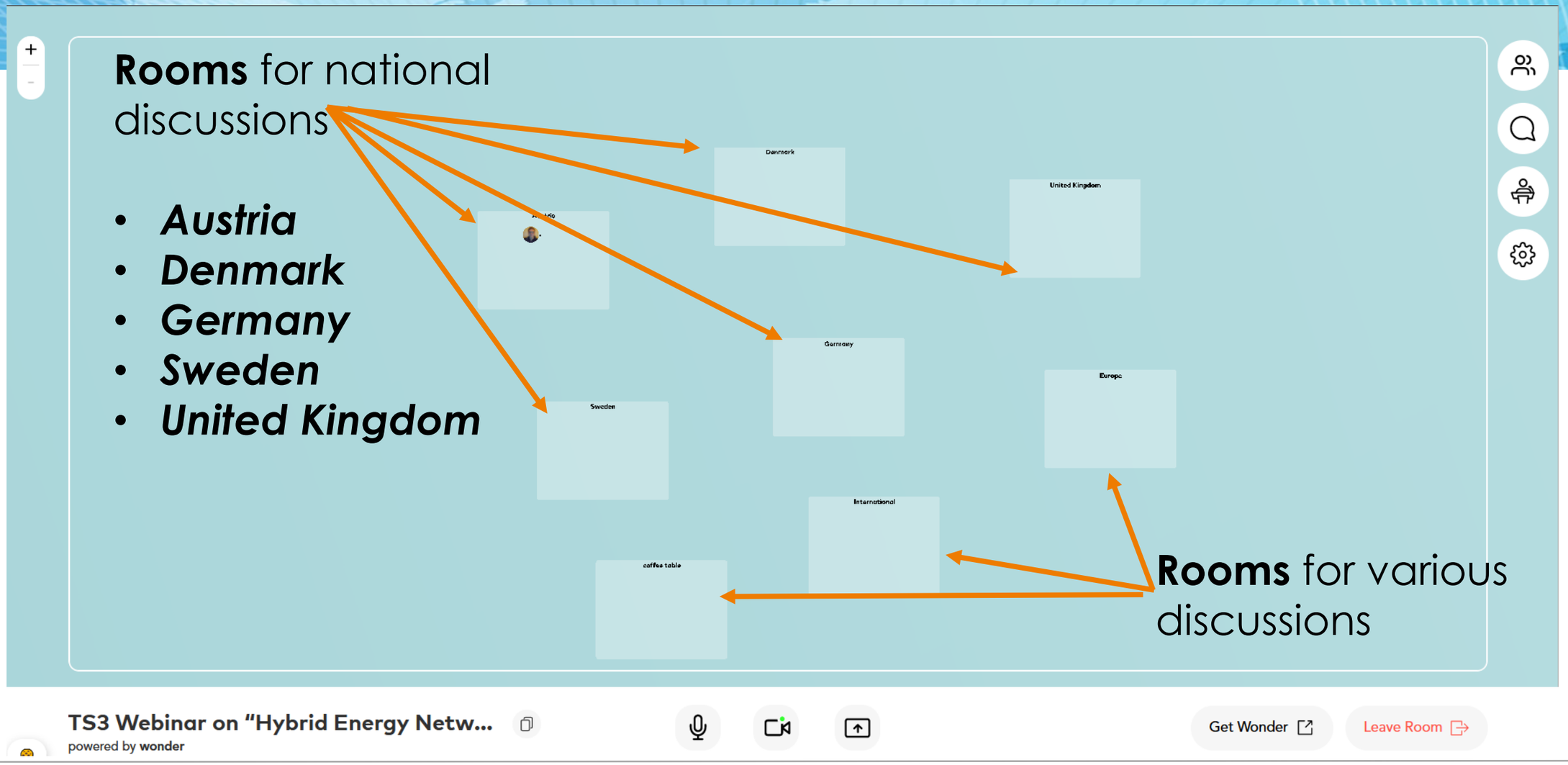
settings

mute

camera off

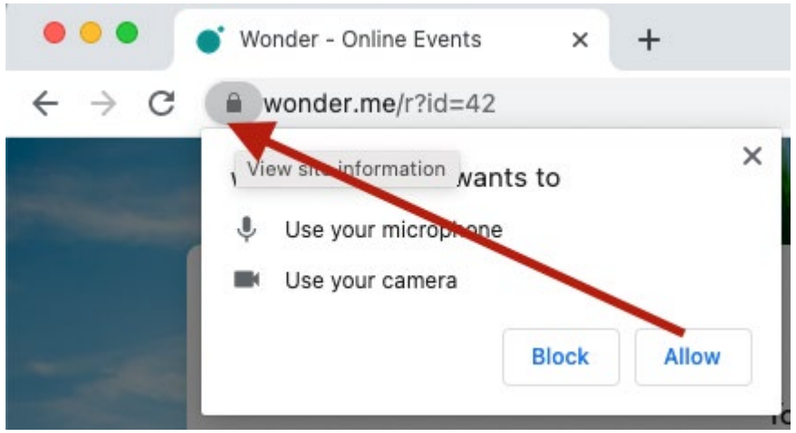
screen sharing

country-based discussion in Wonder.me



country-based discussion in Wonder.me

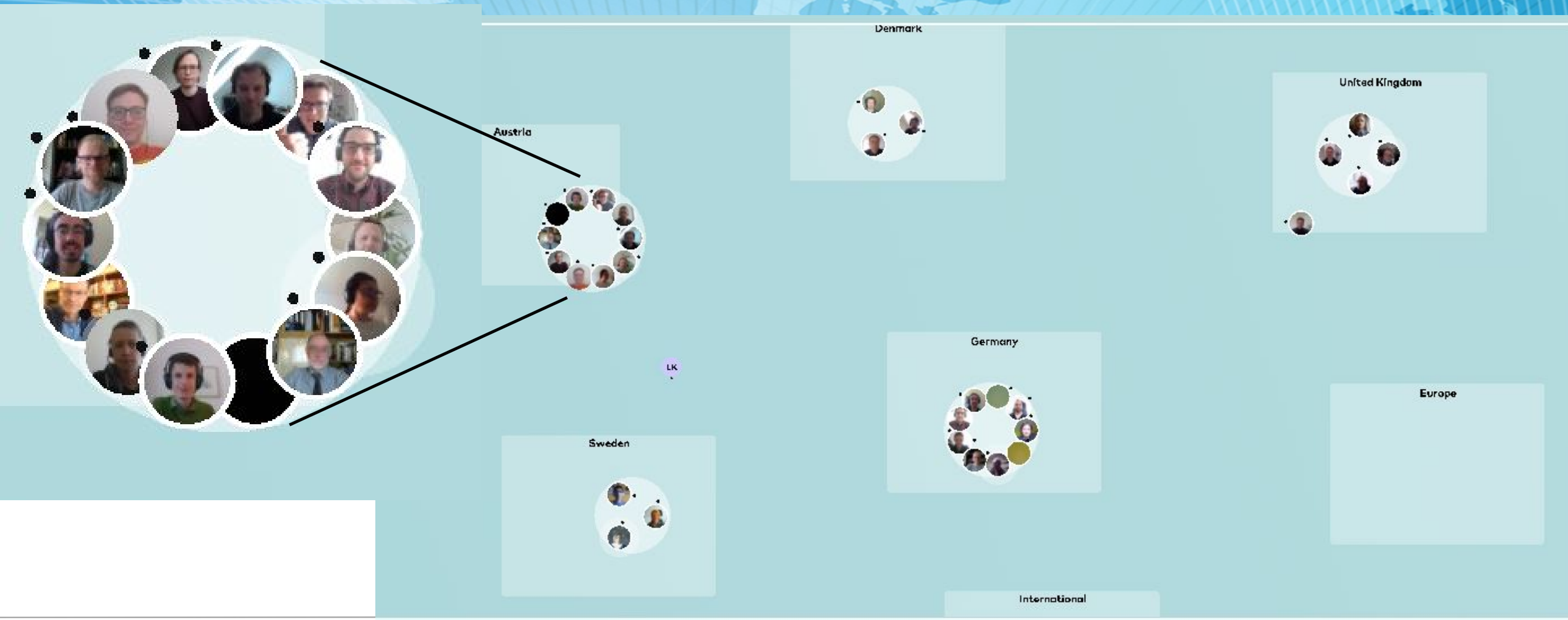
- Wonder is optimized for **Google Chrome and Edge**
- Make sure your browser is allowed to **access your camera and microphone**
- Make sure **Wonder is the only conference/communication tool** you have open (Zoom, Microsoft teams, …)
- Make sure **no other applications or websites** are making use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

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note on other events

Invitation to the Webinar on

IEA DHC Annex TS7: Industry-DHC Symbiosis

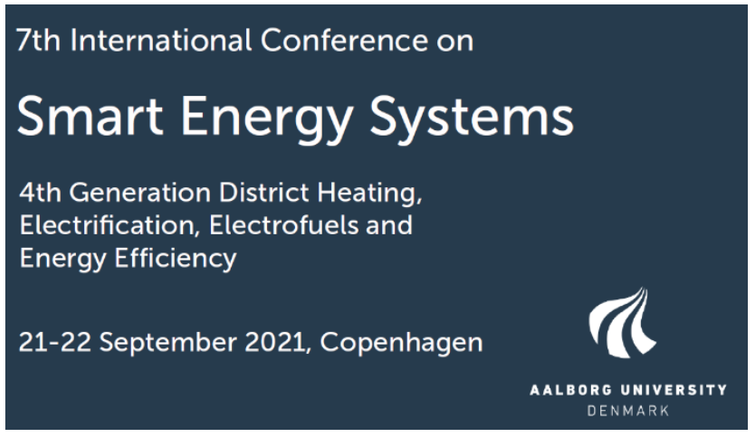
"A systemic approach for highly integrated industrial and thermal energy systems"

Friday, 30th April 2021, 12.30 to 15.30 (CET)

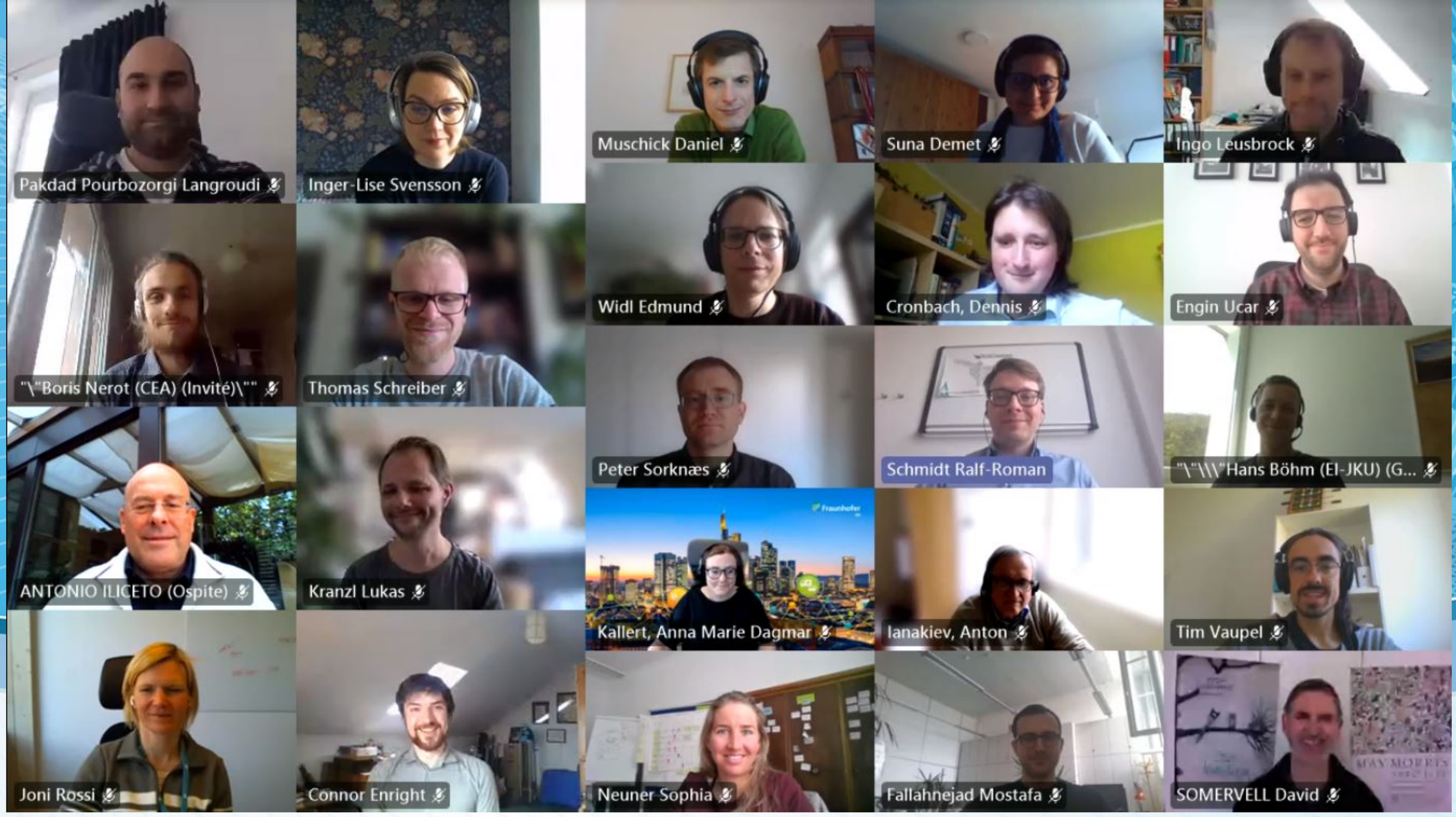
https://missioninnovationaustriaweek.at/events/industry-dhc-symbiosis-a-systemic-approach-for-highly-integrated-industrial-and-thermal-energy-systems/

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

http://dhc2021.uk/



https://smartenergysystems.eu/


Pakdad Pourbozorgi Langroudi
Inger-Lise Svensson
Muschick Daniel
Suna Demet
Ingo Leusbrock
Widl Edmund
Cronbach, Dennis
Engin Ucar
"\"Boris Nerot (CEA) (Invité)\""
Thomas Schreiber
Peter Sorknæs
Schmidt Ralf-Roman
"\"\\\"Hans Böhm (EI-JKU) (G...
ANTONIO ILICETO (Ospite)
Kranzl Lukas
Kallert, Anna Marie Dagmar
Ianakiev, Anton
Tim Vaupel
Joni Rossi
Connor Enright
Neuner Sophia
Fallahnejad Mostafa
SOMERVELL David

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