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)

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Block II: Barriers, trends and solutions for the creation of an integrated energy market

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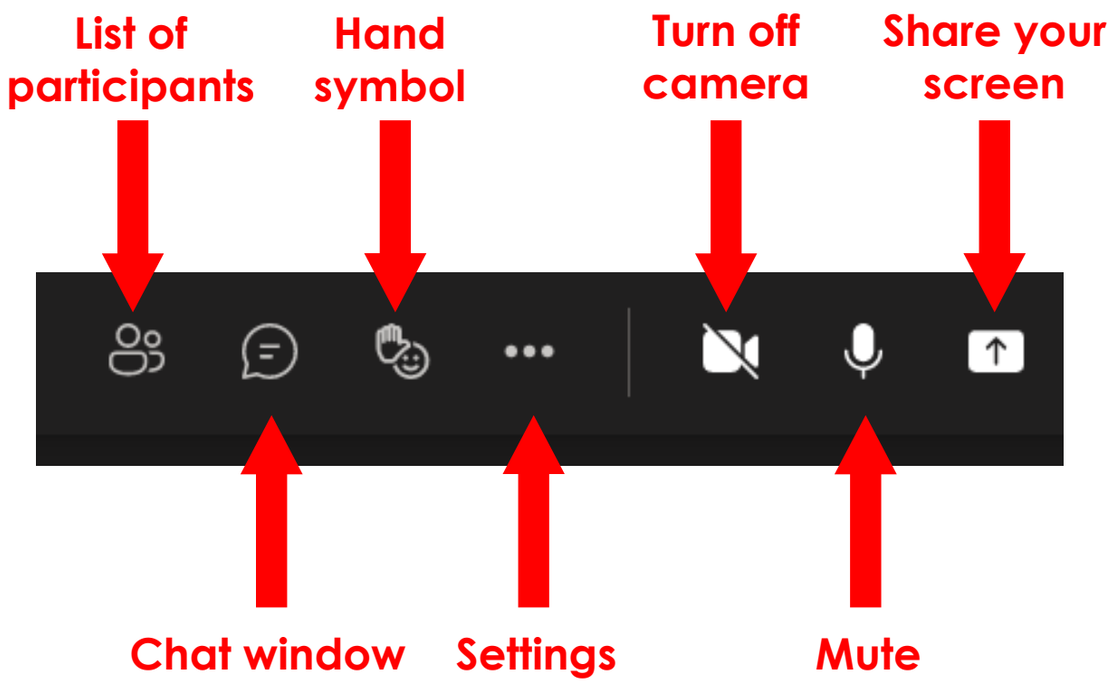
Webinar Etiquette

- 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 II - Barriers, trends and solutions for the creation of an integrated energy market*

11:00	***Testing of technical connections***
11.15	Welcome and introduction into the webinar (Ralf-Roman Schmidt, AIT)
	EU legal framework for energy communities (Achille Hannoset, European Commission/ Consumers, Local Initiatives, Just Transition)
	Local markets for energy and flexibility exchange (Wenche Tobiasson, RISE)
	Sector coupling: Overcoming regulatory obstacles with coupled systems (Michael Kalis, IKEM)
	Overview on different business models and the regulatory framework for hybrid energy networks (Dennis Cronbach, Fraunhofer IEE/ Inger-Lise Svensson, RISE)
	Discussions and feedback in breakout sessions
12:45	***End of Block II***

EU legal framework for energy communities (Achille Hannoset, European Commission/ Consumers, Local Initiatives, Just Transition)

Energy communities – implementation of the Clean Energy Package

Content

- ✓ The purpose of energy communities and existing models
- ✓ Classification of Renewable Energy Communities and Citizen Energy Communities
- ✓ Distinguishing jointly acting self-consumers and energy communities
- ✓ Activities of energy communities: energy sharing and tariffs

Disclaimer

This presentation aims to collect knowledge on energy communities and guide the discussions on the topic.

For this purpose, it uses examples from some Member States. Examples that are just as good might exist in other Member States

This presentation does neither represent an official interpretation nor an endorsement of certain projects.

The purpose of energy communities and existing models

Purpose of consumer empowerment

Empowering citizens

- Energy communities are an effective tool to increase public acceptance of new projects
- Energy communities are a tool to mobilise private capital for the energy transition
- Energy communities could be a tool to increase flexibility in the market

Consumer empowerment

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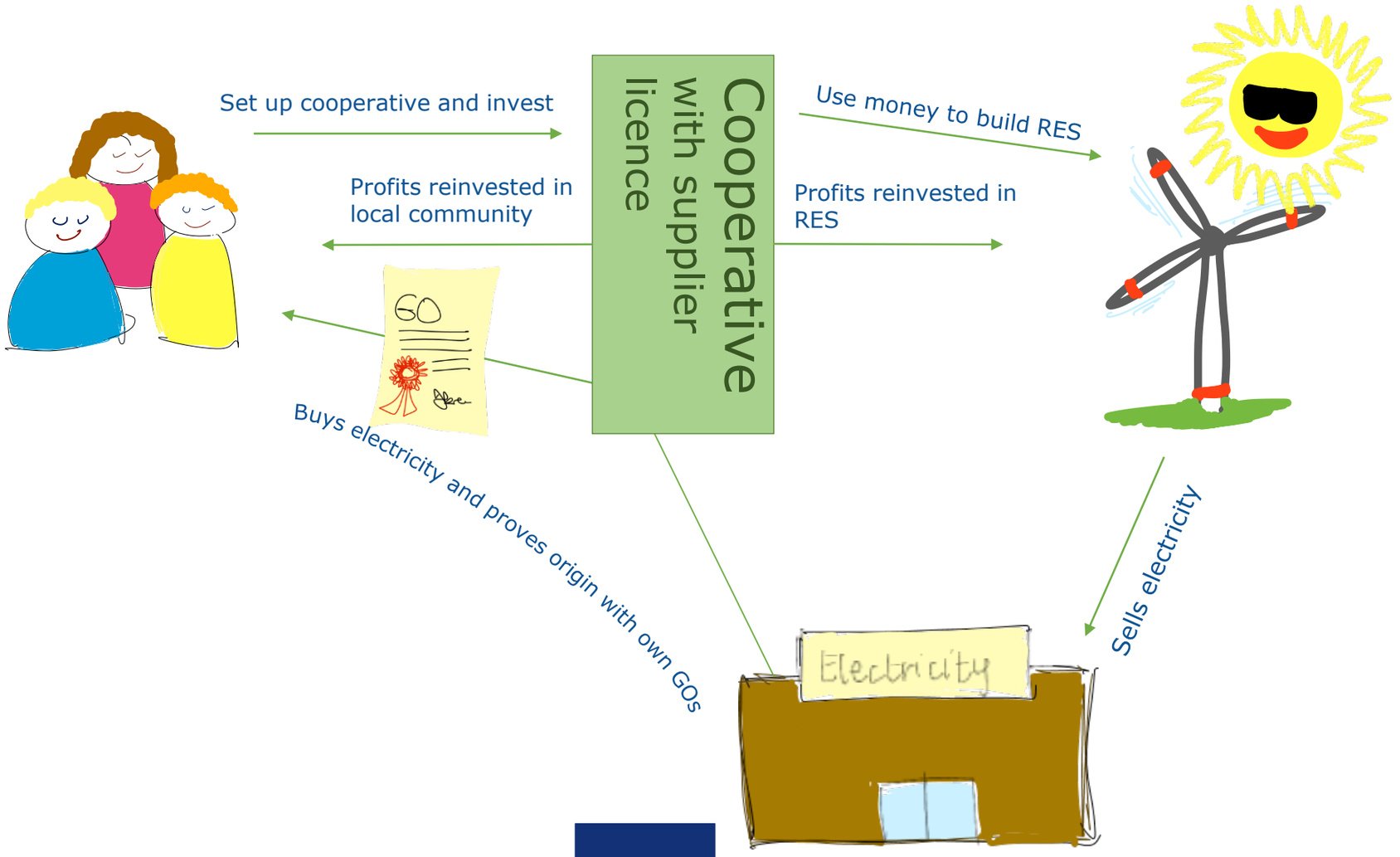
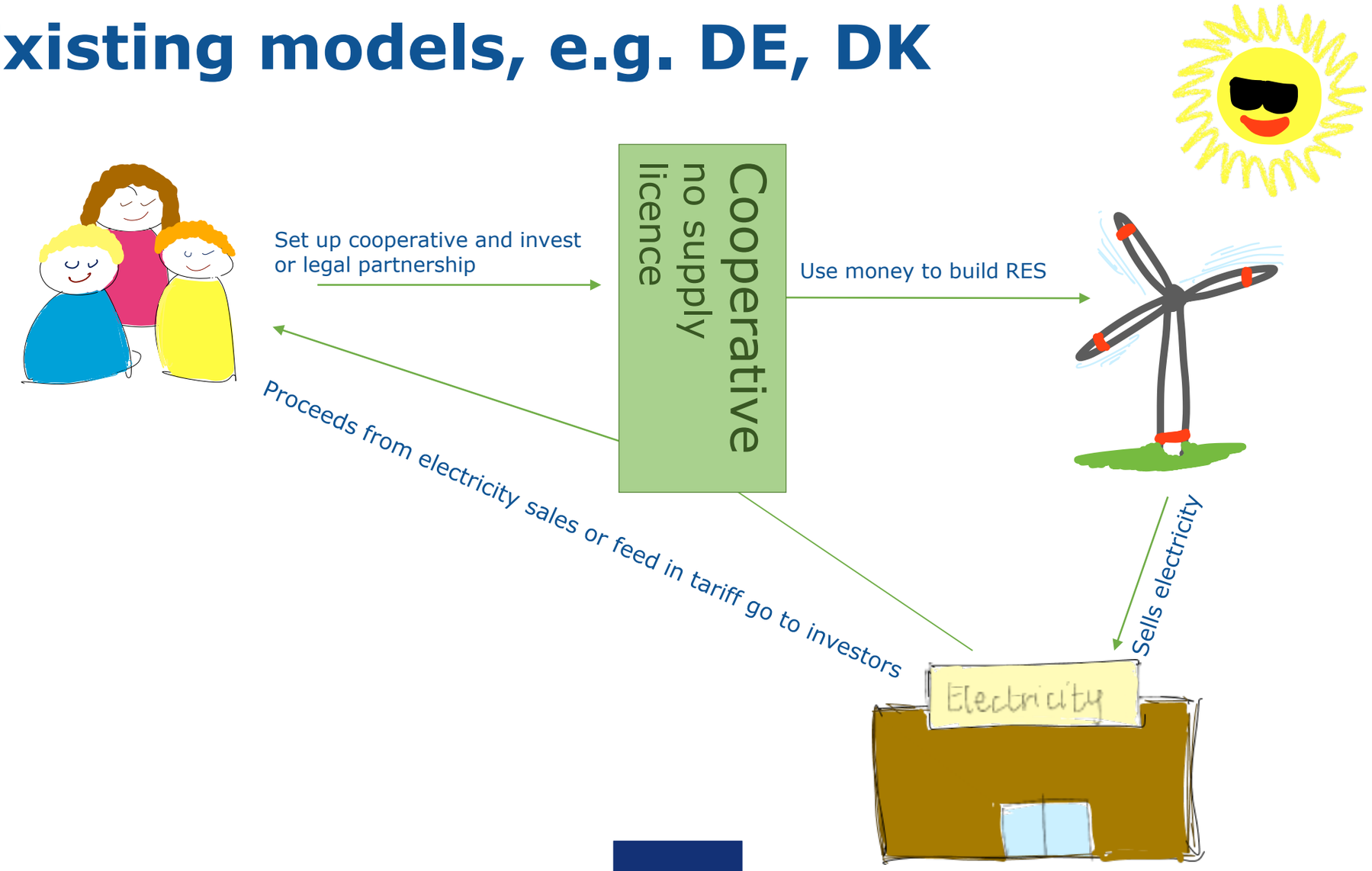
Renewable Energy Directive: all types of *renewable energy*

Electricity Directive: all types of *electricity*

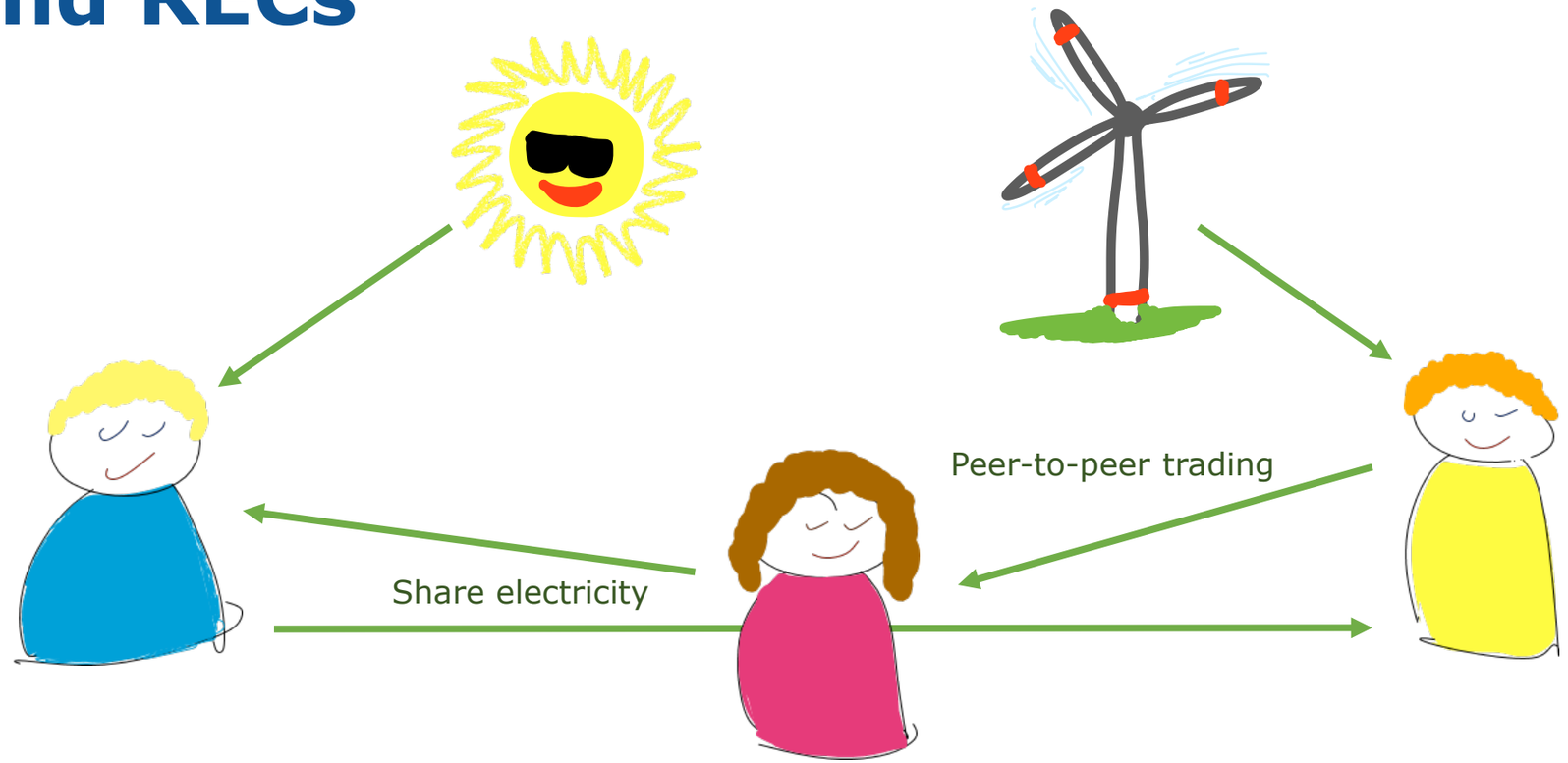
Existing models, e.g. BE, ES



Existing models, e.g. DE, DK



Additional possibilities due to CECs and RECs



- Innovative: energy sharing and peer-to-peer possibility
- Challenge: redefining consumer/supplier relationship and regulate new configurations appropriately

Classification of Renewable Energy Communities and Citizen Energy Communities

Art. 16 of the Directive on the Internal Market for Electricity Directive on “Citizen Energy Communities”

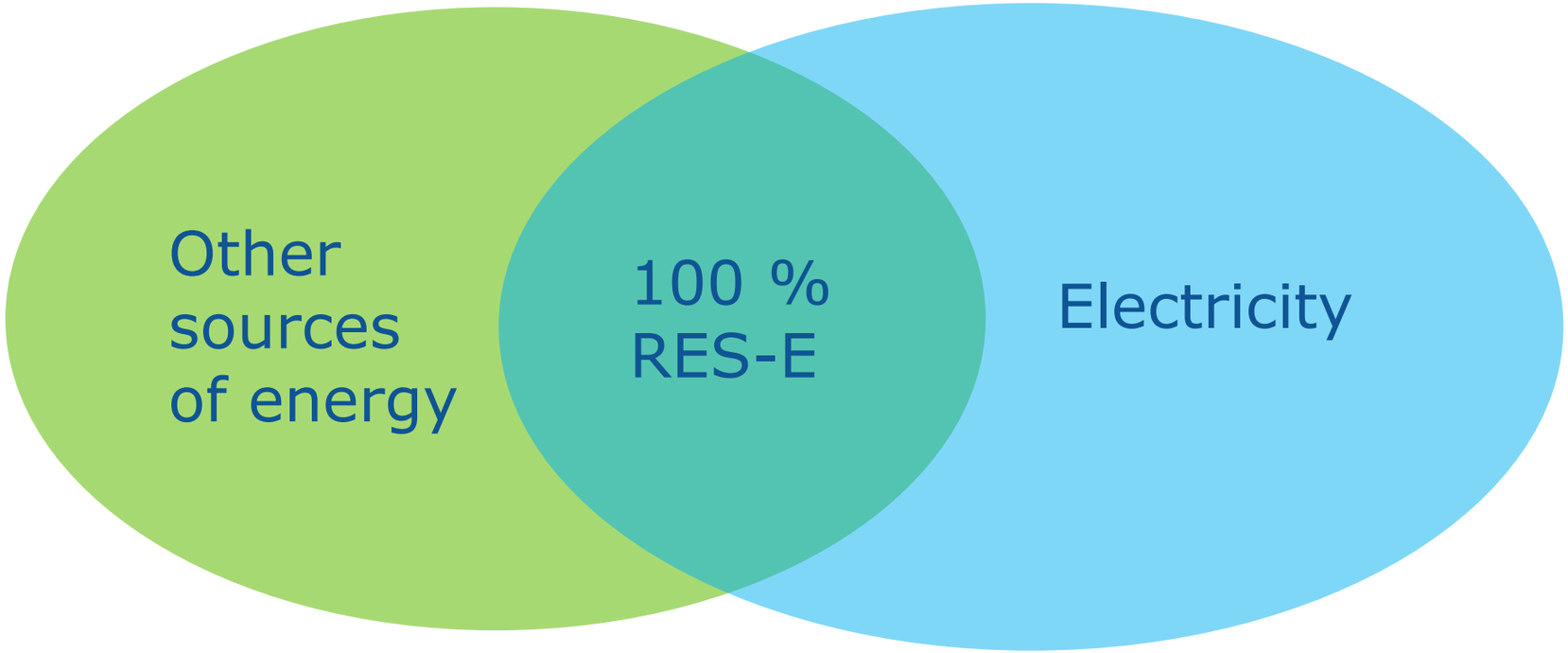
Art. 22 of the Directive on the promotion of the use of energy from renewable sources on “Renewable Energy Communities”

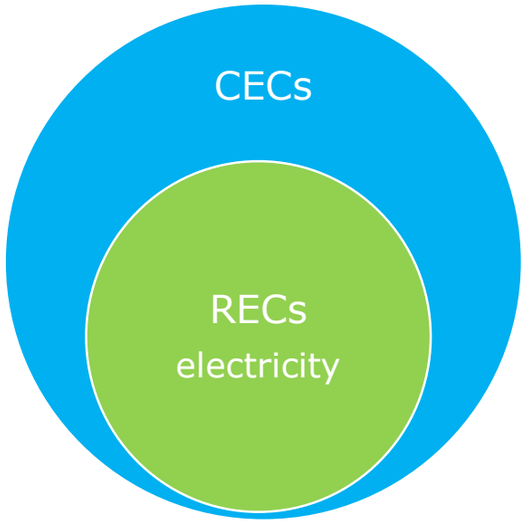
Art. 16 of the Directive on the Internal Market for Electricity Directive on “Citizen Energy Communities”

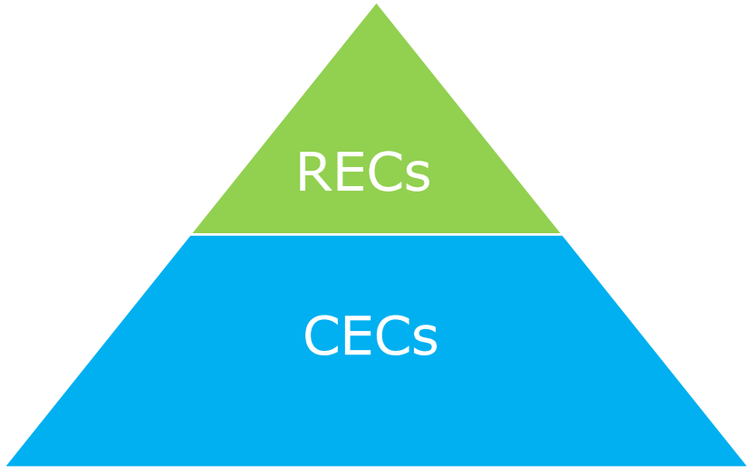
Art. 22 of the Directive on the promotion of the use of energy from renewable sources on “Renewable Energy Communities”

Art. 2 on definitions: makes clear that renewable energy communities are a **social concept**, rather than financial profits

RECs and CECs - overview







- ✓ Promotion of RES
- ✓ Favorable conditions for RES support
- ✓ Strict governance and participation criteria
- ✓ Geographical proximity

- ✓ Recognition as a market actor
- ✓ Ensure level playing field and non-discrimination
- ✓ Strict governance criteria, but open membership
- ✓ No geographical proximity

	CEC	REC
Energy	**Electricity**	**Renewable energy**
Membership	**Any entity**	**Natural persons, local authorities, SMEs**
Control	Effective control by natural persons, local authorities, SMEs	Effective control by natural persons, local authorities, SMEs **located in the proximity of the projects**
Purpose	Primary purpose to provide environmental, economic or social community benefits for members or the local area	
Activities	Generation, storage, selling, sharing, aggregation or other energy services, distribution	

Energy communities as DSOs

Can energy communities act as a DSO?

➔ *As regards electricity, MS may decide whether to grant CECs the right to manage distribution networks ➔ Yes, if Member States allow it.*

➔ *RECs can in principle act as DSO, this is clear from Art. 22 (4) ("RECs are not subject to discriminatory treatment with regard to their activities as […] DSOs […].") But when dealing with electricity, they are a subset of CECs, so it depends on the national regulatory framework.*

Distinguishing jointly acting self-consumers and energy communities

RECs and jointly acting self-consumers

	Energy community	Jointly acting self-consumers
Geographical scope	Proximity of RES installations	Limited to the same building (unless enlarged by MS)
Membership	Open as long as criteria of definition are met	Limited to people living in the same building/apartment block (unless enlarged by MS)
Legal form	Legal entity required	Legal entity not required by the directive (contract between individuals)
Purpose	Provide environmental, economic or social benefits	Not specified in article
Electricity sharing	Must be possible without prejudice to network charges	

Activities of energy communities

Activities of energy communities: existing regulation	
Produce	• Not new, like any other generator
Consume	• The legal entity can use the electricity produced by the installations and provided by external suppliers
Store	• Not specific to energy communities
Sell	• Not new. Legal entity can sell the electricity to its members, on the markets, through PPAs, like any other generator, or receives feed in tariffs
Share within the community	• Emerging concept: e.g. autoconsommation collective in FR or in ES

Considerations: Electricity sharing	
Sharing = supply?	• Depends, defining it as supply might be disproportionate (and hence not in line with article 16.1 e, Elec Dir) • Sharing needs to be possible
Distinction between sharing and supply	• Sharing is multidirectional, and more ad hoc; supply from one steady source • Possible criteria: size of installation, level of professionalisation • Check: regulation for sharing economy, Airbnb, other platforms
Who can share	• Legal entity with its members (could be supply) • Members with RES installations with other community members (if enlarged by MS)
How can it be done	• Through the DSO (e.g. autoconsommation collective) • Through private energy service providers and software solutions

Energy sharing

Category of "sharing"	Energy shared	Parties to the sharing	Scope of sharing	Requirement for MS?
Renewables self-consumer	**Renewable electricity**	same customer	"within its premises within close boundaries" *[physical boundaries]*	mandatory
			"within other premises" *[based on ownership]*	optional
Jointly acting renewables self-consumer		different customers	located within the same building *[physical boundaries]*	mandatory
REC	**Renewable energy**		to other members, without geographical limitation *[based on membership]*	mandatory
Active customer	**Any electricity**	same customer	"within its premises within close boundaries" *[physical boundaries]*	mandatory
			"within other premises" *[based on ownership]*	optional
Jointly acting active customers		different customers	?	mandatory
CEC			to other members, without geographical limitation *[based on membership]*	mandatory

Applicable charges

		Network charges	Other charges or fees
Article 16 EMD Sharing within a CEC	General rule	**cost-reflective** network charges […] ensuring that they contribute **in an adequate and balanced way to the overall cost sharing of the system**	**non-discriminatory, fair, proportionate** and transparent charges […] ensuring that they **contribute in an adequate and balanced way to the overall cost sharing of the system**
	When sharing electricity within the CEC	**applicable** charges […] **in accordance with a transparent CBA** of distributed energy resources by competent national authorities	
Article 22 RED REC	General rule	**cost-reflective** network charges, […] ensuring that they **contribute in an adequate, fair and balanced way to the overal cost sharing of the system**, **in line with a transparent CBA analysis** of distributed energy sources by national competent authorities	**relevant** charges, levies and taxes, […] ensuring that they **contribute in an adequate, fair and balanced way to the overal cost sharing of the system**, **in line with a transparent CBA** analysis of distributed energy sources by national competent authorities
Article 15 EMD Active customers		**cost-reflective**, transparent and **non-discriminatory** charges, accounting separately for the electricity fed and electricity consumed, ensuring that the **contribute in an adequate and balanced way to the overall cost sharing of the system**	**no disproportionate or discriminatory** charges
Article 21 RED Individual RES SC, *i.e. within premises located within confined boundaries*	Elec. injected in / taken from grid	**cost-reflective** network charges	**no disproportionate or discriminatory** charges
	Elec. stays behind the meter	**no charges**	**no charges** (except in the 3 cases foreseen by Art. 21 (3) RED)
Sharing in "joint RES SC", *ie within the same building*		charges "applicable to each renewables self consumer"	

Thank you for your attention

Local markets for energy and flexibility exchange (Wenche Tobiasson, RISE)

Local markets for energy and flexibility exchange

Wenche Tobiasson, PhD
Electric Power Systems, RISE

Local market defined

- Local energy or flexibility market is used to describe a marketplace that coordinate the generation, supply, storage, transport, and consumption of energy from **decentralised** energy resources within a **confined** geographical area.

- Flexibility: modifying generation and/or consumption patterns in reaction to an external signal (such as a change in price) to provide a service within the energy system.

Needs and benefits of local markets

- **Needs**
  - Network congestion – long lead times
  - Decentralised approach
  - Smaller scale generation
  - Prosumers
- **Potential benefits** – findings from ISGAN Annex 6 Survey
  - Deferred network investments
  - Reduced network costs and increase network utilisation
  - Increase consumer engagement
  - Higher share of renewable energy

Further flexibility and efficiency benefits possible through hybrid markets

→ increased social welfare through efficiency improvements

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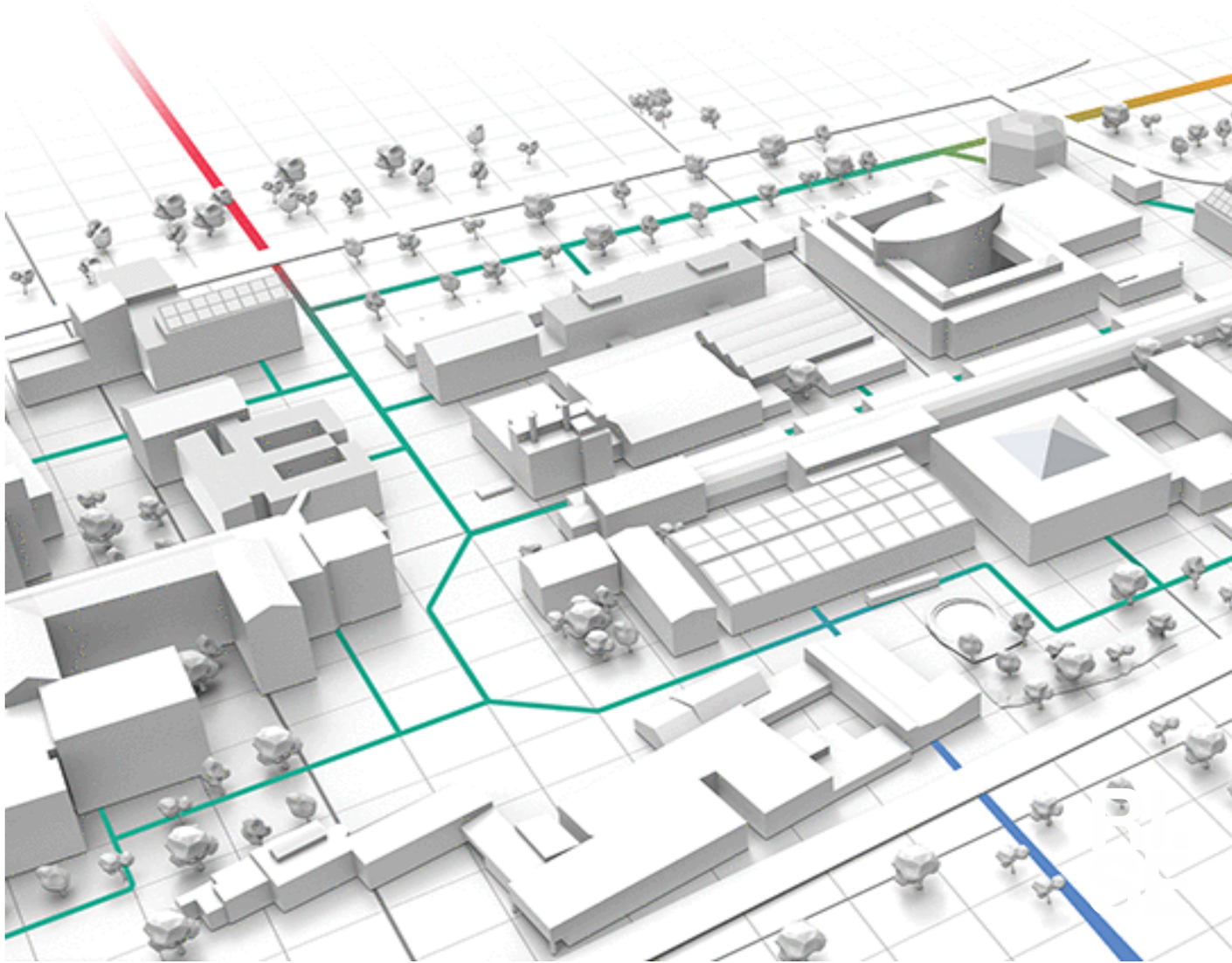
Example market designs

- **FED** – central clearing local marketplace for energy (electricity, district heating and cooling)

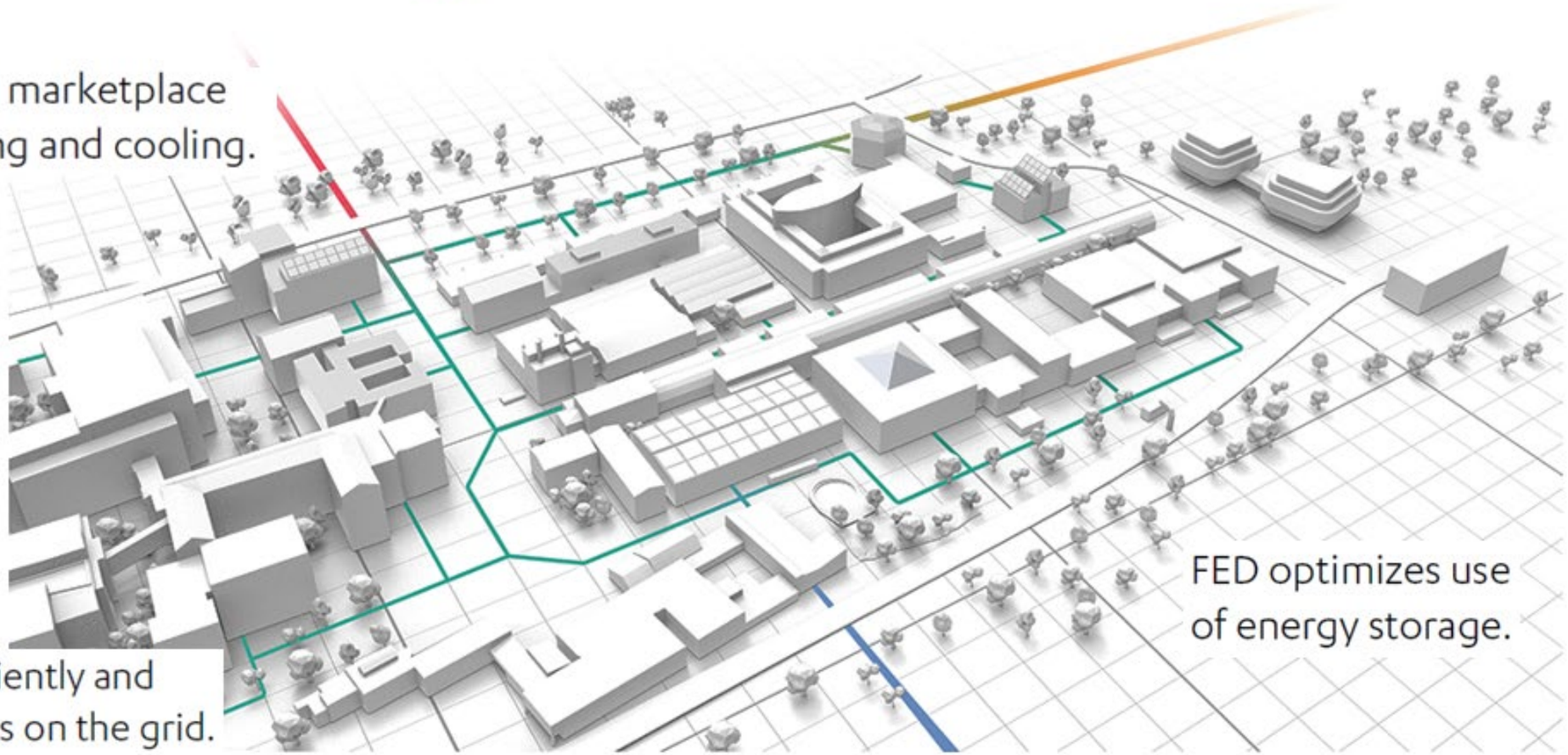
- **FlexiGrid** – peer-to-pool market for flexibility (electricity only)

FlexiGrid



Fossil Free Energy Districts - FED

FED develops a local marketplace for electricity, heating and cooling.

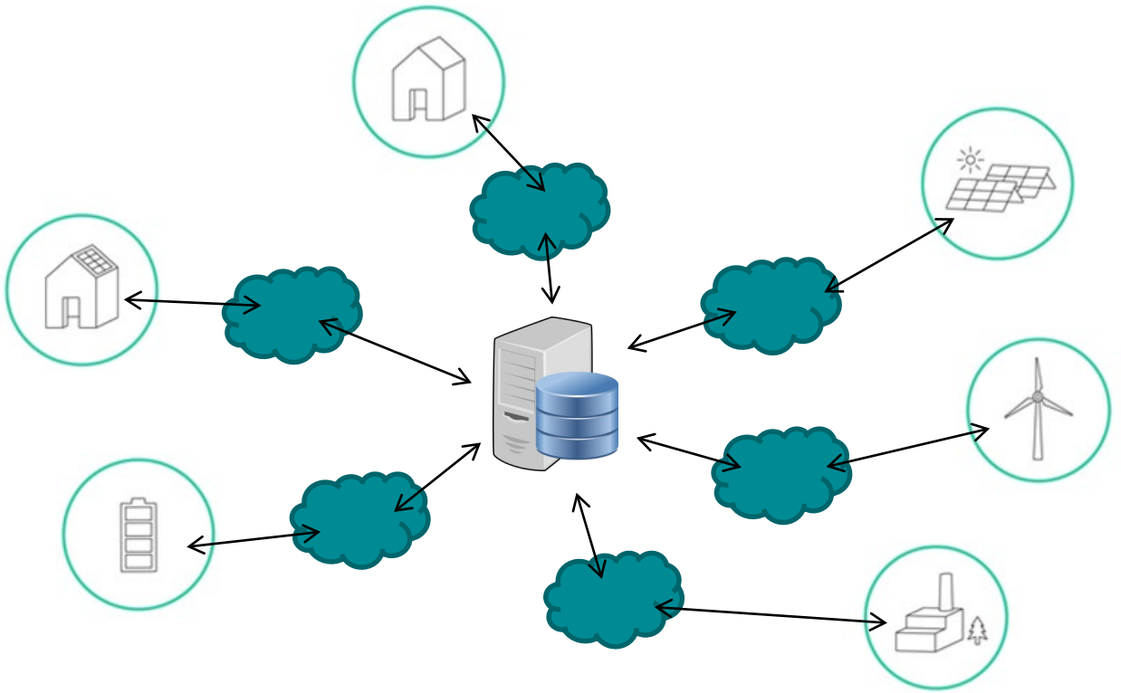


FED optimizes use of energy storage.

FED uses energy efficiently and avoids fossil fuel peaks on the grid.

FED Energy Market – Main characteristics

- Two-sided auction (demand and supply)
- Integrated market for electricity, heating and cooling
- Local infrastructure explicitly included
- Flexibility instruments included
- Locational Marginal Pricing
- Hourly trading, gate closure close before start of hour



FED - bids and flexibility instruments

- Simple bid structure:
  - Energy carrier, hour, supply or demand, location, a single quantity (in kWh) and a single valuation (in currency/kWh)
  - Trading horizon – 9h advisory, 1h final
- Bid valuation:
  - Demand bid: Highest price that the bid will be accepted at
  - Supply bid: The lowest price that the bid will be accepted at
- Bid dependency:
  - A relation between individual bids

FED Energy Market – example market participants

ID	Description
SimpleBld_E	Building, no flexibility, el. only
SimpleBld_H	Building, no flexibility, DH only
TimeBld_E	Building with load shift, el. only
TimeBld_H	Building with load shift, DH only
CarrierBld_EH	Building with energy carrier shift
Grid_E	Electricity retailer
Grid_H	DH retailer
Solar_E	PV panel
HeatPump_EH	Heat pump (cons. el., prod. DH)
CHP_EH	CHP plant (prod. el. and DH)

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FlexiGrid

FlexiGrid project

- H2020 funding, running over 3.5 years, total budget €8.15m
- FlexiGrid will define, test, deploy and demonstrate markets and market mechanisms that incentivise flexibility, in particular for mitigating short-term and long-term congestion
- Peer-to-pool, peer-to-peer and self-adaptive market structures will be developed and demonstrated across four demo sites (Bulgaria, Sweden, Switzerland, Turkey)
- An IoT platform will be developed and utilised in the demos

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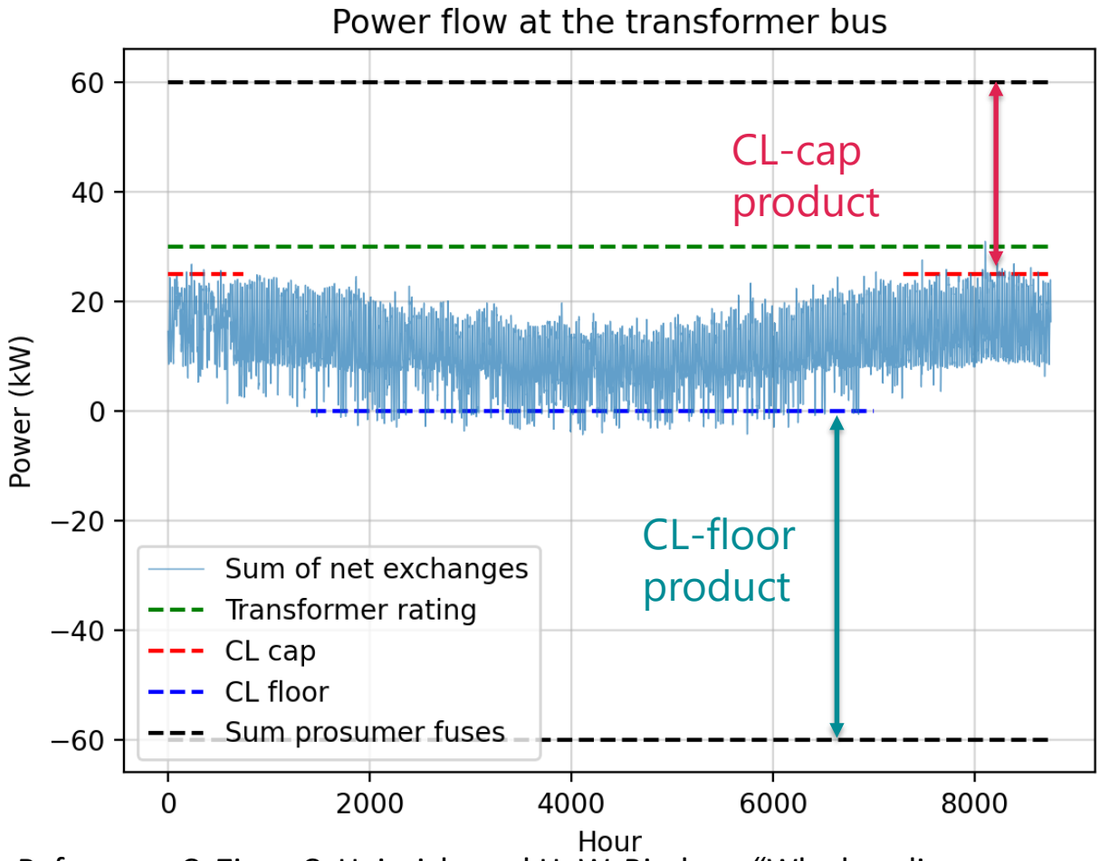
FlexiGrid peer-to-pool market

Traded product - flexibility service, flexibility product, or simply flexibility

- Capacity-limit products
  - Capacity-limit floor (CL-floor product)
  - Capacity-limit cap (CL-cap product)

→ Limiting the sold/bought connection capacity/fuses



Reference: C. Ziras, C. Heinrich, and H. W. Bindner, "Why baselines are not suited for local flexibility markets," *Renewable and Sustainable Energy Reviews*, vol. 135, p. 110357, Jan. 2021

Market actors

- DSO
  - The (main) buyer of the product
- Flexibility service providers:
  - Aggregators
    - The seller of an aggregated product
  - End-user
    - The seller of the product directly to the market or contracted via an aggregator
- Market operator:
  - A neutral, independent party managing the market, receiving the bids, clearing, settlement, etc

Market structure and trading horizons

- **Long-term**: only reservation, an activation price cap from the DSO
  - For reliability, decision making, planning (will not be demonstrated)
  - Payments: Game theory allocation mechanisms
- **Short-term**: activation only
  - The cleared flex providers in the long-term are obliged to bid with prices less or equal to the long-term activation price cap
  - The DSO is obliged to bid with prices more or equal to the long-term activation price cap
  - New competitive providers can participate
  - Payments: Game theory allocation mechanisms
- **Real-time**: adjustments due to forecast errors or failures
  - Everyone can be the buyer or seller
  - Continuous market or auction market (tbd)
  - Payments: Pay-as-bid

Important aspects when designing local markets

- Size of the market
  - Small or granular enough to solve locational problems but big enough to ensure market liquidity
- Value of flexibility
- Accurate measurements – baselines
- Transparency
- Participants and responsibility (e.g. aggregators)
- Interaction with regional/national grid
- Interaction with wholesale markets

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Wenche Tobiasson

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Sector coupling: Overcoming regulatory obstacles with coupled systems (Michael Kalis, IKEM)

The Climate Protection Institute

Institute for climate protection, energy and mobility

27.04.2021 – Michael Kalis

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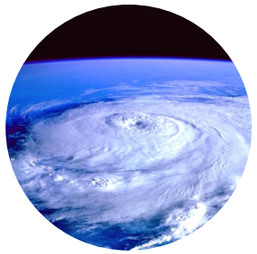
IKEM at a glance

Research

Project Management



NGO

- Founded in 2009
- Non-profit association
- Independent research institute
- Associated research institute of Greifswald University
- Accredited non-governmental organisation with the UN Economic and Social Council
- More than 80 projects with over 200 project partners
- Over 50 employees in Greifswald and Berlin

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Research fields

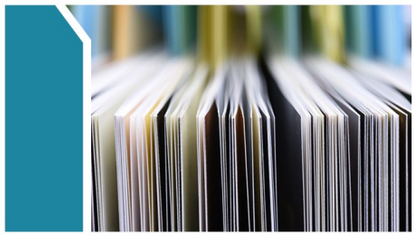
Energy Law

Energy transition in transport

Energy and climate finance

Sustainability & Innovation

Mobility



Science and more

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Sector coupling: Overcoming regulatory obstacles with coupled systems

27.04.2021 – Michael Kalis

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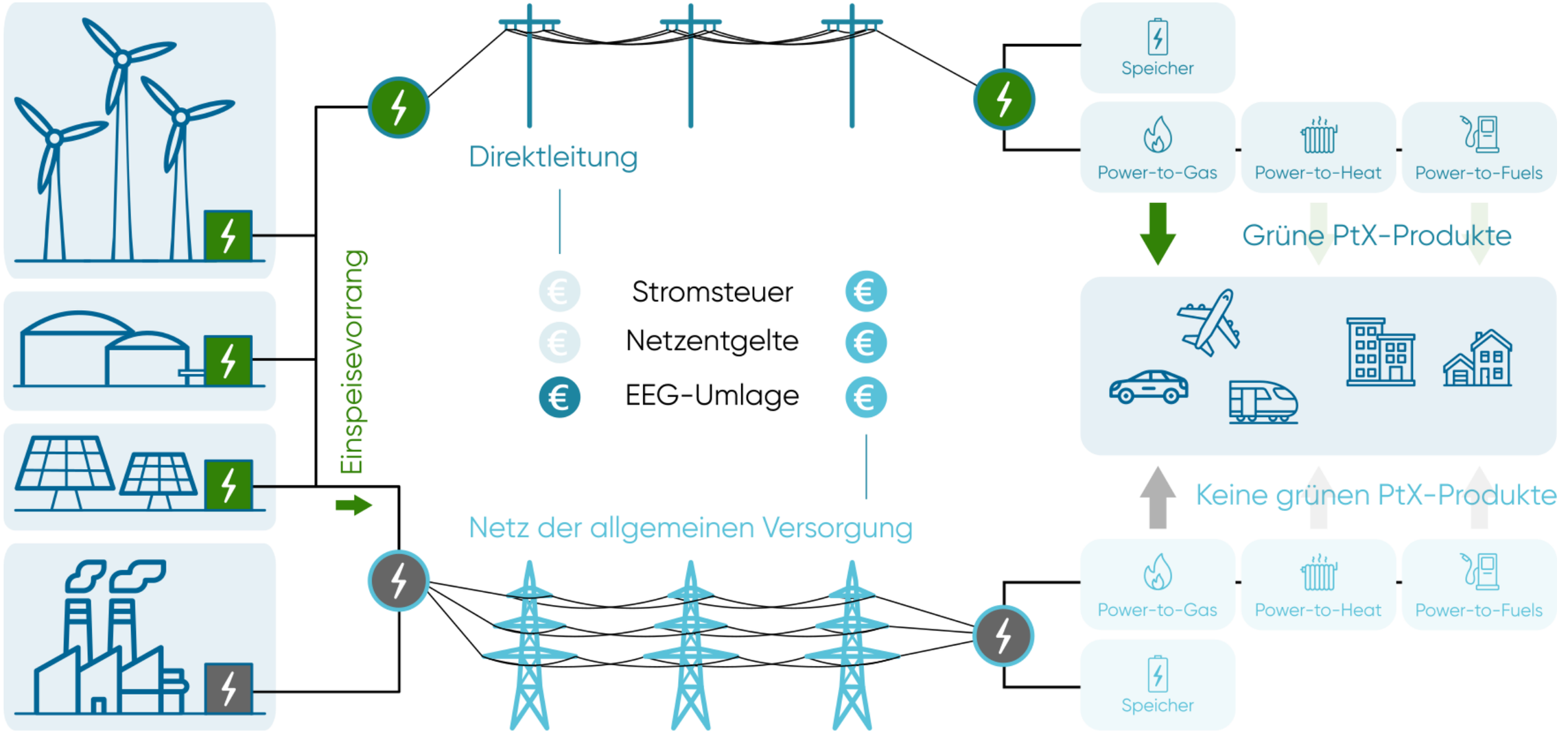
Sector coupling: general regulatory obstacles

- Status quo:
  - Generated and potentially generated electricity from renewable energies partly not used (curtailment)
  - Energy transition with slow progress in transport and heat sector
  - Potential for decarbonization
  - Technology Power-to-X with good technology readiness level
- Regulatory obstacles
  - Sector coupling systems generally have to pay state induced electricity costs (EEG-Umlage, taxes, grid charge)
    - hardly possible to develop a business case
  - Transferring the „green“ (so to say renewable) electricity to the PtX-product when using grid supply is not possible
    - Grid supply is necessary for business case

Status quo



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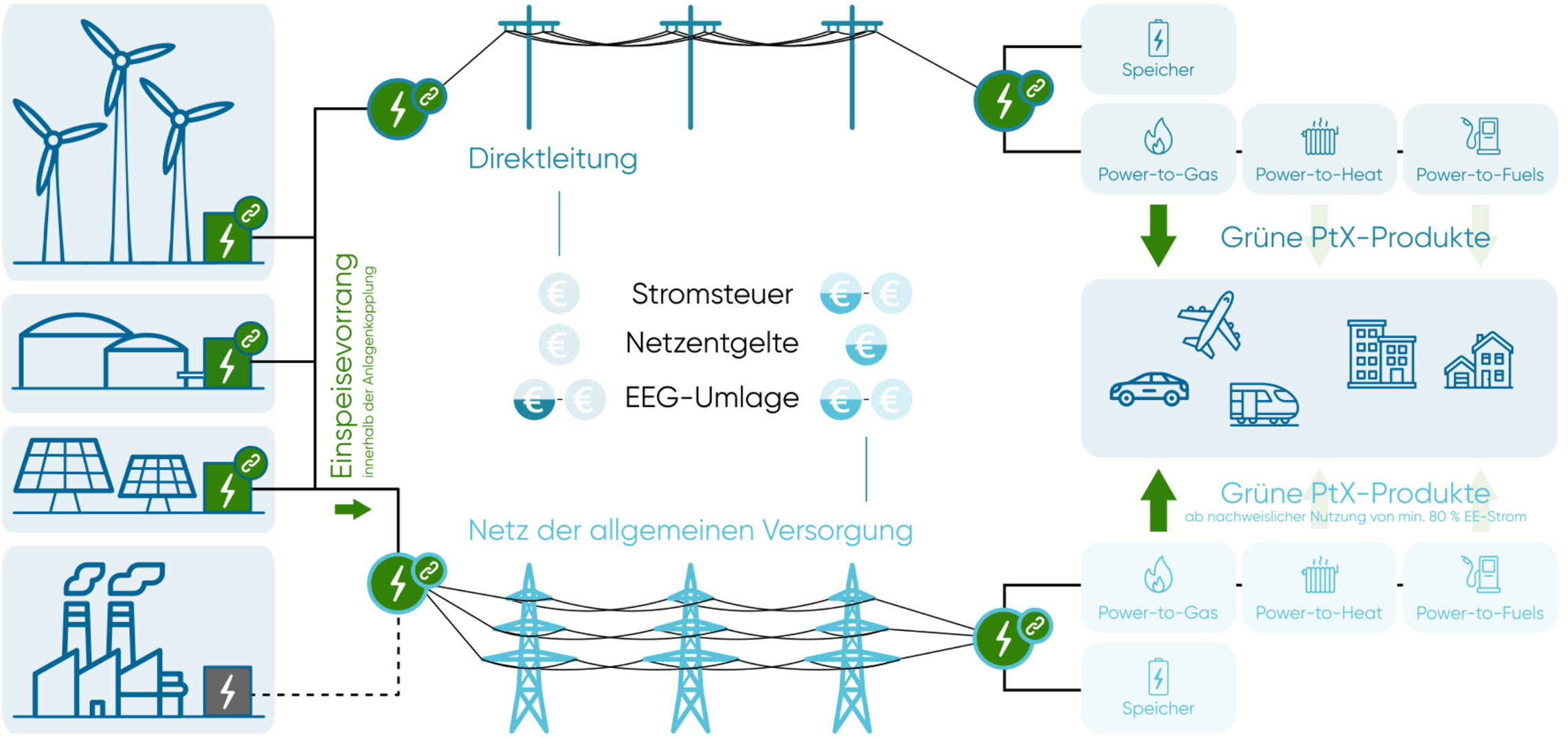
Coupled systems as a new regulatory element



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Main characteristics of coupled systems

- New (legal) definition for facilities, that overcomes the separation of renewable energy facility and sector coupling facility
  - renewable energy facility and sector coupling facility are coupled via direct line or (virtually) via grid
  - Coordinated energy generation and energy demand
- Far predominantly use of renewable energy
  - 80 % renewable energy necessary (Green PPA with quarter of an hour balancing)
  - Instead of common criteria „solely“
- New renewable energy facility to ensure additionallity
  - New renewable energy facility without financial aid and not accounted to expansion path

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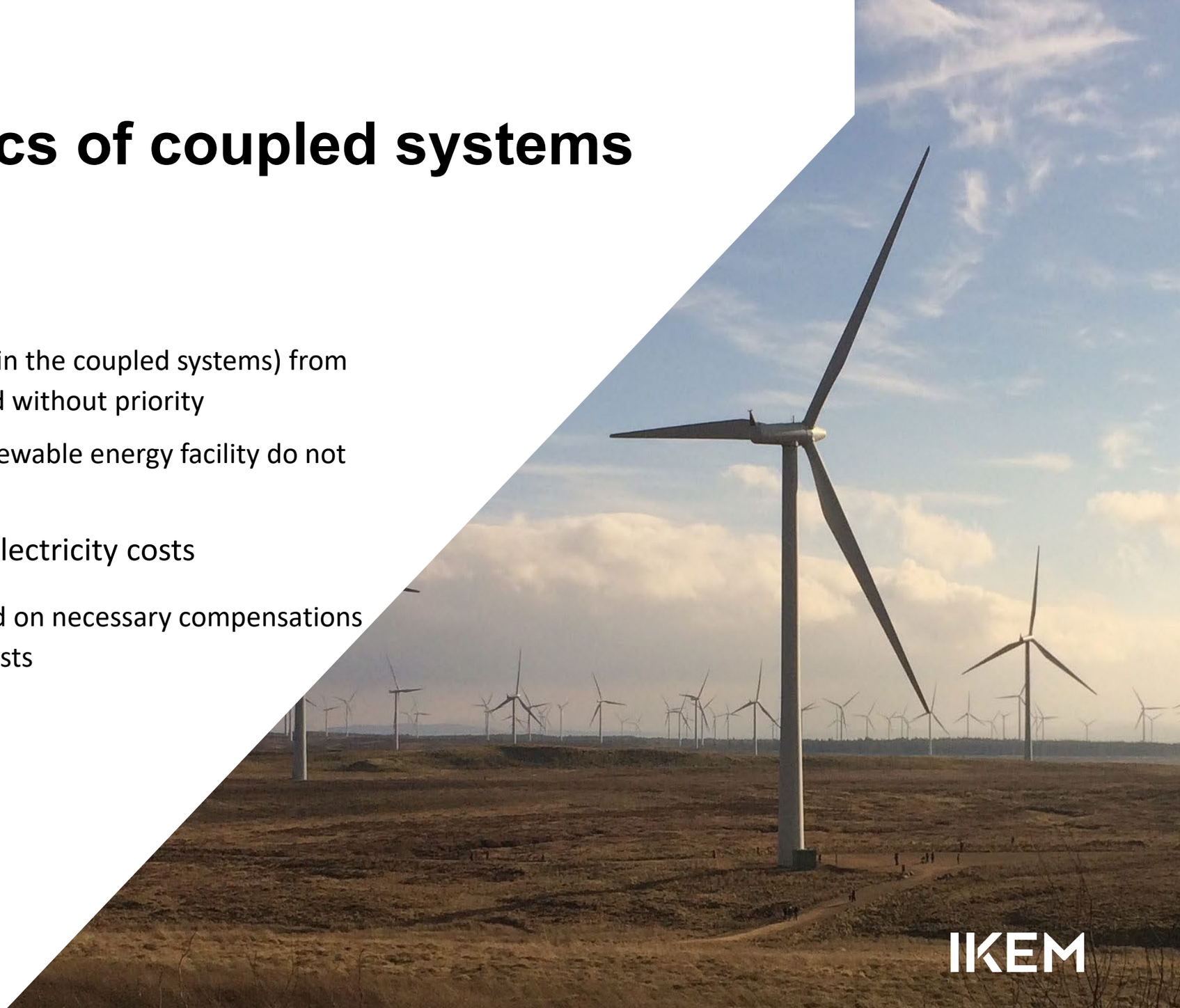
Main characteristics of coupled systems

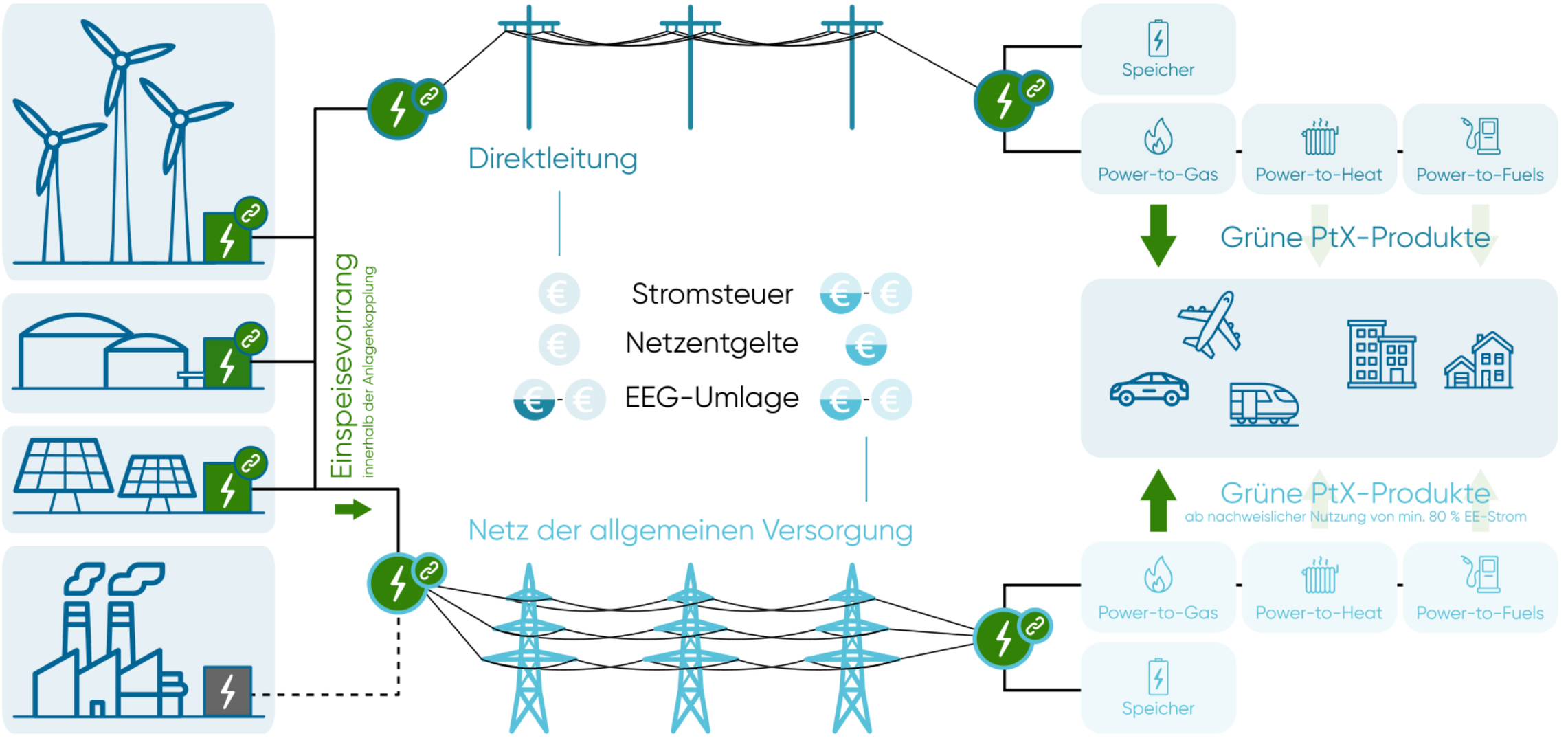
- Dispatchable renewable energy
  - Renewable energy (not used in the coupled systems) from the coupled systems feed grid without priority
  - Coupled PtX, storage and renewable energy facility do not supply volatile
- Compensation of state induced electricity costs
  - In tender coupled systems bid on necessary compensations of state induced electricity costs



Put into perspective: Coupled systems under the RED II?

- Art. 27 III RED II (recital 90): ***Electricity*** *that has been taken* ***from the grid*** *may be* ***counted as fully renewable*** *provided that it is* ***produced exclusively from renewable*** *sources and the renewable properties and other appropriate criteria have been demonstrated, ensuring that the* ***renewable properties*** *of that electricity are* ***claimed only once*** *and* ***only in one end-use sector****.*
  - bilateral renewables power purchase agreement
  - temporal and geographical correlation
  - element of additionality

Coupled facilities as a new regulatory element



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Thank you for your attention

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Overview on different business models and the regulatory framework for hybrid energy networks (Dennis Cronbach, Fraunhofer IEE/ Inger-Lise Svensson, RISE)

IEA TS3 Webinar
On business models & regulatory boundary conditions for hybrid networks

Dennis Cronbach

Inger-Lise Svensson

April 27th 2021

Questions to answer

- What trends can be identified regarding new business strategies for hybrid energy grids?
- What obstacles can be identified for implementing sector coupling strategies?
- Regarding obstacles: What solution approaches exist?
- Are there parallels between different countries?

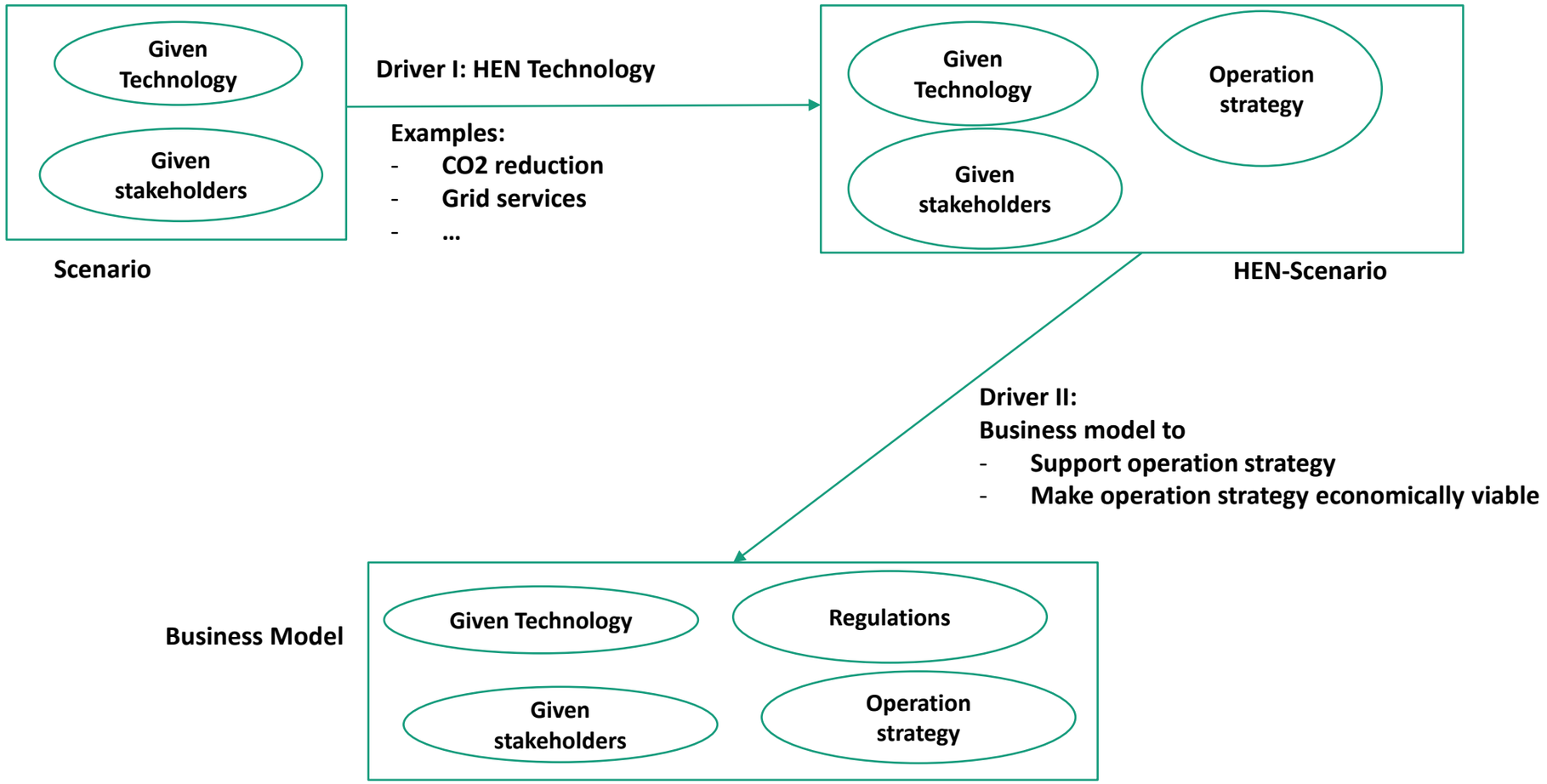
Tools to answer these questions

- Information about projects, contributed by Annex partners
- Studies on the topic

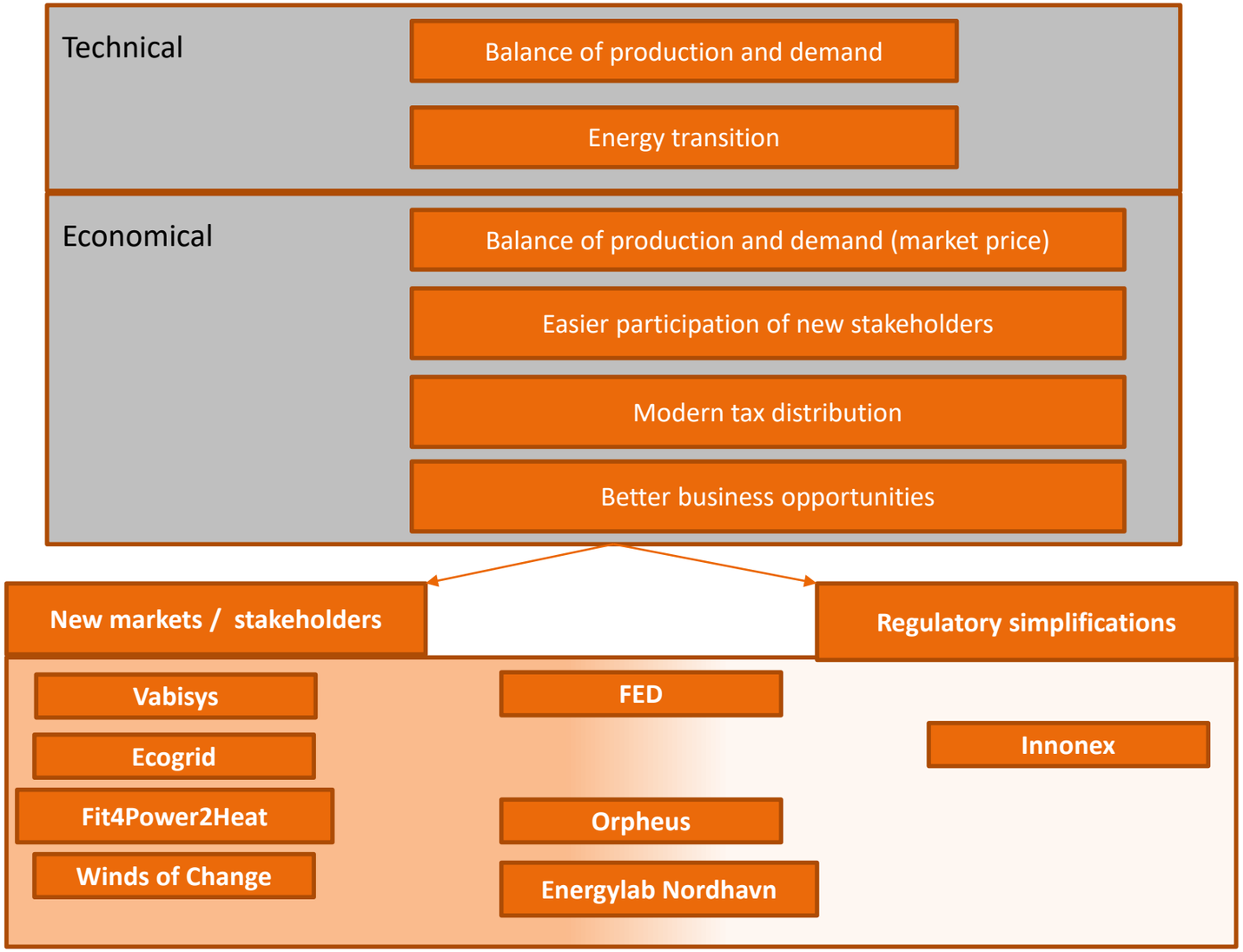
Known problems

- Partner contributions cover only a small amount of EU countries
- Additional literature research is biased via pay walls and the research focus of the own institute
- Topic could fill an annex on its own

Trends & drivers I

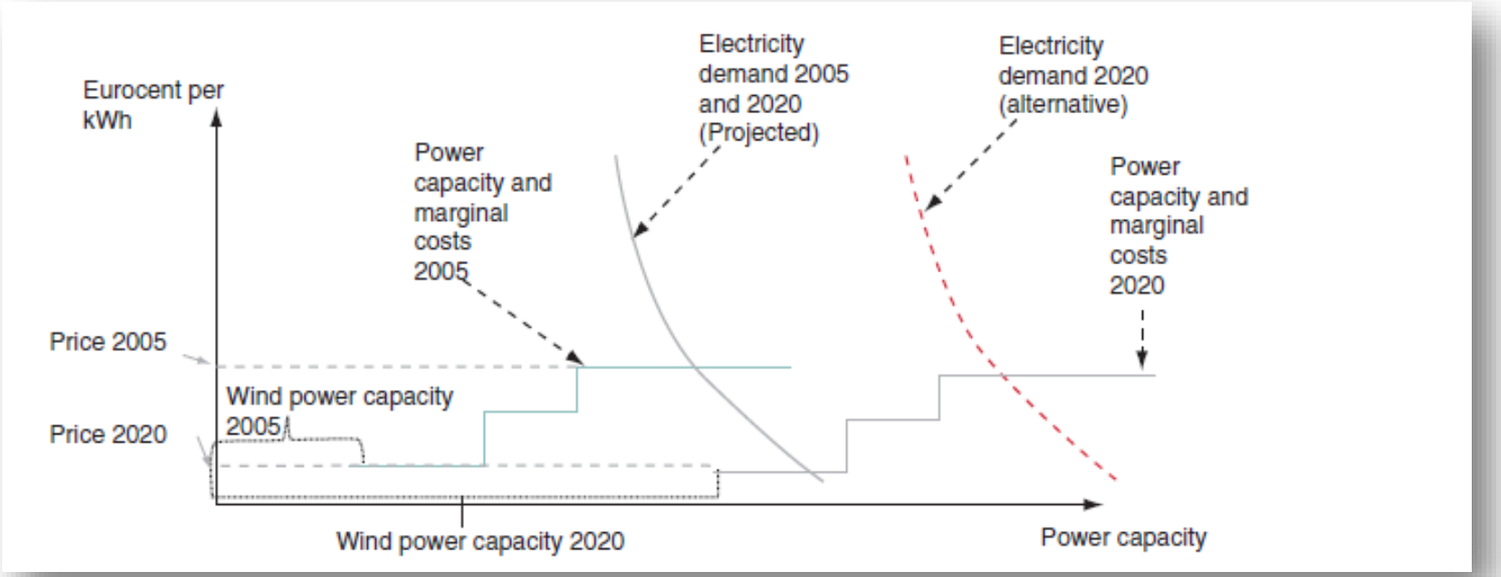


Trends & drivers II



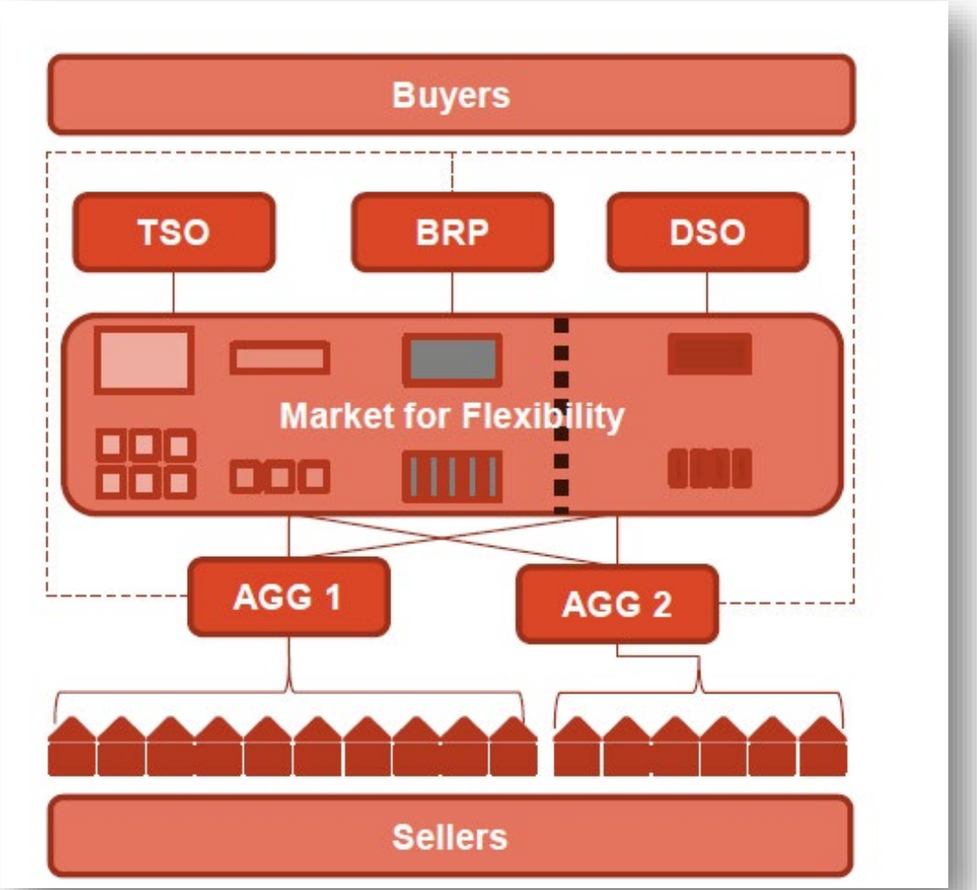
Danish contributions

- Denmark has a large share of wind energy
- Wind parks often are not economically feasible under market conditions
- PSO subsidy phases out and is replaced by a structure with unknown efficiency
- Sector integration and its flexibility provides a solution to make RES more feasible
- Recently finished projects proposed business concepts and regulatory modifications to support business strategies for integrated energy approaches
- More or less similar examinations are done in other European countries
- Figure and statements taken from [1]



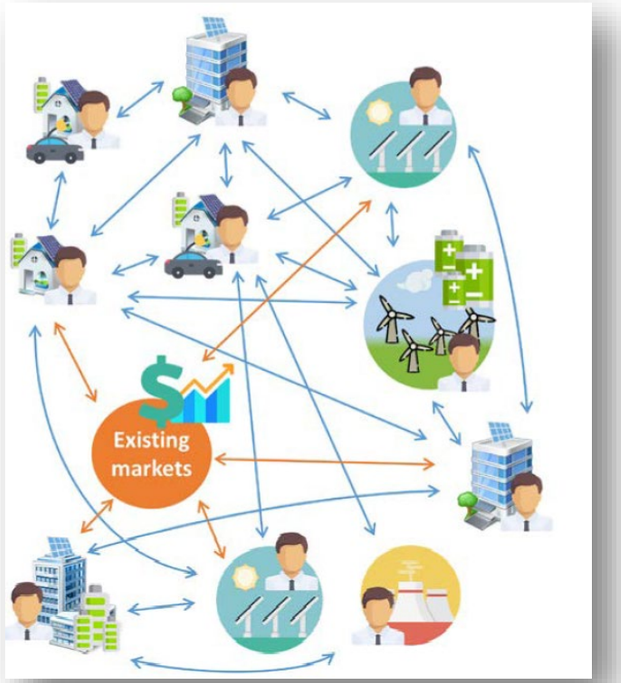
Ecogrid EU & 2.0

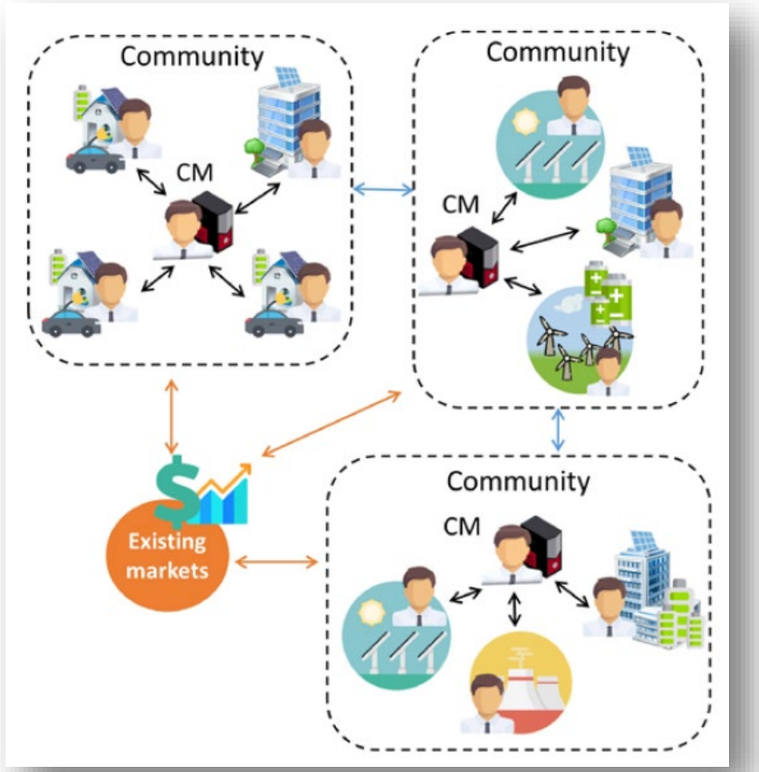
- New type of market in order to balance electricity production and consumption
- Follow up project finished in 2019
- Market model was tested on the isle of Bornholm
- Coupling point devices like heat pumps and heaters are controlled by market prices sent to the customers
- Aggregators are the interface between the households and buyers of flexibility
- Figure and statements taken from [2]



Energylab Nordhavn

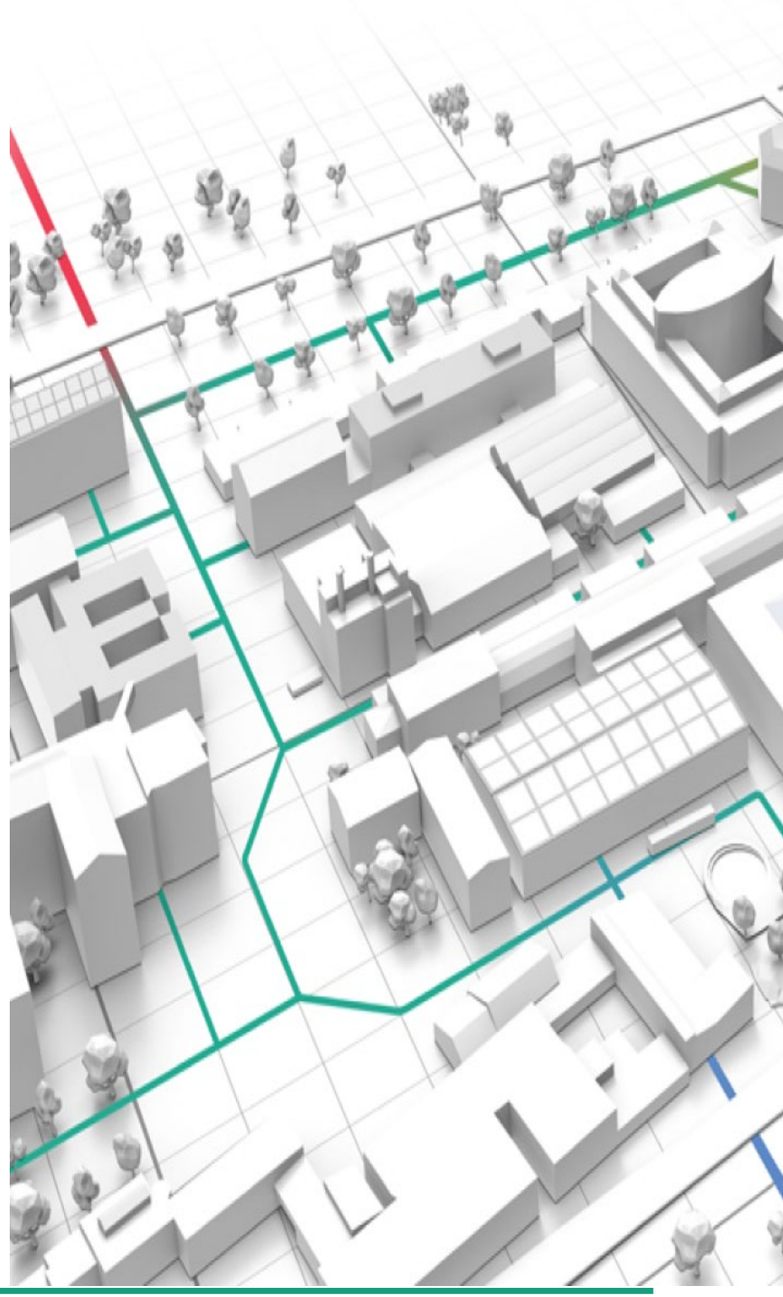
- A part of Copenhagen was used to test and demonstrate future energy solutions
- Among many other project results, new market models were suggested (2019)
- Figures and statements taken from [3]





FED – Fossil free energy districts

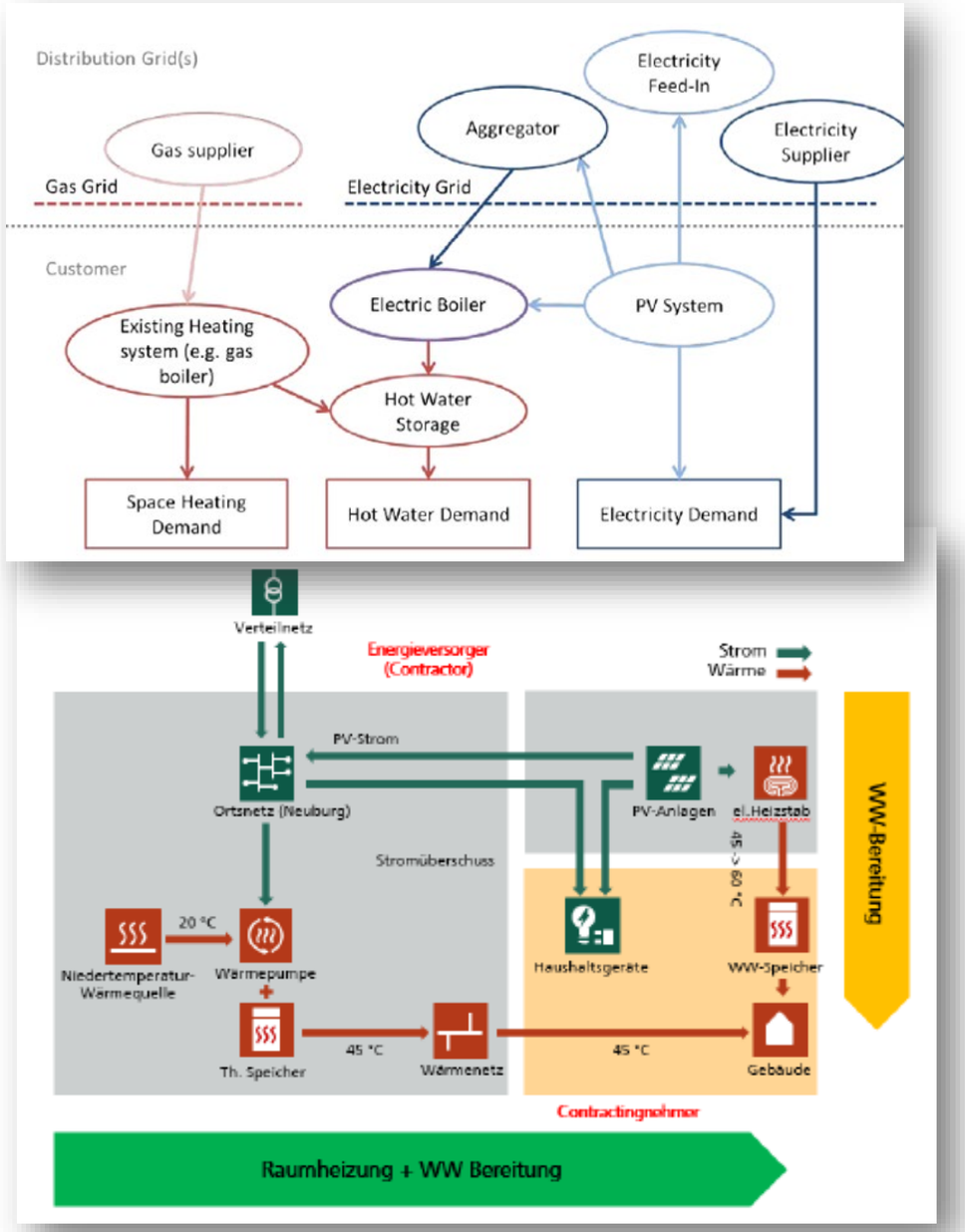
- Energy demand and supply matching function.
- Integrating different energy carriers (heating, cooling, electricity).
- Defines prices and transactions.
- Energy market and system service market
- Hourly market settlement
- All producers and consumers represented by software agents, bidding to the market



Orpheus/Innonex

Similarities between the projects:

- Situated in Germany
- Development of operation strategies for the usage of PV excess power
- Assumptions for regulatory boundary conditions necessary in both cases
- In Innonex, the „Anlagenkopplung“ was shortly discussed as solution concept
- Figures and statements taken from [4] and [5]



Outlook on energy communities

Renewable Energy	Citizen Energy
No big companies allowed	Everyone can participate
RE can be shared among participants	Only electricity
All forms of energy are addressed	Not necessarily local
Local community	

Taken from [6]

Literature

- [1] Maxwell, V.; Perling, K.; Hvelplund, F.: Electricity cost effects of expanding wind power and integrating energy sectors, International Journal of Sustainable Energy Planning and Management Vol. 06 31-38, 2015
- [2] DTU; Dansk Energi; IBM et al.: Ecogrid 2.0 – Main Results and Findings, 2019
- [3] Mitridati, L.; Market-Based Coordination of Heat and Electricity Systems; DTU, 2019
- [4] Ventury GmbH et al.: Innovative Versorgung von Wärmenetzen mit niederkalorischen Abwärmequellen und Matrixsteuerung für Wärmenetzmanagement, PTJ, 2020
- [5] Schwabeneder, D.; Auer, H.; Burgholzer, B.: WP2 Technical, Economical and Social Benefits Deliverable 2.5: Report on the validation of technical, economical and social benefits in the different demonstration sites with special consideration of robustness tests of business model design, Orpheus project, 2017
- [6] Caramizaru, A.; Uihlein, A.: Energy communities: an overview of energy and social innovation, JRC Science for Policy Report, 2020

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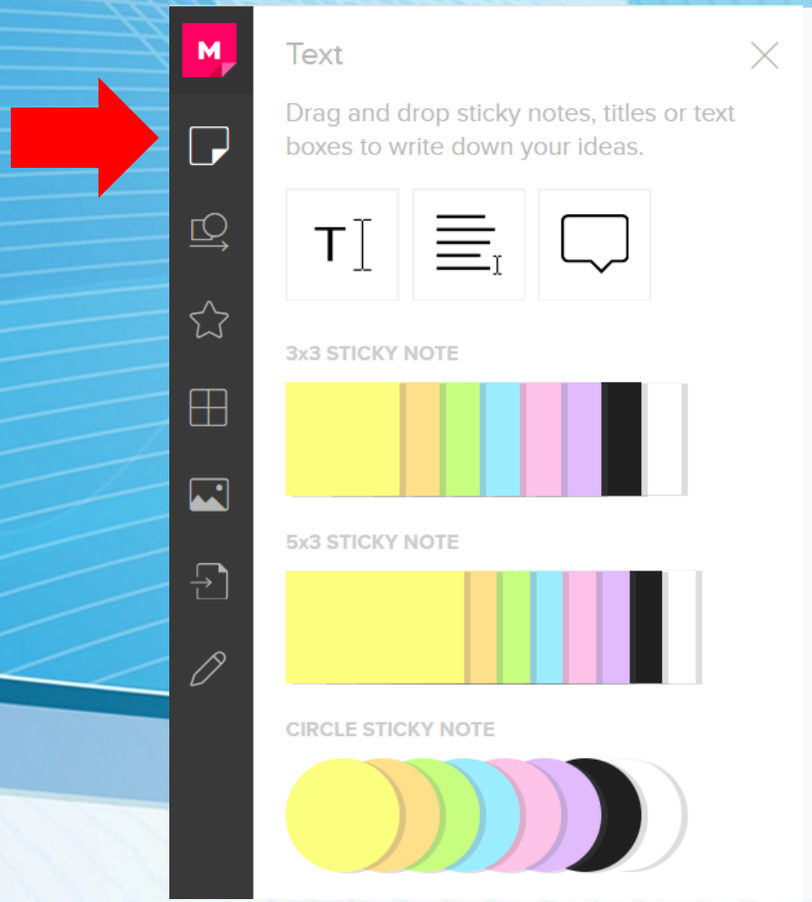
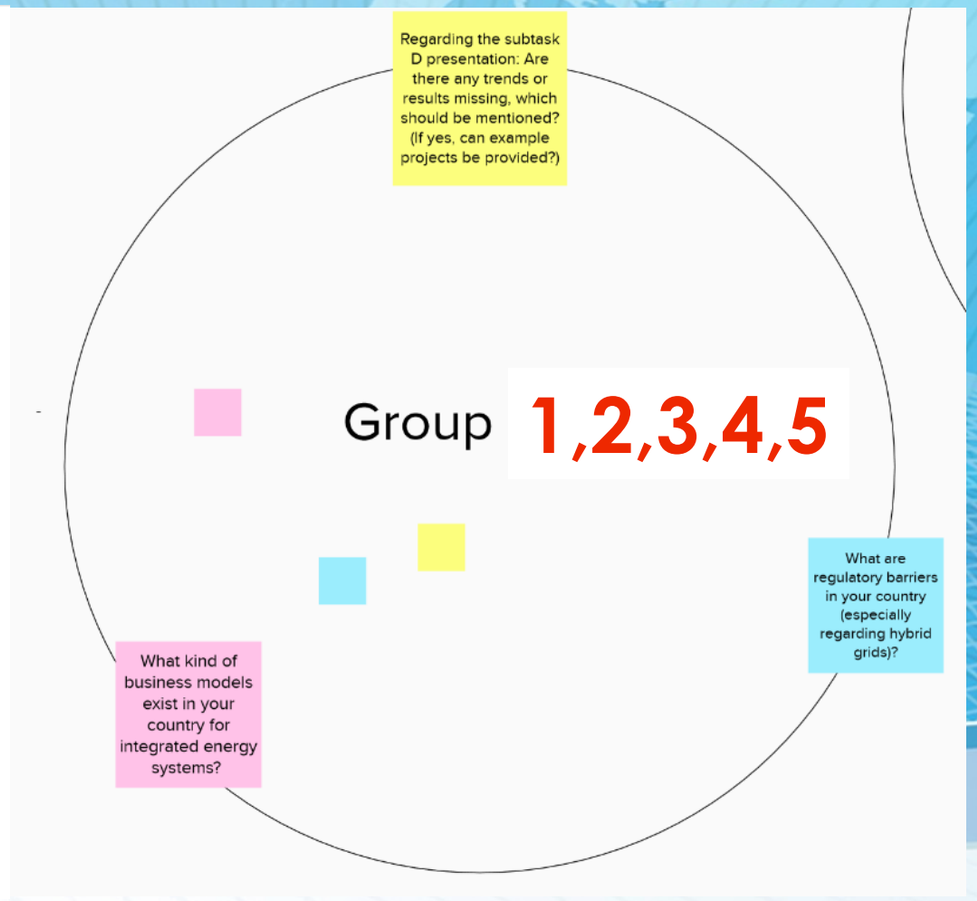
Discussions and feedback in breakout sessions

Discussions and feedback in breakout sessions





mural

Discussions and feedback in breakout sessions

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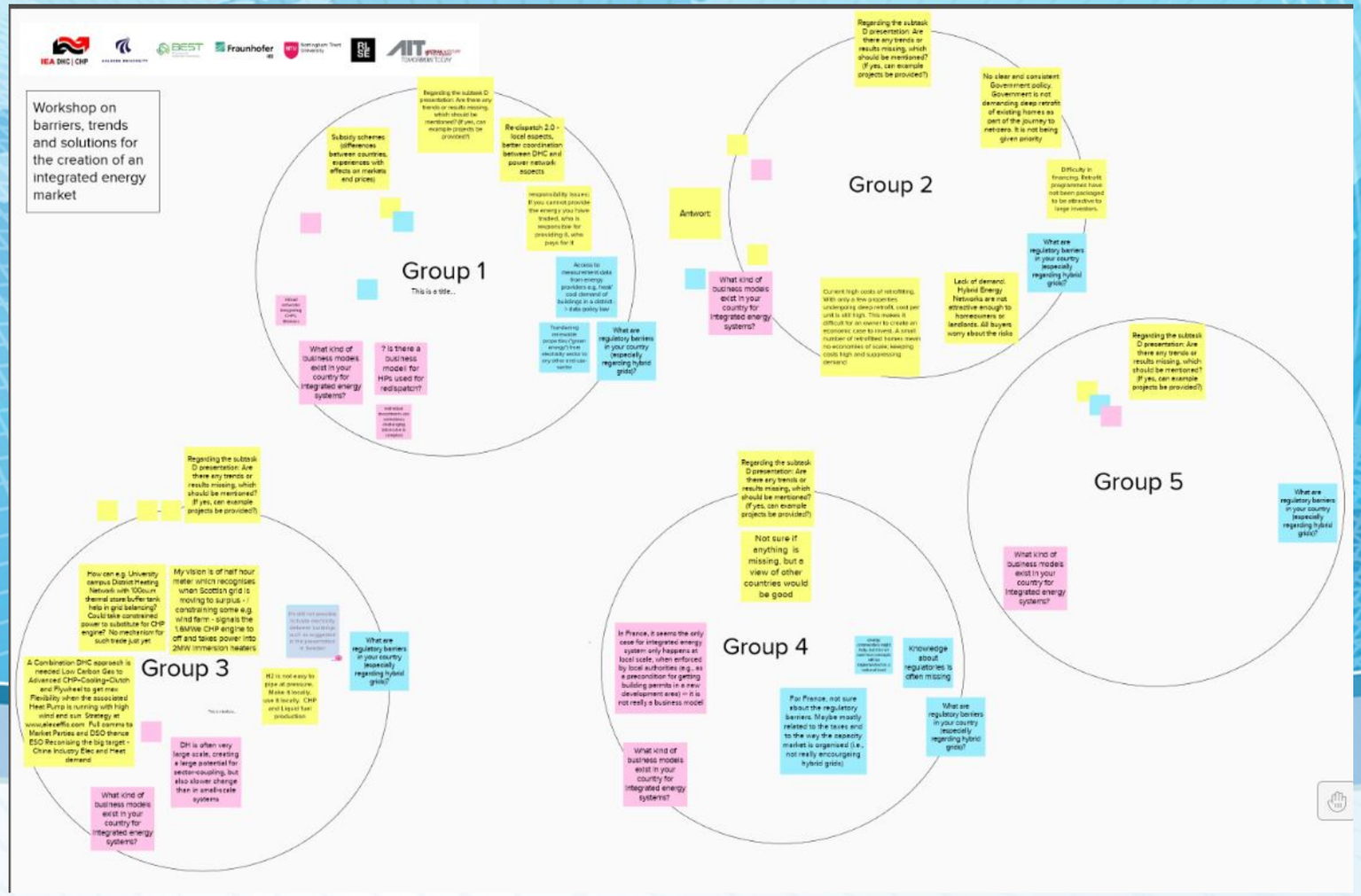
Discussions and feedback in breakout sessions



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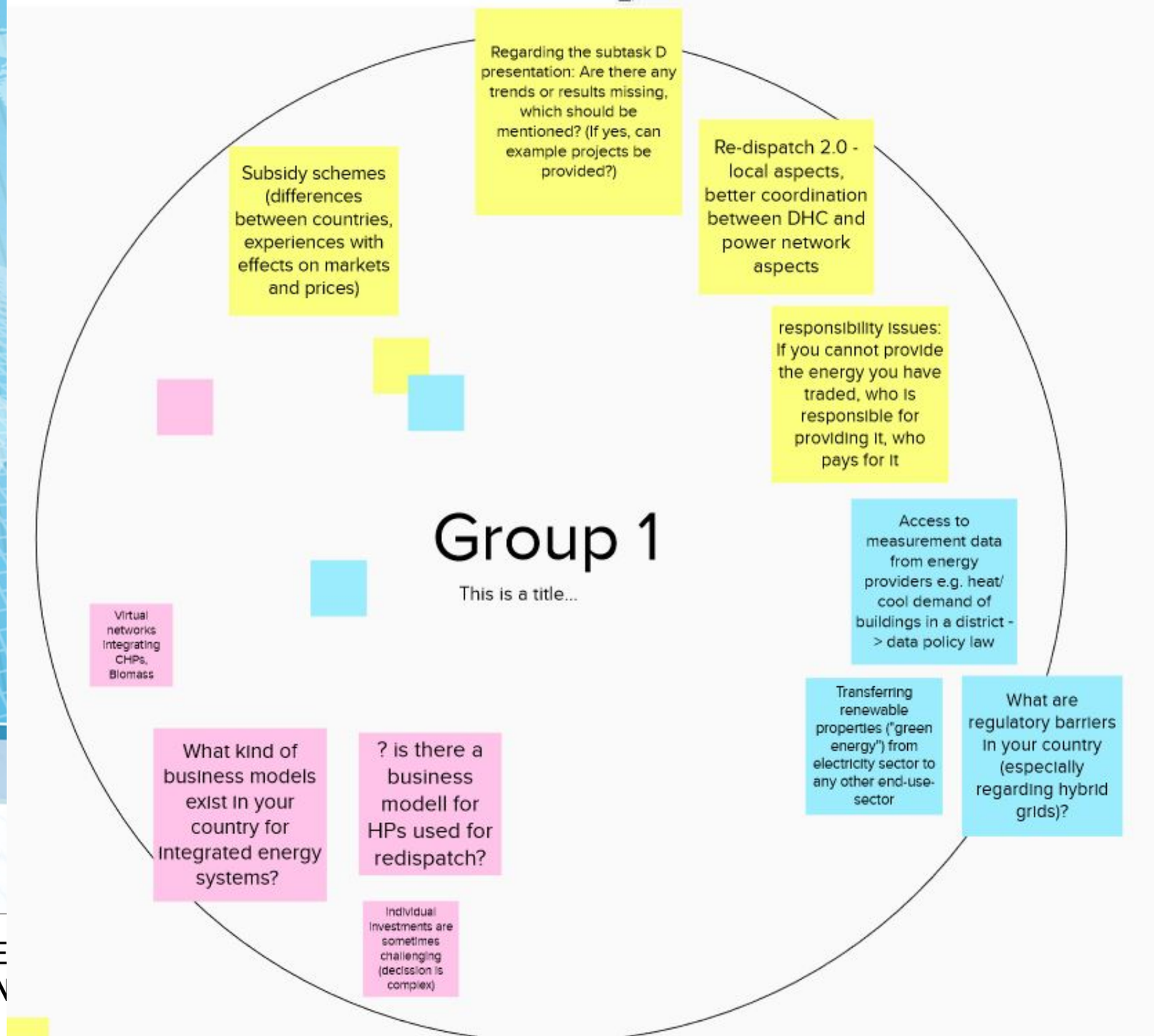

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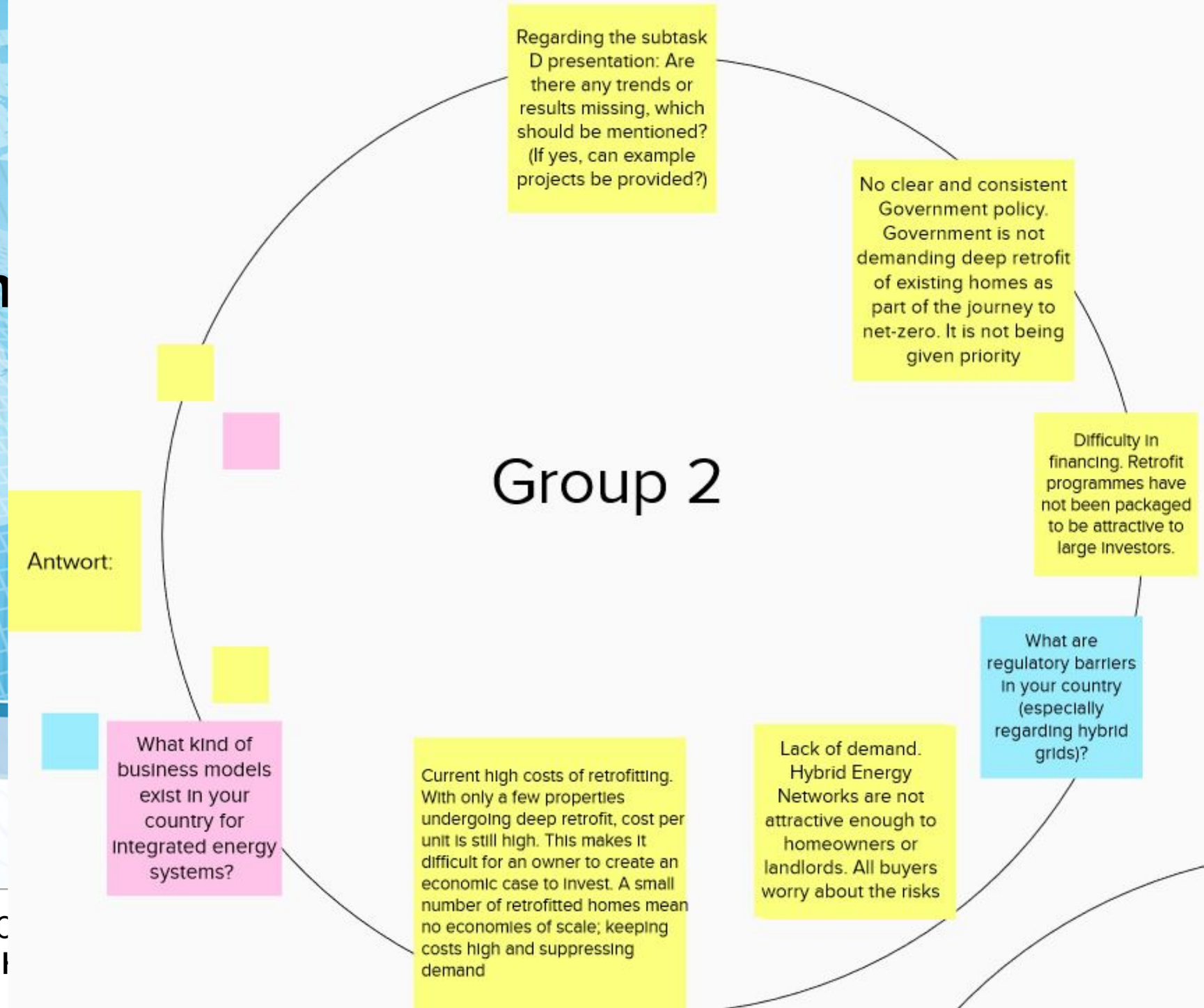
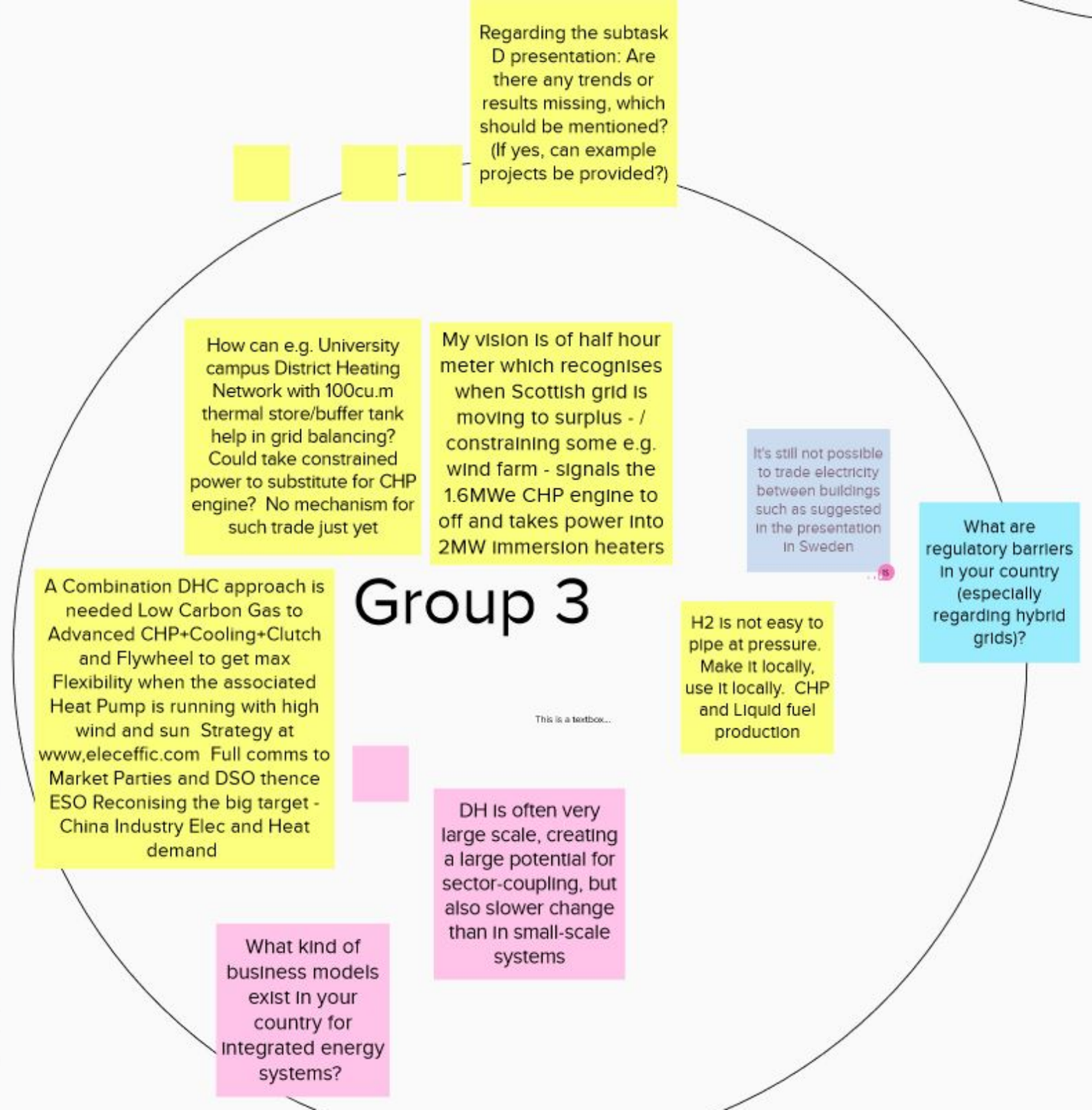


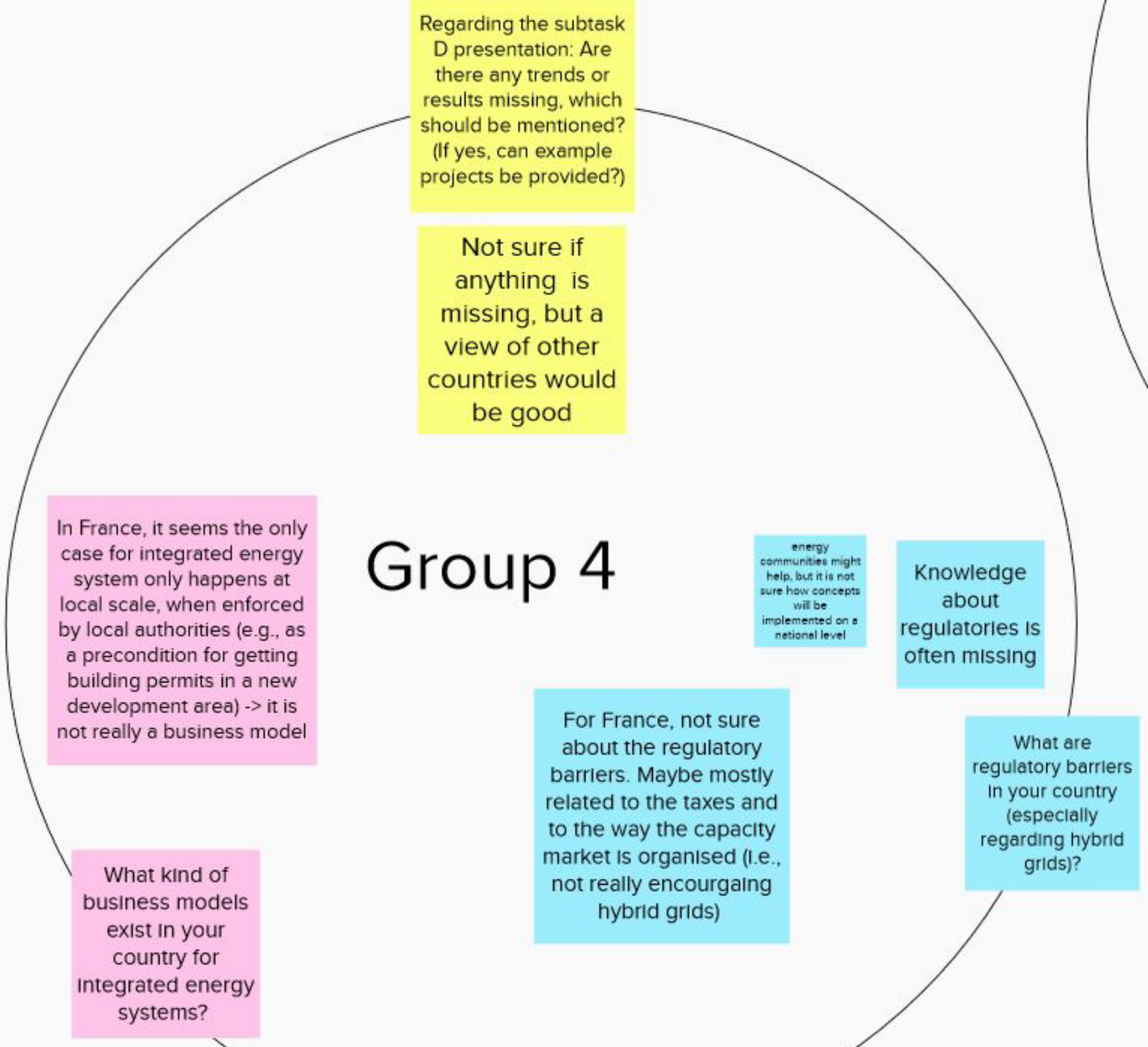
IEA DHC|CHP

INTERNATIC
DISTRICT

Discussions and feedback in breakout sessions



Discussions and feedback in breakout sessions



note on other events

Invitation to the Webinar on

IEA DHC Annex TS7: Industry-DHC Symbiosis

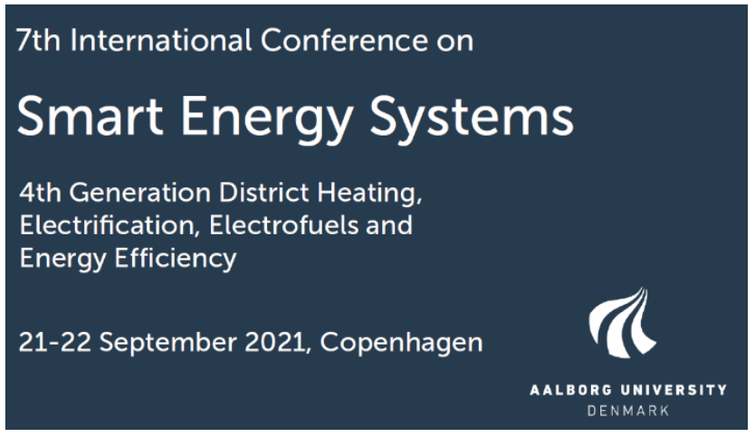
"A systemic approach for highly integrated industrial and thermal energy systems"

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/

Group photo - please smile

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**