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On the status of energy communities' integration in existing energy markets

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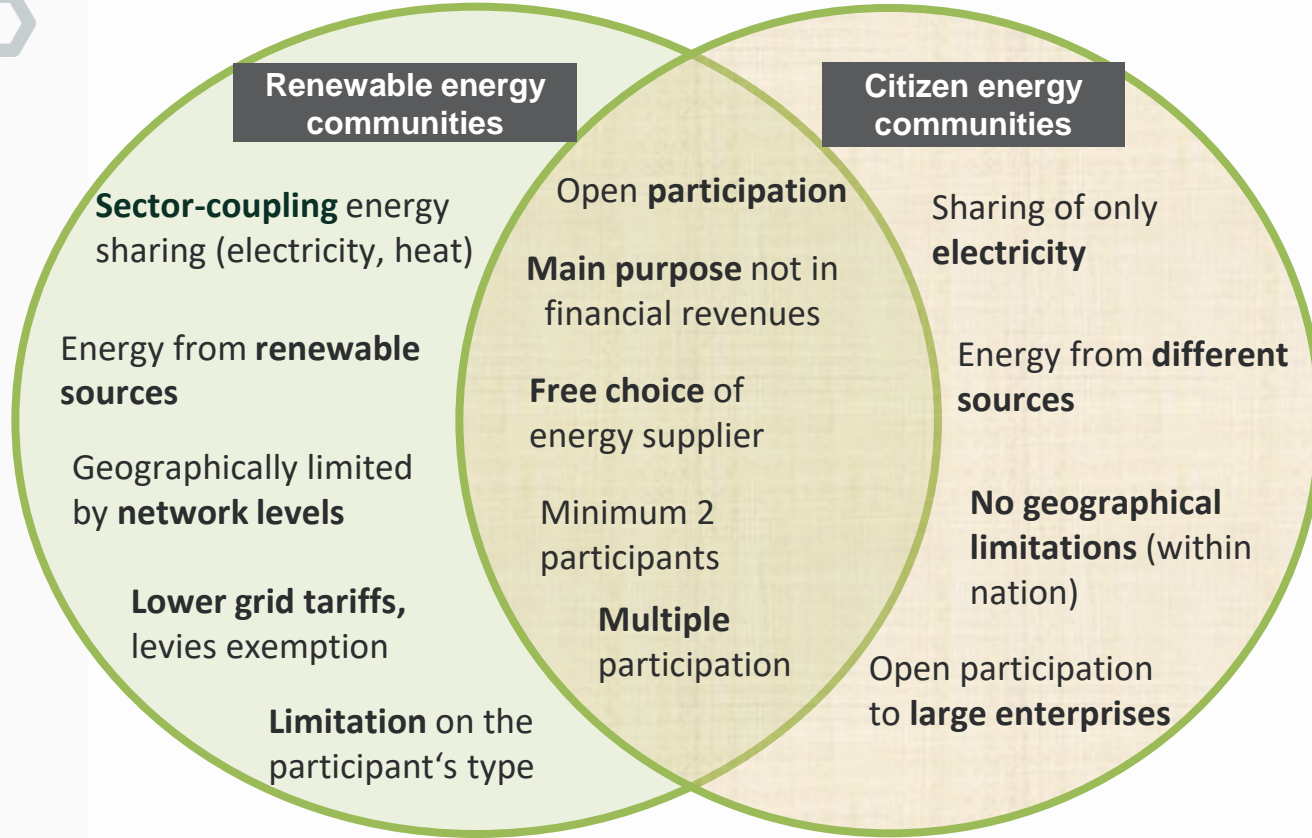
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Energy communities in AT



Different EC, different purposes

RECs

- Sector-coupling
- Renewable sources
- Proximity criteria
- Sharing incentive

CECs

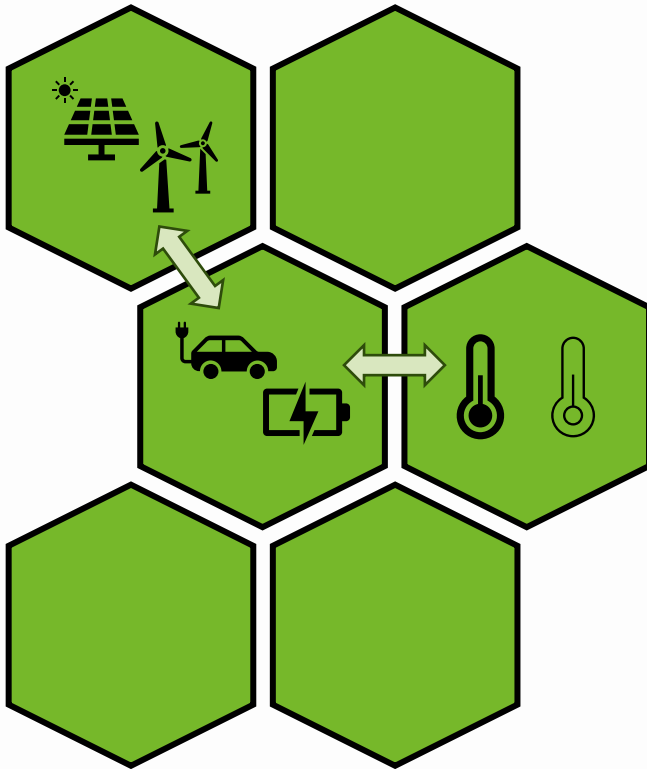
- Electricity
- All sources
- Nation-wide
- Few incentives



Energy communities in AT

- No optimization needed → ex-post allocation energy from DSO using
 - A standard platform ([EDA](#))
 - A **static** or **dynamic** key for the allocation
 - 15-minutes measurements from participants' smart meters
- Free choice of **supplier: one** community → **many** suppliers
- Members in RECs and CECs can provide flexibility externally individually or through **aggregation** → *Opportunities for EC members in electricity markets*

Energy cells concept



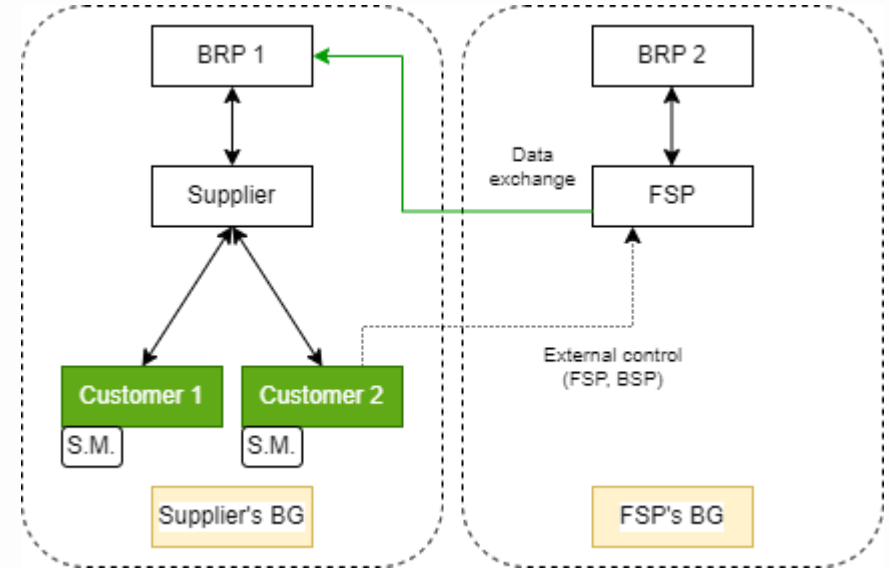
- **Sector-coupling ECs:**
 - Renewable electricity
 - Sustainable mobility
 - District heating and cooling
 - Hydrogen production
 - **Cellular energy system:**
 - *Physically* connected through energy networks
 - *Virtually* connected through communication infrastructures
- *There are issues to be solved **locally** first, to upscale benefits **regionally***

Energy markets in AT

- Aggregators generally in a **different balancing group*** w.r.t. the energy supplier
- **Supplier** are affected by **aggregators** and **energy community**:
 - *rebound/catch-up effects* post activations (aggregator).
 - Responsibility over imbalances (community members)

→ **Interaction of supplier and aggregator/energy community is not (yet) fully defined** ([Perger et al.](#))

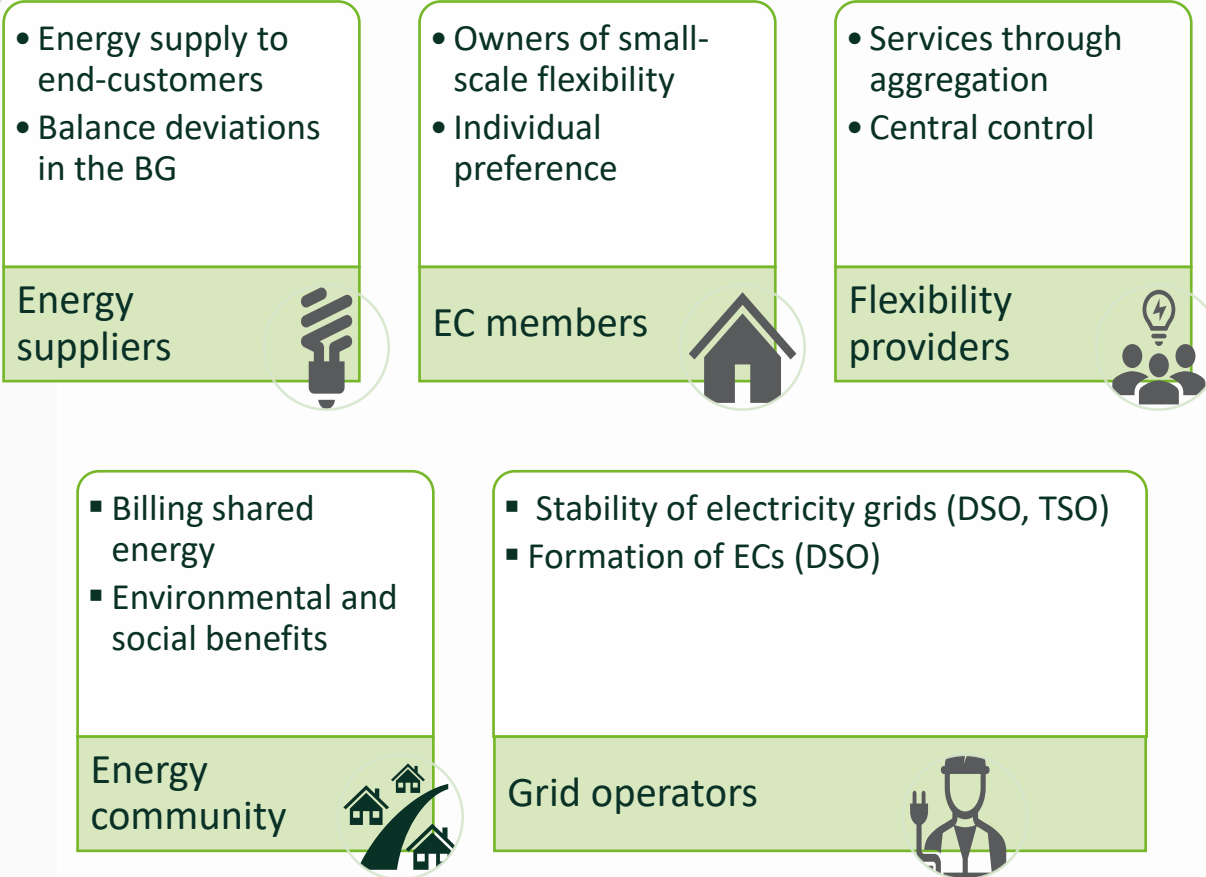
→ **Ongoing integration of energy communities into energy markets**



APCS, [Annex Imbalance Energy Management \(T&C - BGC\)](#).
APCS, [General Terms and Conditions of Business of the Balance Group Coordinator Modalities for System Balancing – Balance Group Representative](#).
E-Control, [Möglichkeiten zur Umsetzung der Marktrolle des unabhängigen Aggregators](#)
DIRECTIVE (EU) 2019/944 (EMD): <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944&from=EN>

* In AT, all producer/consumers are assigned to a balancing group where balancing responsible parties (BRP) are financially responsible for imbalances between demand and generation

Stakeholders for market-integrated energy community



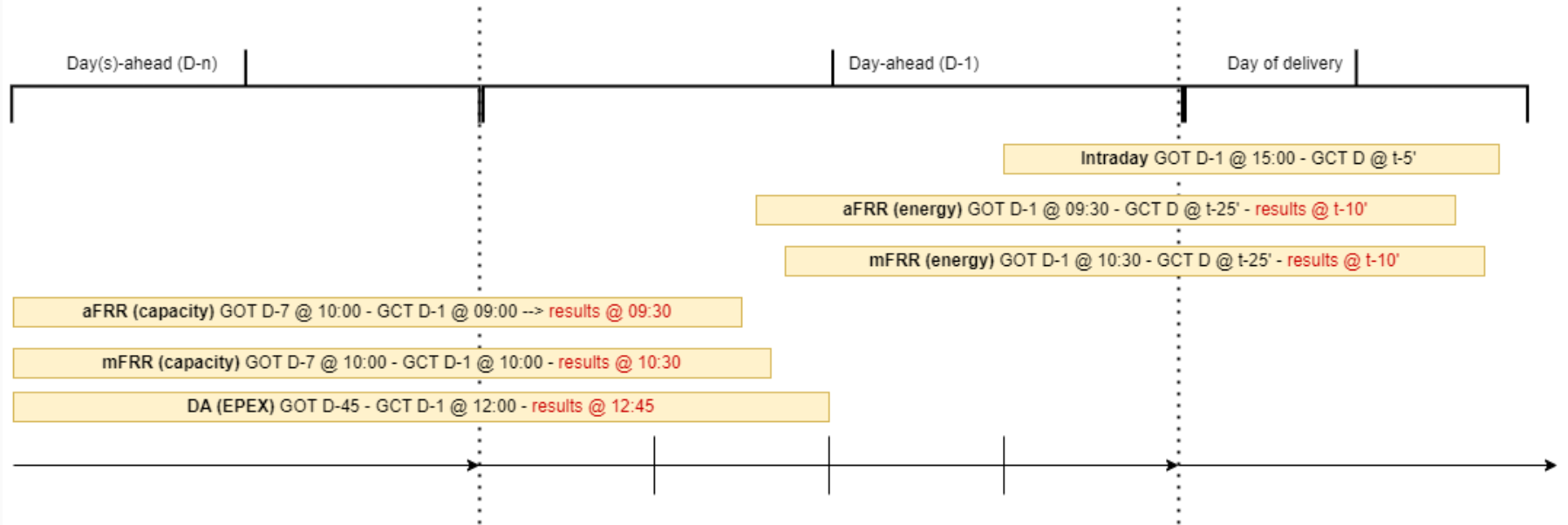
Many actors involved:

- Different roles
- Different responsibilities
- Different interests

Stakeholders need to:

- Exchange information (real-time, forecasts) with defined communication protocols
- Via to be designed **platforms**

Energy markets in AT



Information exchange must fit into:

- **Markets** gate opening/closing time
- **Regulatory** terms, conditions, responsibilities



Market-active energy communities must be integrated in all market processes

Energy markets in AT: <https://markt.apg.at/>

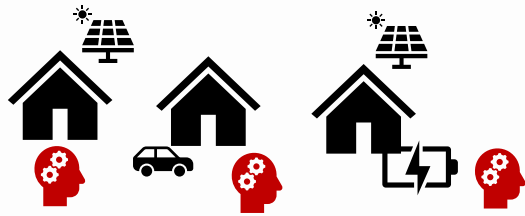
EPEX SPOT day-ahead market: <https://www.epexspot.com/en>



Control concepts for market integration of energy communities

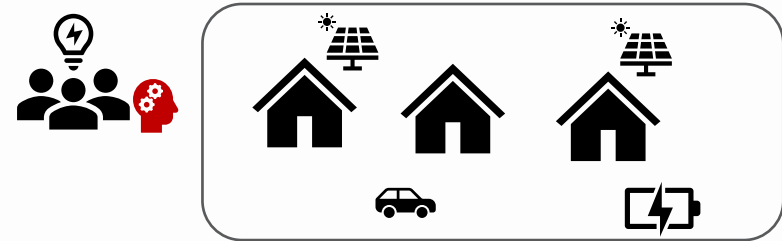
Two general basic control concepts to integrate ECs into the markets:

1. Indirect control



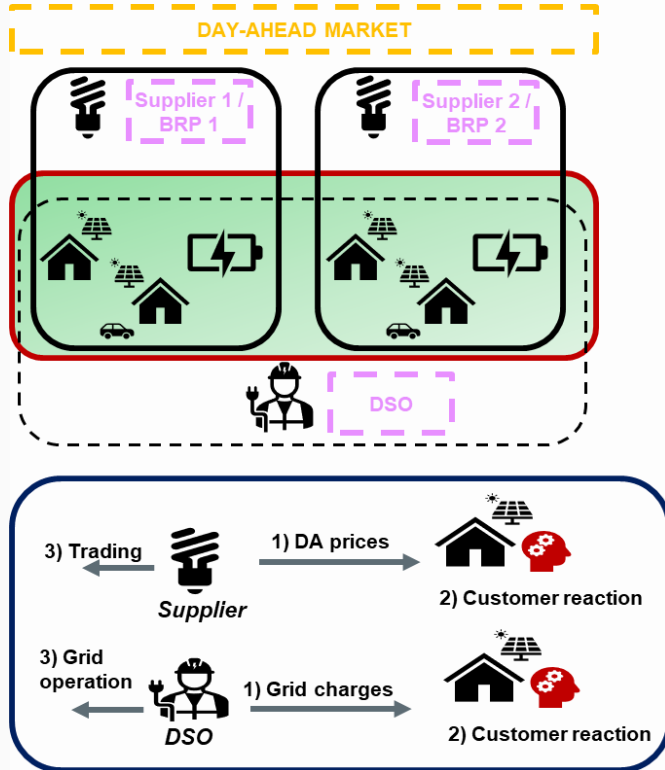
- I. **Individual and distributed** optimization
- II. End-user's objectives and interests
- III. Reaction/schedules **not** communicated

2. Direct control



- I. **Community and centralized** optimization
- II. Community's objective and interests
- III. Reaction/schedules communicated

Indirect control



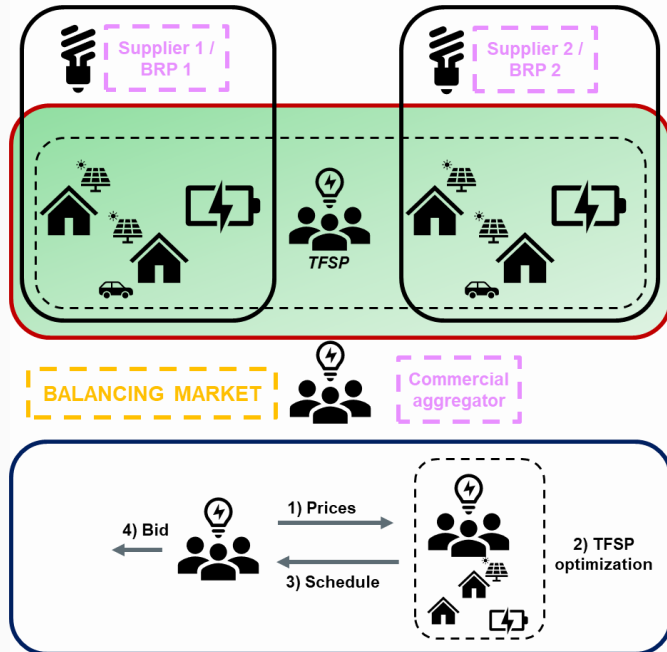
- Participants **may** react to:
 - Market-based tariffs (suppliers)
 - Dynamic grid fees (DSO)

- ✓ Low commitment and responsibilities on schedules
- ✓ Lower energy/grid costs
- x Uncertain participants' reaction
- x Community suboptimal coordination

→ Suitable especially for day-ahead and increase of own consumption

→ For fast activations (balancing market, intraday market) direct control is needed

Direct control: example aFRR



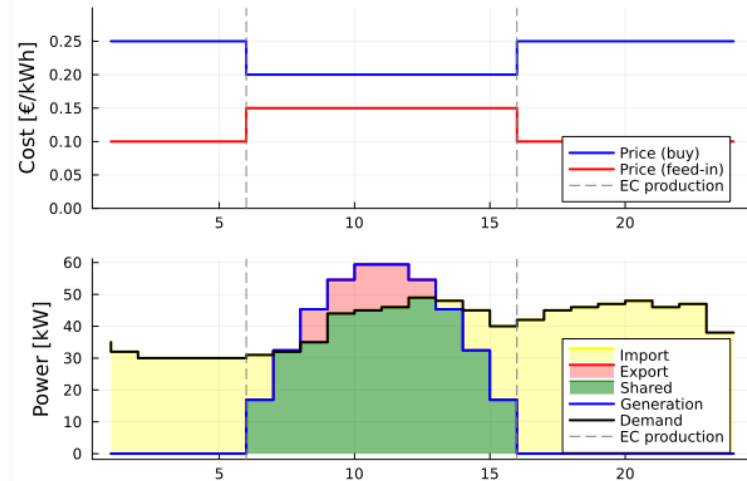
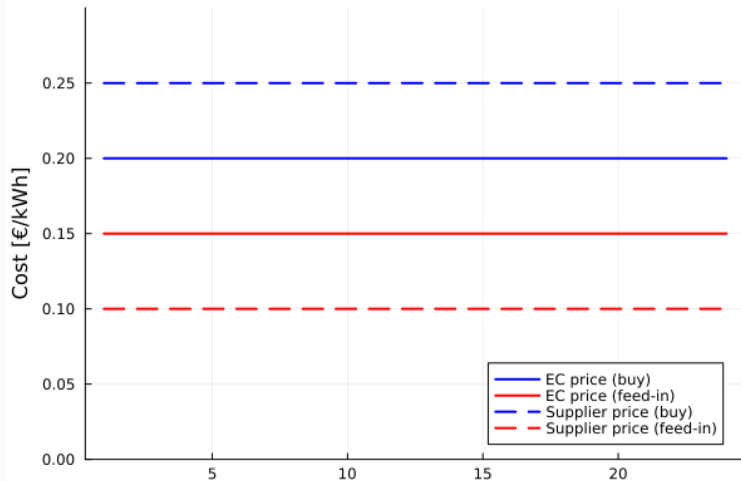
Aggregation for ancillary services (aFRR/mFRR)

- ✓ Planning close to real-time
- ✓ Additional revenues to energy sharing
- x High minimum bid size (aggregation needed)
- x High commitment and responsibilities on schedules

→ Direct control is needed for e.g. balancing markets
→ Complex to set-up within an energy community (many suppliers)



Flexibility and generation forecasts



Conventional pricing:

- Purchase price < supplier's purchase price
- Feed-in price > supplier's feed-in price

Improvements:

- Planning of flexibility trading
- System/customers' behavior prediction

Open question: how to improve forecasts of the EC ?

→ at local level there is (i) most of knowledge, but also (ii) most of errors



Lessons learnt

- Energy communities can be a vehicle to develop regions into "energy cells"
- Solving problems locally allow to **upscale** lessons learnt
- A **structured** information exchange (real-time, forecasts) between the actors is needed (especially for **aggregation**)
- Market potential for energy communities' flexibility in both **indirect** and **direct** control
- Direct control must be easy to implement and include **social interests** and **preferences**



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Die **100% Erneuerbare-Energie-Reallabore** sind eine Leitinitiative im Rahmen des FTI-Schwerpunkts „Energiewende“ des Bundesministeriums für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie. Ziel ist es, für unterschiedliche Regionstypen in Österreich prototypische Systemlösungen zu entwickeln, zu fördern und zu begleiten.



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