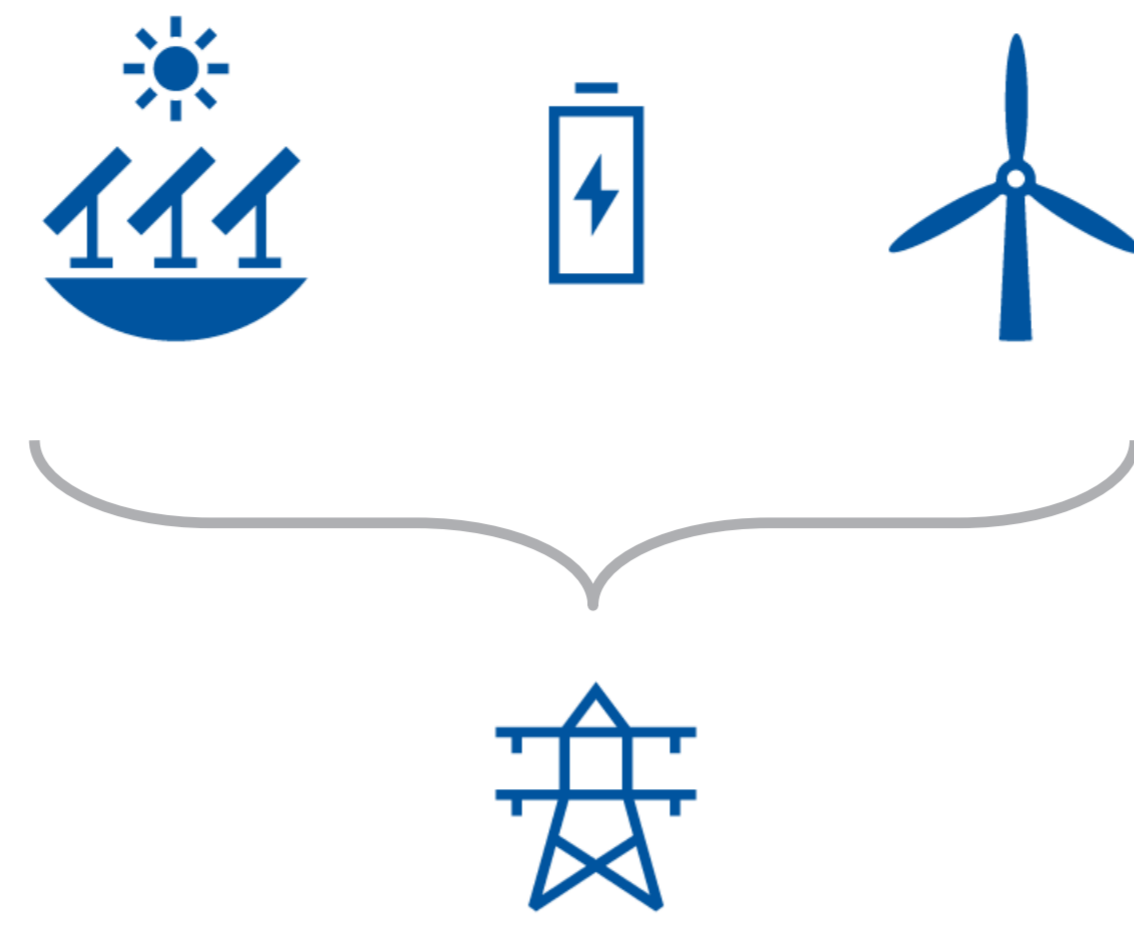


Reactive Power Provision from Inverter Based Resources in Future Power Grids

Challenges

- Higher need for reactive power for voltage control
- Increasing share of renewable energy sources leads to faster and more frequent voltage changes
- Decentralized Energy Resources can provide reactive power for voltage control



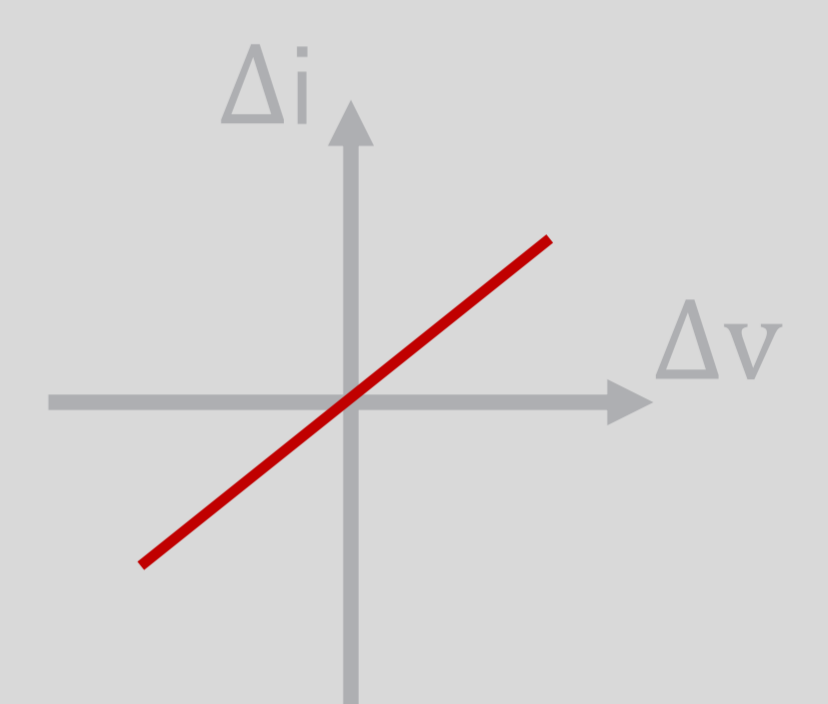
Research Questions

- How can inverter based resources participate in voltage control?
- Which coordination and control concepts enable the use of reactive power from other voltage levels for transmission system voltage control?
- How do different optimizations and controls for inverter based resources interact?

Current Work

Dynamic Grid Support

- Fast voltage changes e.g. in case of short circuits require dynamic provision of reactive power from faster acting equipment and controls
- Question:** Can the distribution grid provide **dynamic grid support** to support the transmission system in case of faults?
- Method:** EMT simulation of reactive power control of inverter based resources



Distribution Grid Restrictions

- Question:** Which operational factors limit reactive power provision from medium and high voltage grids?
- Method:** Use Optimal Power Flow and **Optimal Reactive Power Flow** and iteratively maximize the provided reactive power at the point of common coupling
- Active Constraints show limiting factors: Line capacity, voltage bands...

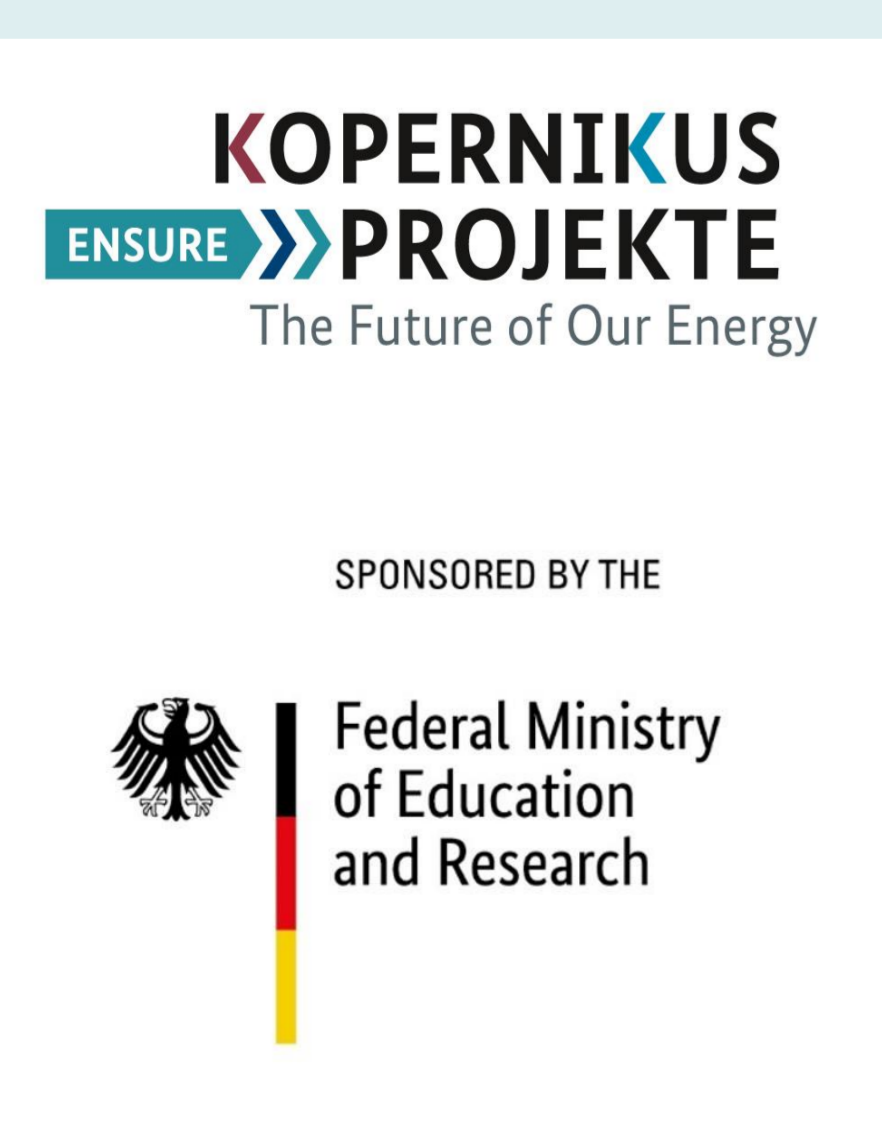


Framework for the Coordinated Reactive Power Provision

- Question:** How can reactive power be provided to another grid layer considering minimum communication between grid operators, multiple assets and operational limits?
- Methods:** Framework consisting of **Feasible Operating Regions** to aggregate reactive power for superordinate grid layer and a **Model Predictive Control** to disaggregate the required reactive power to individual resources
- Operational limits as well as stability concerns can be taken into account



Ancillary Services with Inverter Based Resources



Future Work

- Demonstration of coordination concepts with a **Co-Demonstration platform** developed in ENSURE
- Distributed Real-Time Simulation with **Power Hardware in the Loop** setups using real laboratory equipment

