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ACTIVE DISTRIBUTION SYSTEMS AND DISTRIBUTED ENERGY RESOURCES

11106

Scenarios and field trials on active distribution grids in the German Kopernikus projects SynErgie and ENSURE

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Kopernikus overview

- The Kopernikus projects make up one of the largest research initiatives in Germany in the field of the energy transition. Their aim is to make it possible for Germany to be climate-neutral by 2050.

- The **SynErgie** project studies how energy-intensive industrial processes can be made more flexible in order to adapt them to the availability of renewable energy sources
- The **ENSURE** project is developing the power grid of the future.
- The **P2X** project investigates the conversion of CO2, water, and electricity from renewable sources into gases, fuels, chemicals, and plastics.
- The **Ariadne** project analyses in a joint learning process between science and society how policy measures work – from individual sectors to the big picture.

Kopernikus SynErgie

- **Syn**chronized **Energy** management for energy-adaptive processes
- Energy management on an industrial level to compensate the fluctuation of infeed of renewable generation
- Usage of offered flexibilities in energy-intensive industries
- Challenge to integrate energy flexibilization and flexibility marketing in a complex, partly existing IT system
- To overcome the problems a practice-oriented and open design approach was chosen
- With this platform design additional applications can be derived, e. g. energy flexibility as a business model or strengthening the organizational structure and increasing sustainability in production

Kopernikus ENSURE

- ENSURE aims to develop power grid technologies able to cope with the future power system with centralized and decentralized elements in Germany
- First goal of the second phase of ENSURE is to draft an overall systemic concept for the energy supply that is embedded in the existing socio-economic framework, and to ensure transferability of the results within Germany and Europe, with a time horizon of 2045
- Second goal is to pilot technology developed in ENSURE phase one:
  - Solid State Transformer to provide a 750DC microgrid
  - MVDC-Back-to-Back converter for horizontal load flow
  - Digital substation for holistic condition monitoring
  - MV-PMUs to increase observability of the MV grid
- Third goal is to develop different energy scenarios based on discussions with different stakeholder
- Fourth goal is to provide proposals for future regulatory framework to the authority

C6

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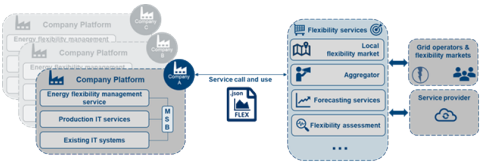
SynErgie



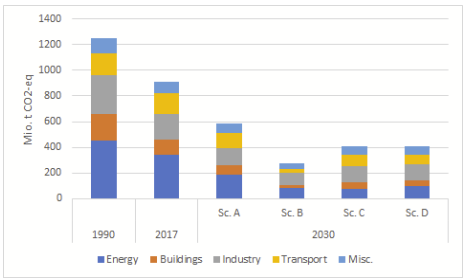
Energy Synchronization Platform

- Interaction of several company platforms and market-oriented services
- Mapping of entire process of information-automated energy flexibility trading from machine to the energy market via different flexibility services
- It includes framework conditions, interfaces, data models, stakeholders and security aspects

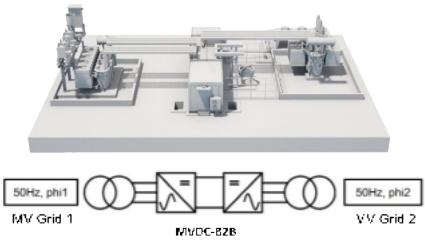
ENSURE Scenarios

- Construction of four energy scenarios together with 11 professional stakeholder, including industry, NGOs, non-departmental public bodies
- Constructed scenarios differ in the climate protection level, European cooperation level, electrification of economic activities and grade of decentralization
- Scenario B aims to contribute to a +1.5°C target in respect of increase of the average temperature
- Scenarios C and D are less ambitious but follows the target of climate neutrality until 2050. They differ mainly in the grade of decentralization
- Scenario A assumes a greenhouse gas reduction by 85% until 2050

Required development of greenhouse gas emissions



MVDC Back-To-Back converter



- Flexible horizontal power transfer between load- and generation-dominated MV subnetworks
- Flexibilization between 20kV and 10kV grid assisted by optimal active power flow
- Reducing electrical disadvantages compared with conventional assets
- Optimal power quality with active and independent reactive management.

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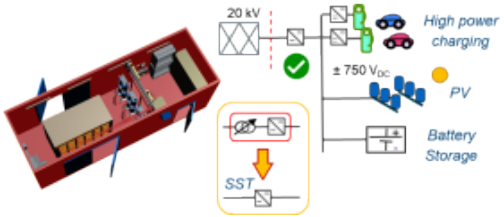
Solid State Transformer

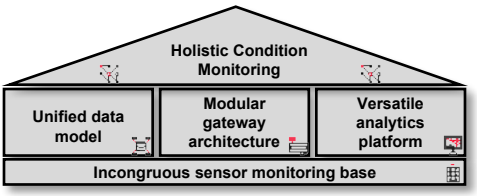


- Compact station for an efficient provision of LVDC (± 750V) for PV, batterie storage and charging stations
- Direct connection to 20 kV DC w/o conventional transformer
- Set-up of a demonstrator with up to 2 MW of bidirectional power to the grid

Digital substation for holistic condition monitoring

Concept of a holistic assessment of the substation by digital integration of monitoring solutions using-

- A unified data model that prepares vendor agnostic asset models
- A modular gateway that aggregates heterogenous communication protocols
- A versatile analytics platform, based on reliability centered maintenance and monitoring program



PMU in medium voltage grids

- Fast and easy determination of power flow without any model data and complex algorithms
- High resolution of samples (10 – 240 samples per second)
- Precise time stamp for all measurements. Easy to compare data from different locations. No data preprocessing necessary.

Legal and regulatory obstacles

- The German regulation is optimized for the operation and maintenance of the existing grid infrastructure and necessary network expansion.
- The current regulation does not properly cover research and development activities.
- The current situation makes it quite ambitious to realize projects like mentioned in this paper and even more ambitious to realize pilot solutions on a large scale.
- National and European public funding opportunities covering only a part of these costs and limited by laws.
- The corresponding European policy on state aid are laid-out for companies in competition markets but does not consider business of regulated DSO and TSO companies
- Solution: Successfully verified project proposals for public funding with a project focus on the critical infrastructure and with a national interest, the regulatory framework should cover the not funded project costs of the regulated DSO and TSO companies.

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