

Team NeMo (Network Modeling) is a joint research group of Flensburg University of Applied Sciences and Europa-Universität Flensburg engaged in cross-sector electricity system modeling. Since 2015, we have been investigating key questions surrounding Germany's future energy system, with a particular focus on electricity grids. Our work concentrates on techno-economic analyses at high spatial and temporal resolution and considers a broad range of flexibility options.

Website:



Motivation

- Grid expansion planning as a central challenge of the energy transition
- Forecasts indicate substantial investment requirements for transmission and distribution grid expansion
- Sector coupling introduces new challenges as well as additional flexibility options
- Lower grid levels gain in strategic importance due to decentralisation

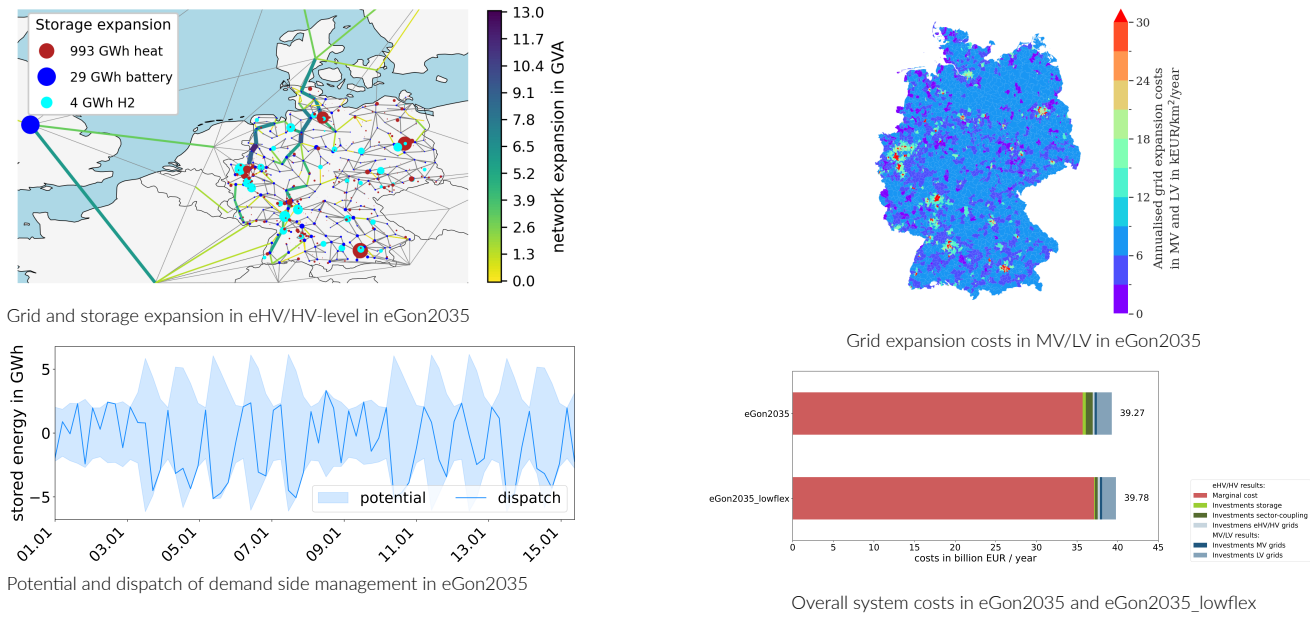
→ Effective **coordination across grid levels** becomes indispensable

→ **Transparency and openness** are key to achieving widely accepted, well-founded and targeted solutions

Research Questions:

What are grid and storage expansion needs in transmission and distribution grids?
To what extent can flexibilities lower grid expansion needs?

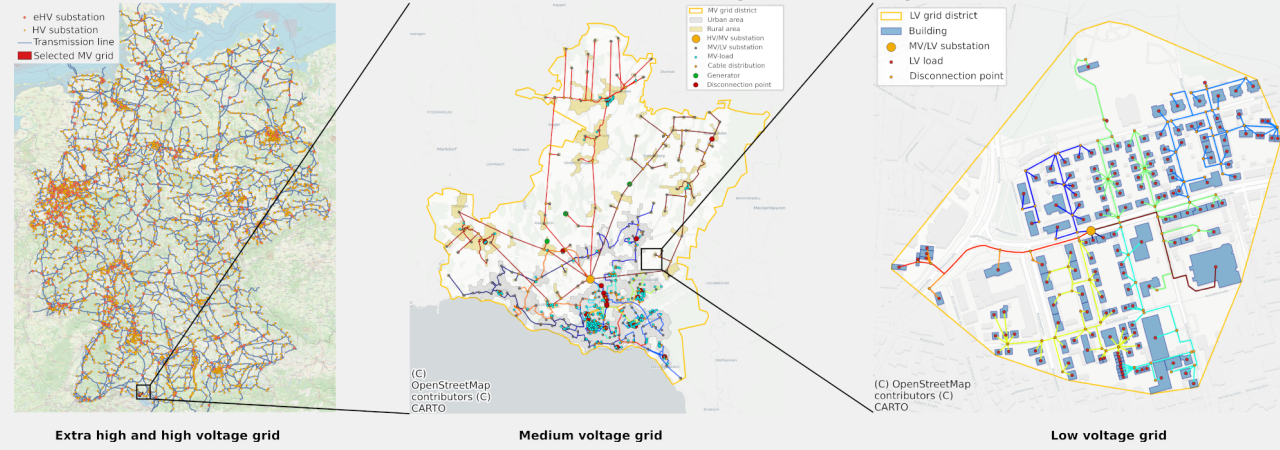
Results of Case Studies



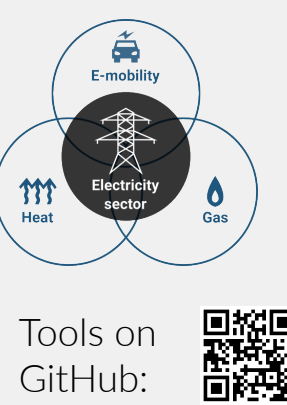
- Utilizing flexibility options reduces overall system costs and lowers CO₂ emissions.
- While top-down dispatch optimization is effective for extra-high and high voltage grids, it can increase expansion requirements in medium and low voltage grids.

Key Features of Data and Tools

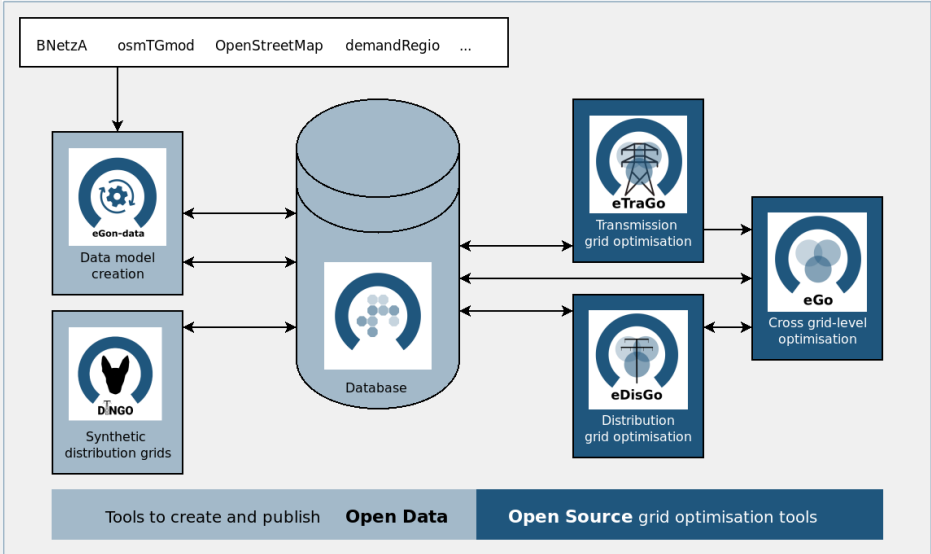
Power Grid Model for Germany Considering All Voltage Levels:



Cross-Sectoral Model:



Open Source Tools:



- Data in a high spatial and temporal resolution (per building, hourly) across Germany
- Grid calculation tools enabling consistent optimization across different grid levels
- Open Science: Based on open data and open source, all tools and data are available

Research Projects



2025-2027

Analysis of local and regional energy networks in the context of the integrated European energy system

Project Partners: Flensburg University of Applied Sciences, Europa-Universität Flensburg, Reiner Lemoine Institut gGmbH, DLR Institute for Networked Energy Systems, Technische Hochschule Ulm

Funding: Federal Ministry for Economic Affairs and Energy



2024-2026

Distribution network planning taking into account controllable consumption devices in accordance with §14a EnWG

Project Partners: Flensburg University of Applied Sciences, Stadtwerke Husum Netz

Funding: Gesellschaft für Energie und Klimaschutz Schleswig-Holstein



2025-2026

Potential for climate-neutral energy and heat supply in Schleswig-Holstein

Project Partners: Europa-Universität Flensburg, Landring GmbH

Funding: Gesellschaft für Energie und Klimaschutz Schleswig-Holstein



2026-2027

Model-based analysis of electricity bidding zones in Germany

Project Partners: Europa-Universität Flensburg, Flensburg University of Applied Sciences

Funding: Gesellschaft für Energie und Klimaschutz Schleswig-Holstein

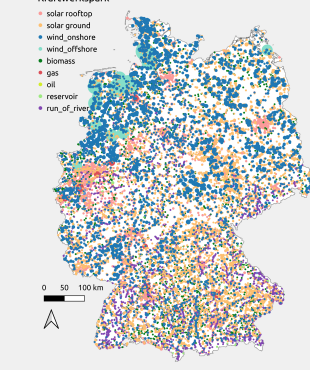
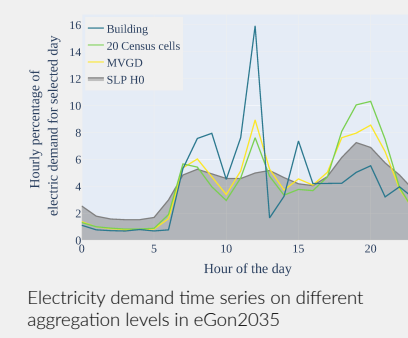
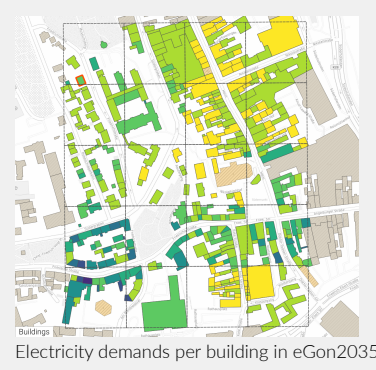


- Spin-Off founded in 2024
- Offering the transfer of scientific tools and data, along with customized case studies
- Website: www.netzwende-agentur.de

Data Model

Different scenarios available, e.g.:

- eGon2035:** Based on NEP 2021 scenario C 2035
- eGon2035_lowflex:** Like eGon2035, with fewer flexibilities
- eGon100RE:** Fully decarbonized system (year 2045)



Grid Optimization Tools



electricity Transmission Grid optimization (eHV/HV-level)

- PyPSA-based optimization of the German energy system considering neighbouring countries
- Identification of grid and storage expansion needs
- Optimization of flexibility deployment



electricity Distribution Grid optimization (MV/LV-level)

- Determination of grid expansion needs
- Assessment of flexibility options and their potential to mitigate the need for grid expansion



Interface: electricity Grid optimization

- Dispatch of generation and flexibility options per HV/MV substation
- Selection of representative MV/LV grids

Recent Publications



Challenges of top-down flexibility deployment for grid expansion across all voltage levels; C. Büttner, K. Esterl et al.; Environmental Research: Energy; 2025



The impact of redispatch on grid and storage expansion planning in the German energy system; C. Büttner, U. Müller; Energy Informatics Review; 2024



Avoiding false inter-zonal meshing in the clustering of a large-scale German power grid; K. Esterl, C. Epia et al.; Energy Strategy Reviews; 2024



Influence of flexibility options on the German transmission grid – A sector-coupled mid-term scenario; C. Büttner, K. Esterl et al.; Renewable and Sustainable Energy Transition; 2024



Open modeling of electricity and heat demand curves for all residential buildings in Germany; C. Büttner, J. Amme et al.; Energy Informatics; 2022

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