

*Burabay Forum:
Cooperation between bordering regions of Kazakhstan and Russia*

Research activities at the Center for Sustainable Energy Systems (ZNES) Flensburg, Germany

Cord Kaldemeyer | Astana, 15th of August, 2017

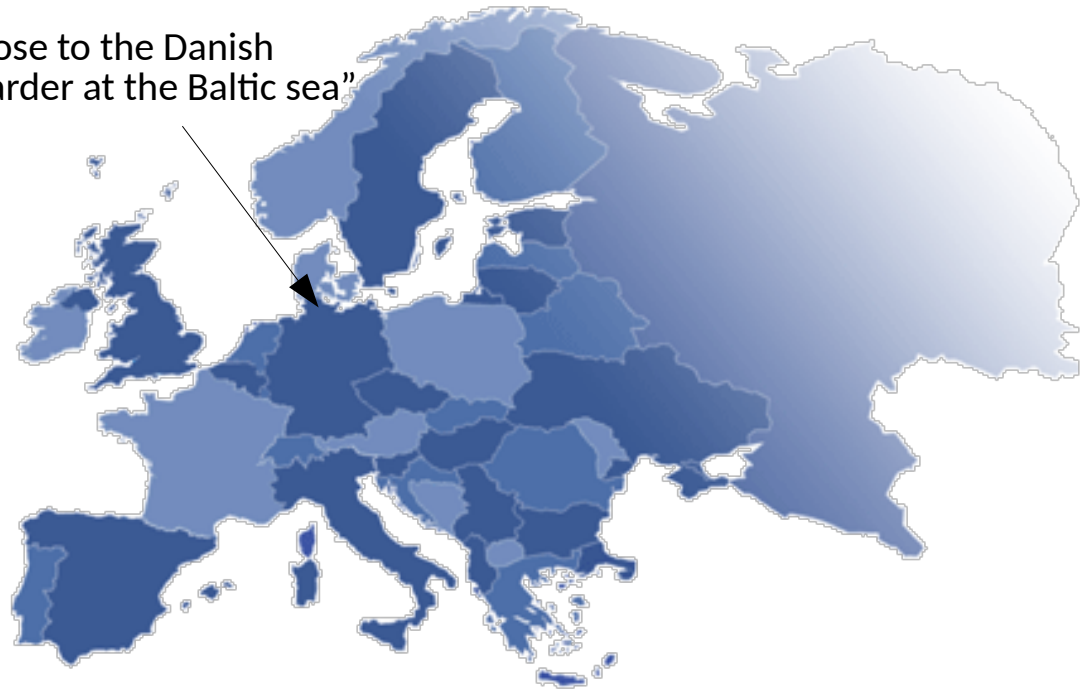
- Visit at Nazarbayev University
- Flensburg and its research institutions
- Selected research projects and activities
 - Development of modelling tools
 - Modelling for decision support
 - Open source and open data
- Conclusion

- Joint research project for West-KAZ
 - Started in 2016 at DIW PhD autumn school in Berlin
 - Article „*Optimal operation scheduling and reserves allocation in the power system of western Kazakhstan taking into account the uncertainty of wind power generation and the demand*“
 - Finished by ~90-95%
- Taking part in conferences
 - Poster presentation on International Conference on Nanomaterials and Advanced Energy Storage Systems
 - Visit of Future Energy Forum
- Professional exchange about energy modelling topics



- Town in border region
- Population ~86,000
- Two universities
 - Europa-Universität
 - University of Applied Sciences
- Students ~10,000

“Close to the Danish
border at the Baltic sea”



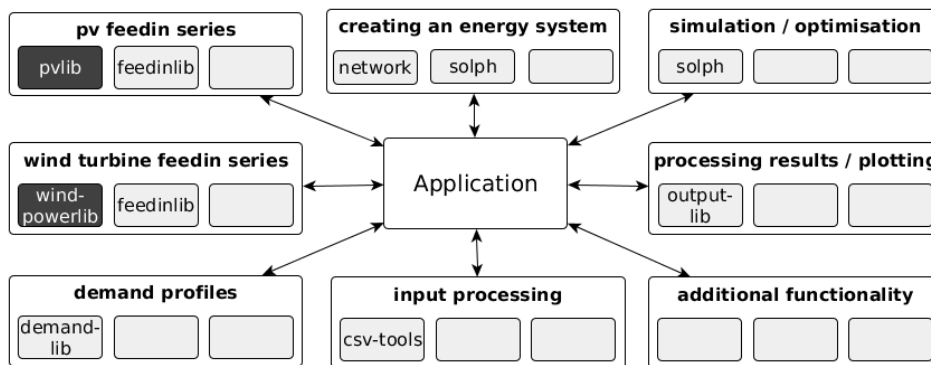
- Interdisciplinary center for research and development constituted by
 - Europa-University of Flensburg
 - Flensburg University of Applied Sciences
- ~50 people including professors and researchers
- Research clusters
 - Biomass
 - Climate Protection
 - System Integration
 - Thermal Systems
 - Wind
- Research, development and implementation of sustainable energy systems



- Research area is „Energy System Analysis“
- Development of open source modelling tools
 - The Open Energy Modelling Framework
- Energy system modelling for decision support
 - Compressed Air Energy Storage (CAES) as storage option
 - District heating systems connected to the electricity grid
- Promoting open source and open data
 - Openmod Initiative
 - Open Power System Data

→ Providing a brief overview of each project/activity

- Flexible tools are needed to model future energy supply systems which will become increasingly complex
- Many models or model generators are not free and open



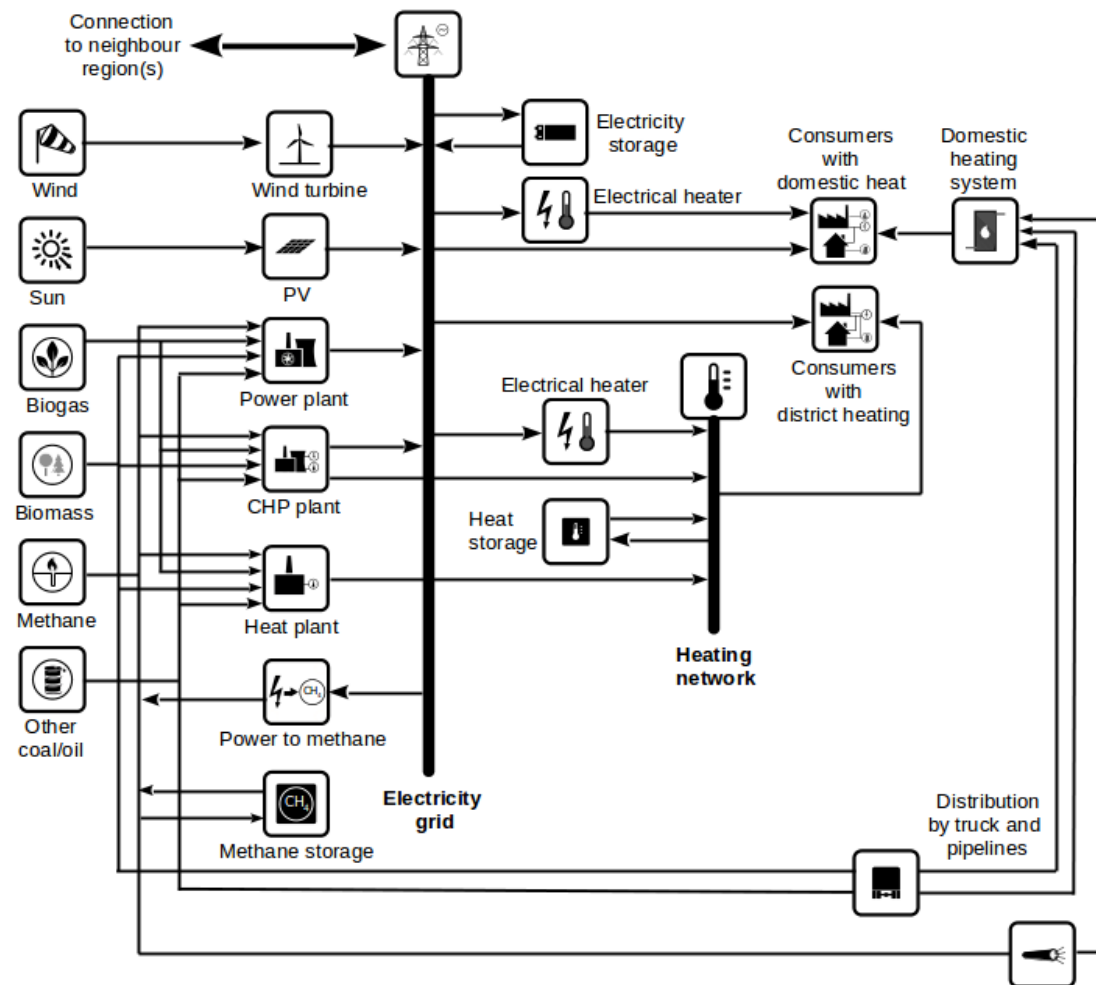
More info: www.oemof.org

- „The Open Energy Modelling Framework“ (oemof) is a set of collaboratively developed Python packages
- These can be used to build models of energy supply systems

Development of open source modelling tools

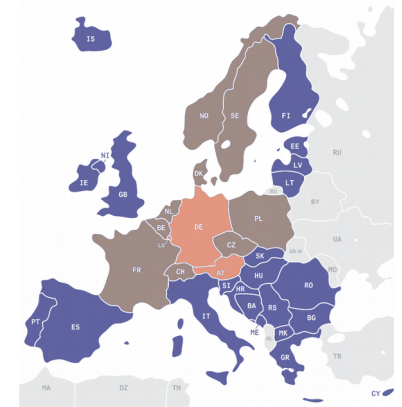
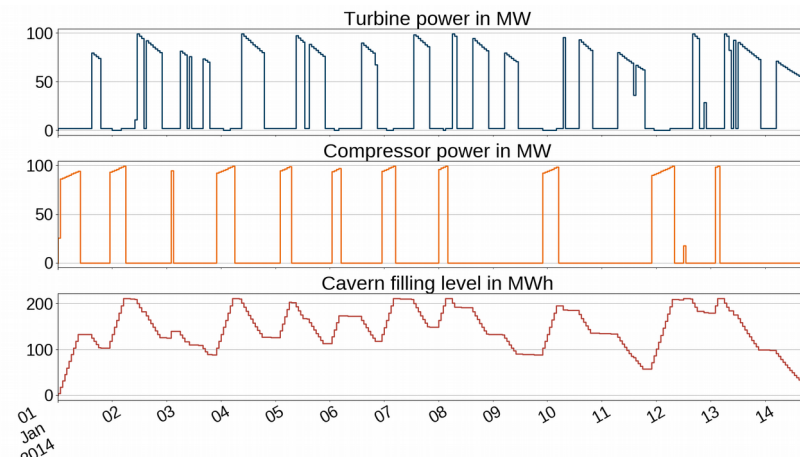
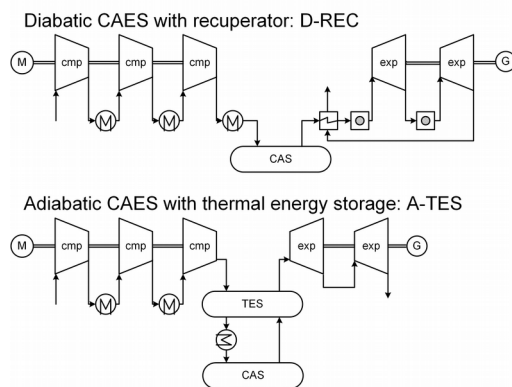


→ Example of a rather complex multi-carrier energy system that can be modelled within oemof



- Compressed Air Energy Storage (CAES) is one storage option with different concepts that is technically relatively mature
- Concepts have to be assessed in Germany's future energy system

Thermodynamic model → Unit commitment model ← Power market model



- Simple diabatic concepts with low investment costs are economically more viable than adiabatic concepts
- Nevertheless, no CAES concept will be economically feasible in future if market conditions do not change

- Heat and power sector coupling in district heating systems can be realized through different setups of technologies
- Setups have to be assessed in future energy systems

Thermodynamic models → Unit commitment model ← Specific setups

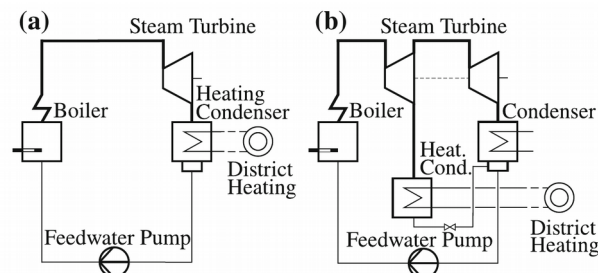
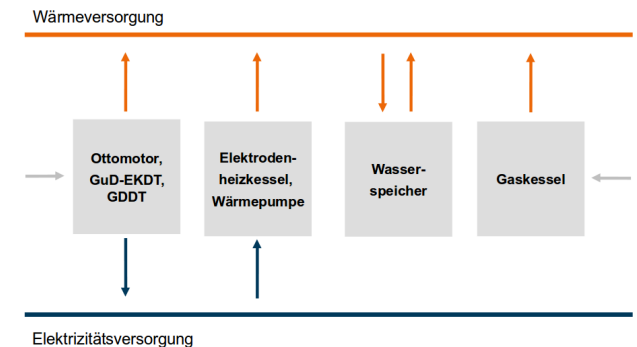
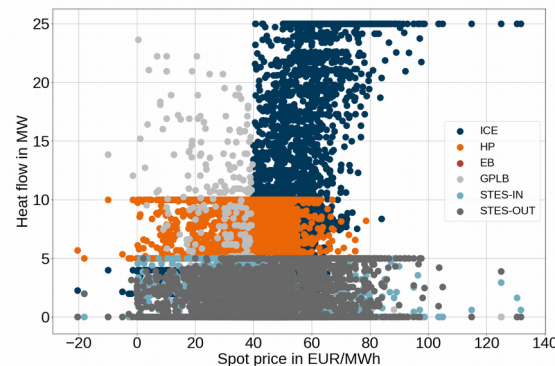


Fig. 1 a Back pressure turbine, b extraction condensing turbine

Source: Mollenhauer et al., Evaluation of an energy- and exergy-based generic modeling approach of combined heat and power plants, 2017

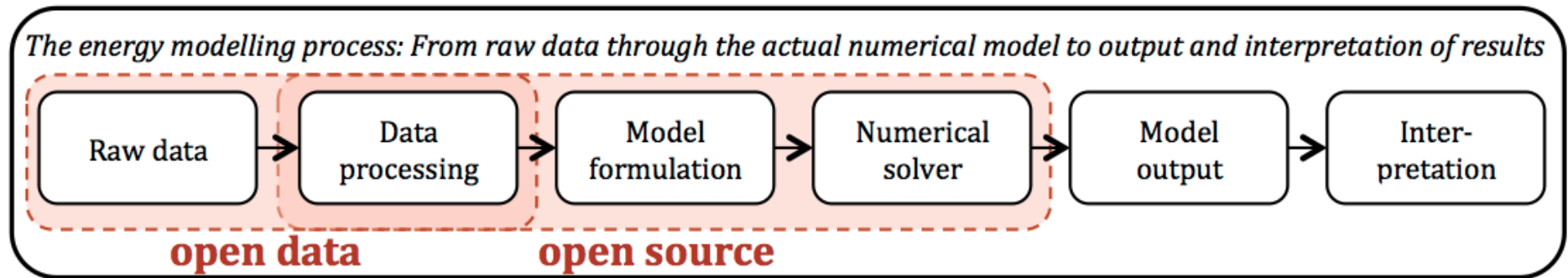


- Real technology characteristics of local district heating operator can be captured in MILP models to a large extent
- Different market conditions and feed-flow temperature levels have significant impact on a setup's business economy (preliminary)

Promoting open source and open data



- Energy models are widely used for policy advice and research
- Most models are black boxes – even to fellow researchers



More info: www.openmod-initiative.org

- Open models and open data improve quality, transparency, and credibility, leading to better energy policies
- This allows the community to advance the research frontier and gain the highest benefit from energy modelling for society

Promoting open source and open data



→ Energy professionals such as modelers and analysts in academia, consulting firms, and industry rely on data

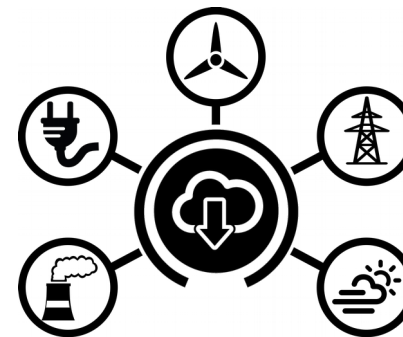
→ Currently, energy modelling data is often subject to quite restrictive terms of use and inconvenient to use

Data Platform

This is the Open Power System Data platform. We provide European power system data in five packages:

OPSD (Internal) data packages

Data package	Description	Download latest version	Documentation and script
Conventional power plants	List of conventional power plants in Germany and European countries	2017-07-07 (753 kB)	View or access on Github
National generation capacity	Aggregated generation capacity by technology and country	2017-07-07 (2 MB)	View or access on Github
Renewable power plants	List of renewable energy power stations	2017-07-03 (169 MB)	View or access on Github
Time series	Load, wind and solar, prices in hourly resolution	2017-07-09 (162 MB)	View or access on Github
Weather data	Script for the download of MERRA-2 weather data	2017-07-05 (75 MB)	View or access on Github



Germany
Land of Ideas
Landmark 2017

Nationaler Förderer
Deutsche Bank

More info: www.open-power-system-data.org

→ A free data platform to collect, check, process, document, and publish data that are publicly available has been set up

→ The quality of data and documentation is improved and researchers can focus on research and avoid redundant work

- Energy system modelling is helpful for decision support
 - Decision-making spaces can be investigated
 - „What if...“-questions can be answered at low costs
- Open source and open data enhances scientific progress
 - Open models and open data improve quality, transparency, and credibility
 - Researchers can focus on research and avoid redundant work
- Promoting both requires strategic initiatives and research projects

Cord Kaldemeyer, M.Eng

Research Assistant, Flensburg University of Applied Sciences
PhD Student, Europa-Universität Flensburg

cord.kaldemeyer@hs-flensburg.de

+49 (0)461 1260

+49 (0)176 64029178

www.znes-flensburg.de

www.hs-flensburg.de

www.uni-flensburg.de