Smart Grids -
electricity forecasts Germany

DATA#009 - Andreea:

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08.12.2022

Thats me

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- worked the last 6 years as energy efficiency expert
- here to:
  - leave Excel behind me
  - learn necessary skills to shape future energy systems
  - have fun

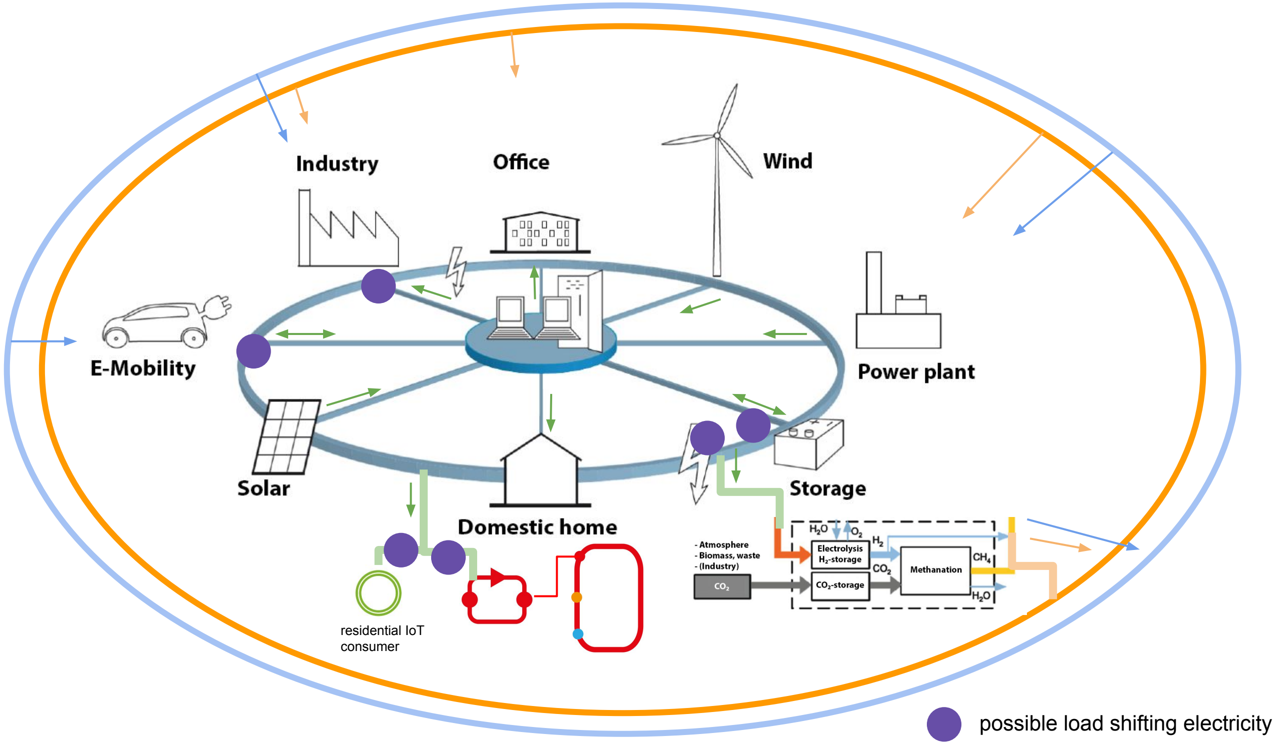
Smart Grids and Sector Coupling heat-power-mobility

Holistic multivalent perspective for energy transformation contains also the integration of:

- green methane and green H2
- buffer storages heat pumps and hot water
- electrolyzers

Applications of green gases are:

- high temperature process heat
- heavy load mobility
- chemical industry
- peak load gas power plants
- maybe aviation



Future energy efficiency gains rely also on live data availability concerning supply and demand

<u>Driver for physical energetic resource allocation:</u>

- Current and predicted energy generation and consumption
- Current and predicted grid states and storage loads
- Current and predicted energy prices
- Weather forecasts + historical weather data
- e-mobility kilometers demand
- known patterns in energy consumption
- expected variance in residual load
- planned maintenance activities of energy generators and grid bottlenecks
- technical possibility of load shifting

efficient resource allocations relies on extended data processing

<u>Approach for informational modelling:</u>

1. comprehensive modeling of digital siblings of elements in energy system
2. implementation of necessary information flows
3. hourly energy forecast (heat, cold, power) on macroeconomic level (generation and consumption)
4. control concepts (kWhs, €s, tons CO_2, supply security, …)
5. resource allocation (power, natural gas, storages (heat, power, H_2, natural gas))
6. facility control signals for generators, storages and consumers

project scope for final project is step 3

Simplified flow chart

Input

- timestamp
- Weather API: temperature, wind speed, sunshine hours
- MaStR: database for german power plants (class, size, geolocation)
- BDEW: standard load profiles
- SMARD.de: historical data for training
- generell statistics about energy demand Germany and energy consumption structure

static input   dynamic input

Processing

- electricity demand for residentials and industry (additionally heat and cold demand necessary)
- power generation forecast of wind and solar power plants
- differential calculation of fossil power generation

Output

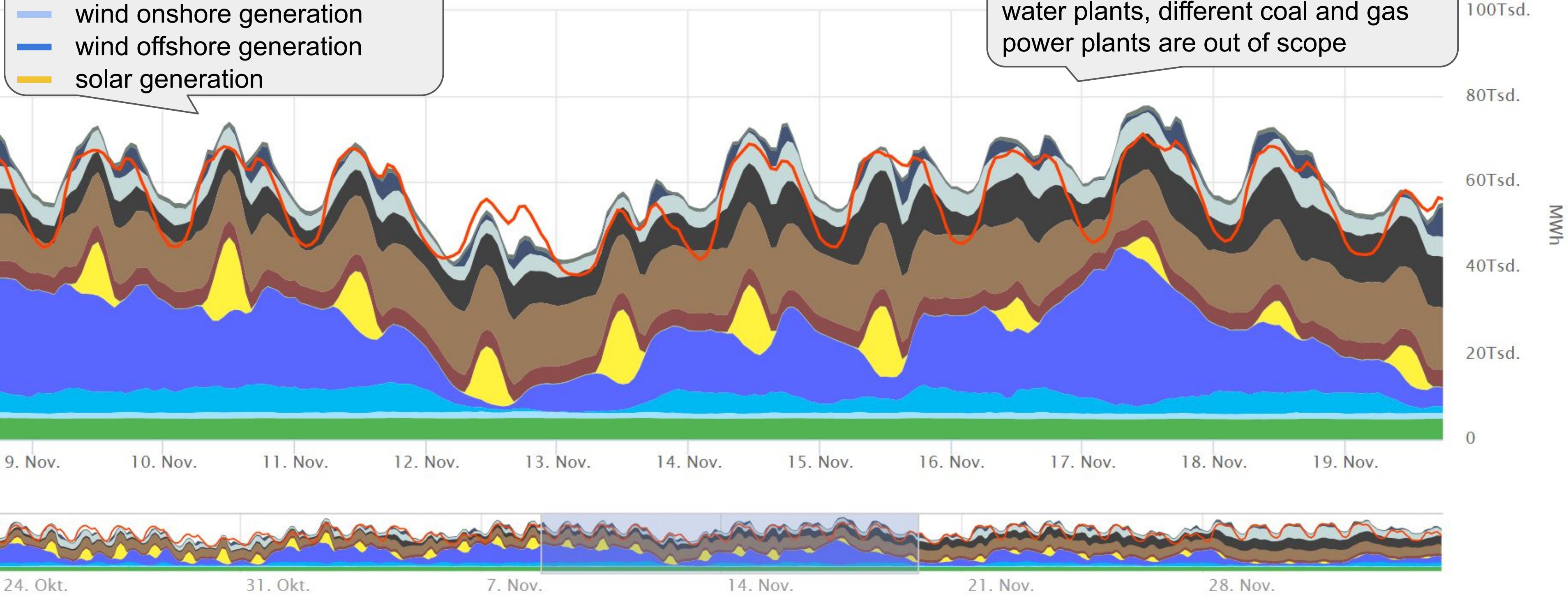
- hourly electricity demand forecast Germany
- simplified hourly forecast of electricity generation structure Germany

closed feedback loop for test data on SMARD.de

Historical and live electric load curves Germany

- consumption
- wind onshore generation
- wind offshore generation
- solar generation

other power plant classes like biomass, water plants, different coal and gas power plants are out of scope

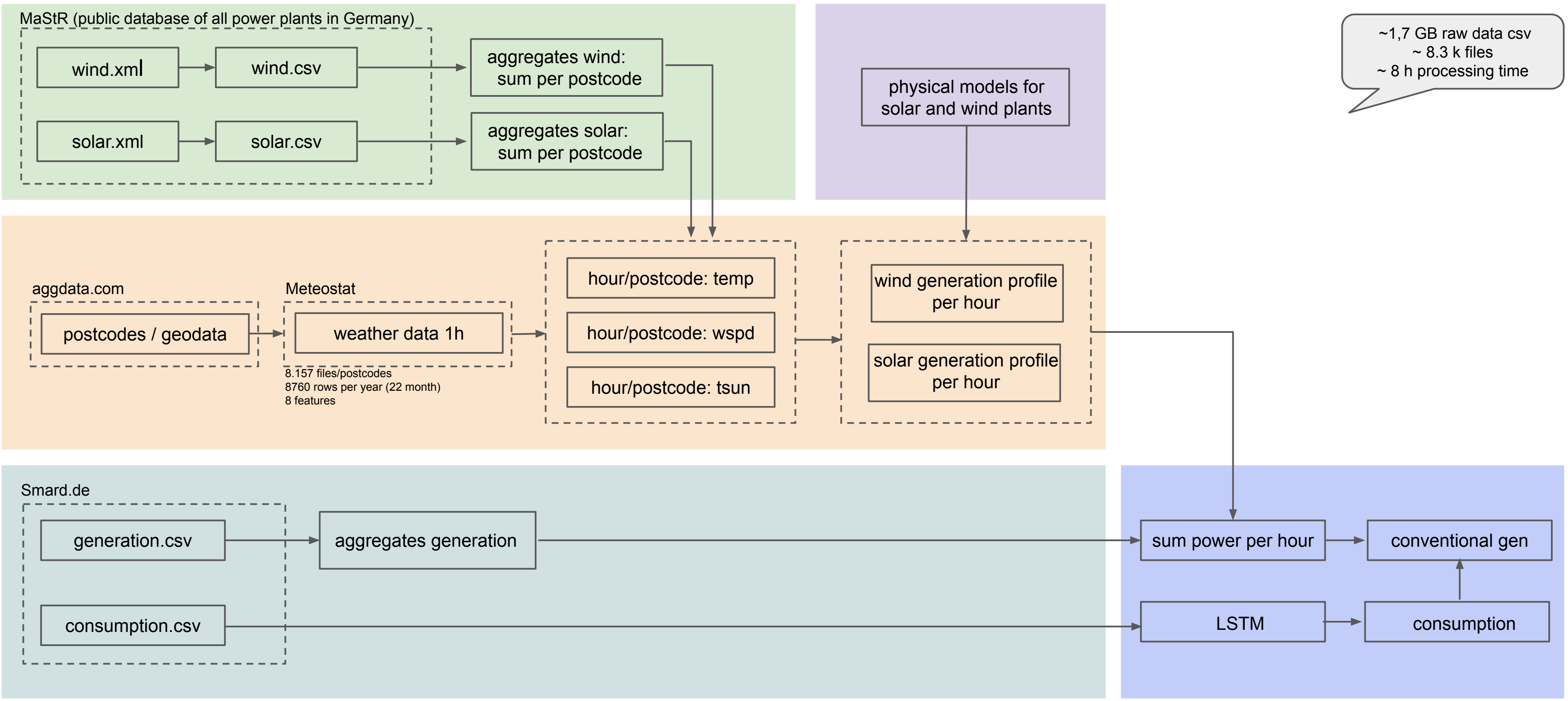


$P\_Conventional = P\_Consumption - P\_Green$

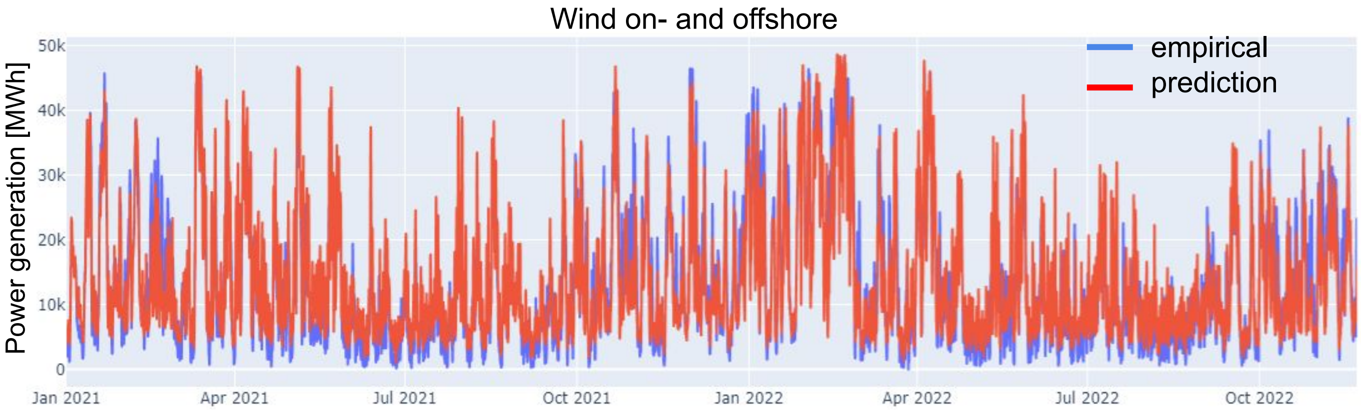
Imports and Export out of scope

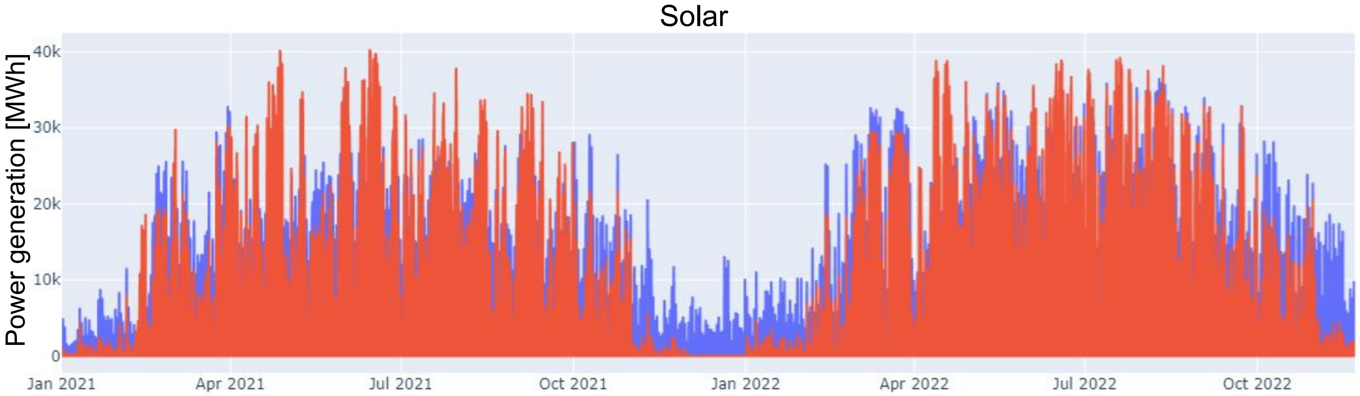
smard.de

data processing



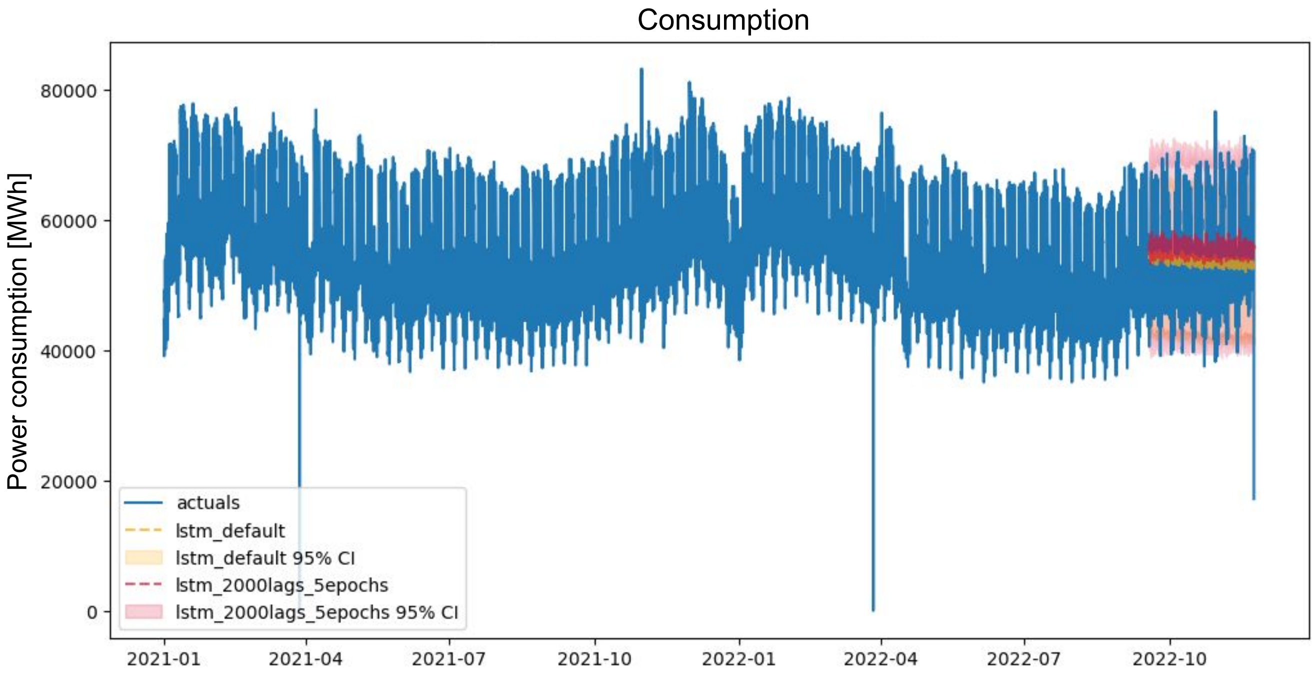
Results of generation prediction





- main input variables:
  - nominal power of power plants
  - wind speed
  - sunshine duration
- train accurancies R_2:
  - .79 for wind
  - .66 for solar
- especially physical model for solar prediction needs further improvement
- plant shut-offs due to grid bootle-necks not considered in model

Results of consumption prediction



- trained a LSTM model on historical data
- no further independent variables used for explaining consumption

Limitations

- current processing time of algorithm design
- lack of APIs of live data fetching
- important input variables not publicly available

- combining data from more different sources
- sharpen physical models

End