Power system impacts of highly weather dependent future energy systems (PSfuture)

A Data Management Plan created using DMPonline

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Project abstract:

Sector coupling and electrification are expected to play a crucial role in the energy systems of the future, with wind and solar generation providing the vast majority of all energy demand. When, e.g., heating and transportation sectors are electrified, the clean variable renewable energy (VRE) generation allows Europe to reach its ambitious CO2 reduction targets across the entire energy system.

However, the growing installations of such weather dependent generation can cause challenges to the operation and planning of power systems. As, e.g., electric load and hydro generation also depend on weather, the future power and energy systems will be highly weather dependent. Going towards 2050, with also climate change having an impact, understanding these weather dependencies and their impacts on the system-level is crucial.

Using advanced meteorological modelling and power system analysis, the Power system impacts of highly weather dependent future energy systems (PSfuture) project helps to ensure that power systems are prepared for such highly weather dependent energy systems of the future, and that they can continue their reliable operation with as low costs as possible.

A key development in PSfuture is to take large-scale climate change scenarios and translate them to European-wide time series data (e.g., wind speed, irradiation, temperature). The meteorological time series, which drive both VRE generation and electric load, are crucial inputs to system-level studies. Such studies need both higher temporal and geographical resolution than usually given in the climate change scenarios. These time series are then used in power and energy system analyses towards 2050 to include the effects of climate change in the studies. As climate change progression is uncertain, multiple scenarios will be modelled. Adequacy and system balancing studies will be carried out to model the impacts of the different scenarios on the European power systems.

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Data Collection

- Historical measured wind and solar generation data; for model validation. From online, from DTU Wind Energy and from DTU Wind Energy's contacts (e.g., ENTSO-E, Energinet).
- Historical weather data (wind speed, irradiance etc.); for model validation. From online, from DTU Wind Energy and from DTU Wind Energy's contacts.
- Historical electric load data; for model estimation and validation. From online and from contact ENTSO-E.
- Historical heating load data; for model estimation and validation (when considering sector coupling). From online and contact at DTU Management.
- Historical wind and solar generation forecast error time series; for modelling and validation. From online, ENTSO-E and other DTU Wind Energy contacts.
- Power system data (e.g., transmission capacities) needed for analyzing system adequacy and balancing needs; for modelling and validation. From online and ENTSO-E.
- Reanalysis data (weather data); for modelling and model validation. From reanalysis data providers (e.g., ECMWF).
- Simulated data for the future with climate change modelld; WRF to be ran using these data. From climate change data providers (e.g., ECMWF).

Data formats:

- Csv for most time series data.
- Netcdf or similar format used in the weather modelling community.

Data strucuture:

- For Csv suitable format for Python data frame handling (consider time also)
- For Netcdf: standard structures

Data versioning:

- Final data to be versioned using the DTU Data service
- All code and also some small amount of data can be included in Gitlab to get versioning

- Data from DTU Wind Energy's contacts (e.g., ENTSO-E) may be confidential. These are to be handled with special care.
- Output data should be made freely available (if no specific reasons to stop this).
- The project doest not include personal data.

Data Storage

- For the large weather data (multi TB): Data to be stored at the DTU Wind Energy's cluster/server. Data backup policy needs to be checked.
- For GB-level data, e.g., wind and solar generation time series, data to be stored at the department drive (Q) and/or the files.dtu.dk system (includes backup).
- SharePoint will be used for project descriptions, reports, presentations etc. (includes backup).
- Final output data can be published at the DTU Data service (should be backed up).

Documentation

- Especially final output data will be documented in detail (using suitable metadata taxonomy).
- Temporary data will be documented in the files.dtu.dk system.
- All crucial data used as basis of publications will be documented with care.

- Metadata for all data to be published in the DTU Data system.

- Metadata for the the data used in publications (in addition to the descripions given in the papers).

Data Sharing

- Final output data to be shared, e.g., via the DTU Data system
- files.dtu.dk system can be used to share internally at DTU.
- SharePoint can be used to share (small amounts of data) to specific persons (also outside of DTU).
- Data journals will be considered for publications.
- Resticted data used as input cannot be shared without specific permissions.

- Final outputs via tha DTU Data system and in data journals.
- Specific data via files.dtu.dk and SharePoint.

Long-term Preservation

- Final outputs in DTU Data system sholuld be stored for long-term.
- Data journals' data should be stored for long-term.
- Some output data (that are not part of the final publicly available output data) can be shared for multiple years in DTU Wind Energy's system (e.g., cluster/server); these possibilities need to be checked.