Data for modelling a future net-zero energy system

Brief description of the project:

Energy system models are key tools to analyse the design of systems that meet the Paris Agreement. Such models require large amount of data such as future costs of technologies, renewable energy generation based on weather data, technology availability. In this project the student will contribute to the open-source dataset of a power system model developed at the Department of Technology Systems.

- Name of supervisor(s) : Marianne Zeyringer + colleagues at the Energy Systems Modelling Group
- Preferred background of candidate(s): Renewable Energy Systems, Computational Science, Meteorology, Mathematics, Physics, Economics or equivalent
- Number of available projects: 1-2
- Preferred project period: to be decided between supervisor and student

Background and outline of project work:

Energy and power system models are key tools to analyse the integration of high shares of renewables energy technologies into energy systems that meet the Paris Agreement.
At the Department of Technology System we develop the power system model highRES (see ref[1]). highRES designs a cost-optimal and net-zero power system for Europe in 2050. We currently run a European model with higher spatial resolution for Norway.
The model minimises power system costs (operating costs and annualised investment costs) to meet hourly demand subject to a number of technical constraints; thereby optimising the dispatch and locational investment into power plants, storage and transmission grid extension. Results are the cost-optimal power system design including location of capacities as well as total system costs and power prices.

Model inputs are technical constraints on power plant operation, the current transmission grid and future technology costs including annualised investment and operating costs. We use historical meteorological data from climate reanalysis in physical power production models to model hourly wind, solar and hydro capacity factors.

Examples of data improvement that could be undertaken by students are for example around costs and renewable energy capacity factors:

- Costs: We currently assume the same technology costs for 2050 across countries. A major improvement would be to disaggregate costs per country based on e.g. differences in labour and costs of capital.

- Renewable energy: Further improvements could be using actual wind and solar generation profiles to bias-correct the renewable capacity factors across Europe.

The tasks will be decided based on the background of the student and the needs for model improvements.

Expected output: new published open-source dataset and documentation, possibly a publication.

1. Price, J. & Zeyringer, M. highRES-Europe: The high spatial and temporal Resolution Electricity System model for Europe. *SoftwareX* **17**, 101003 (2022).