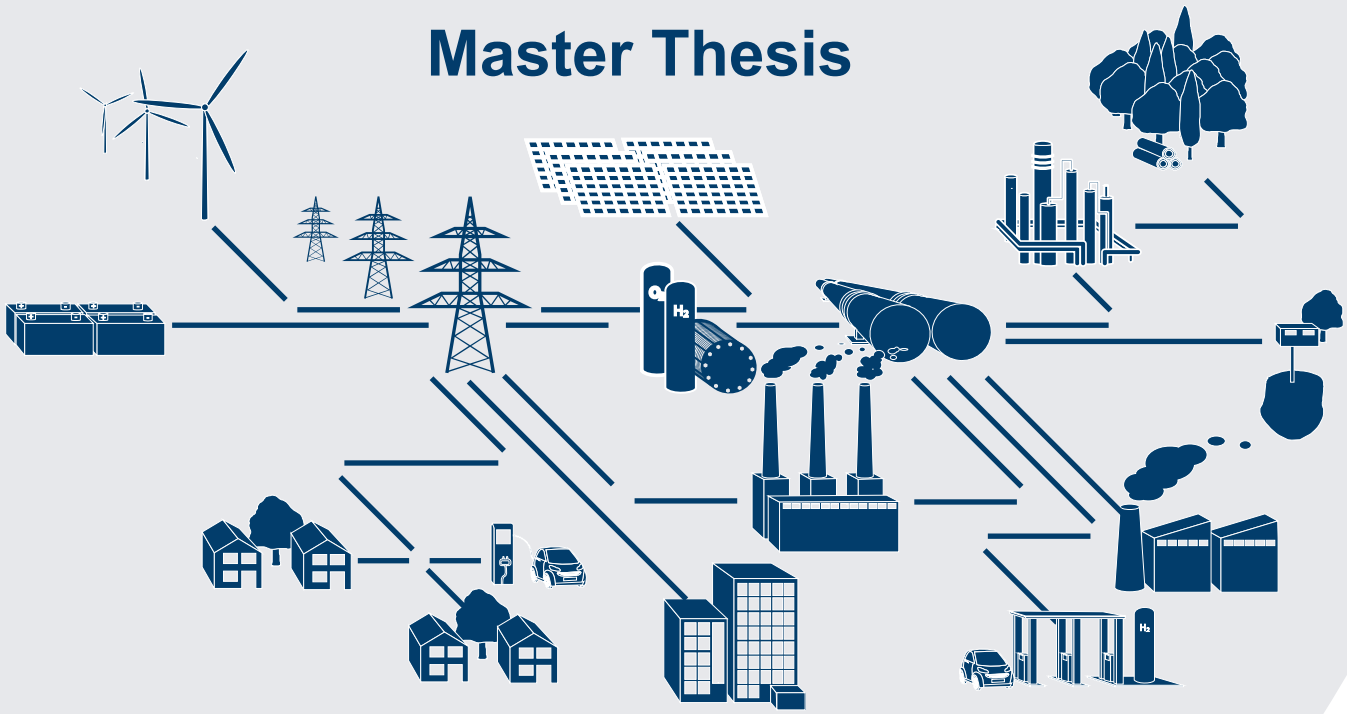
Institute of Energy and Climate Research

Electrochemical Process Engineering (IEK-3)

JÜLICH Forschungszentrum

Master Thesis



The Influence of the Sequence of Typical Periods on Cost Optimal Energy System Design with a High Share of Renewable Energies

Background:

Facing the turnaround in energy policy and the growing share of intermittent energy sources such as photovoltaic and wind, the Institute of Energy and Climate Research (IEK-3) develops energy system models. These focus on designing cost-optimal and feasible energy systems based on existing input time series such as electrical or chemical energy demand and energy generating potentials like wind speeds or irradiance at specific places for a large number of discrete time steps. In order to keep the models computationally tractable, the input time series are usually clustered and, in this way, aggregated to a small number of typical days or weeks, with the goal to reduce the complexity and number of variables for large systems. Due to the fact that some components such as storages couple the time steps with each other according to the order of filling and withdrawal periods, maintaining the order of time steps throughout the aggregation is highly important for the optimized energy system design. Since the majority of energy systems is designed using one year of hourly resolved time steps, which only contain a small number of possible typical period combinations, the investigation of other and possibly more crucial typical period orders is extremely relevant for the operational safety of energy system designs based on the aggregation of big data.

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Your Job:

The offered thesis aims at highlighting the influence of the sequence of typical days on cost optimal energy system designs. In a further step, a method should be developed to predict the most critical sequences of typical days for the energy system design for both, the cost and its operational feasibility. Concretely, your job can be divided into the following steps:

- Literature research to what degree the order of typical periods is considered in energy system models
- Induction into our existing energy system models
- Running test cases for a small energy system model with identical typical periods but in different order
- Calculating probabilities of certain typical day sequences and searching for the most crucial ones concerning cost optimality and feasibility
- Conclusion for the safety of energy system models designed for only one year of input data
- Option for the advanced: Prediction for probabilities of typical day sequences that crush the energy system

Your Profile:

Very good academic marks in electrical engineering, mechanical engineering, energy engineering, physics, mathematics, computer science or related fields of study. Ability to work autonomously and analytically within a project team. Ideally you already have experience in modelling, programming (preferred in Python) and a high affinity for complex mathematical problems.

Our Offer:

- A pleasant working environment within a highly competent, international team in one of the most prestigious research facilities in Europe
- You will be supported by top-end scientific and technical infrastructure as well as close guidance by experts
- You will have the opportunity to work with excited researchers from various scientific fields and take part in the design of a future German and European energy system
- Your work is remunerated
- Depending on your performance, the small work packages can be adapted

Contact:

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