UiO:Energy and Environment summer research project

EV load curves of high temporal and spatial resolution for electricity system modelling

Name of supervisor:	**Tobias Verheugen Hvidsten**
Preferred background of candidate:	**Renewable Energy Systems, Maths, Computational Science / Informatics, Physics or similar**
Number of available projects:	**One**
Preferred project period:	**Summer 2023**

This summer research project will be connected to the UiO:Energy and Environment Convergence Environment *EMPOWER: Sustainable batteries in Mobility – (Em)powering a Net-zero Energy Transition*. EMPOWER is an interdisciplinary research project investigating how electric vehicle batteries can enable an energy transition in Norway which is sustainable and results in net-zero emissions. The summer project will cover two out of the four main research areas of UiO:Energy and Environment:

- Energy transition and the environment
- Energy systems, materials and models

Transport is the biggest greenhouse gas emitting sector in Norway. Battery electric vehicles (EVs) are emerging as one of the essential technologies in the decarbonisation of road transport, a major contributor to the emissions of the transport sector. Having committed to the Paris Agreement, Norway aims for large reductions in its greenhouse gas emissions to limit global warming and mitigate the effects of climate change. A large-scale deployment of EVs to replace fossil fuels are being undertaken to achieve this. The electrification of the transport sector causes a coupling with the electricity system and an increased electricity load which must be met, ideally by renewables.

Electricity system models can be used to investigate the effect of electricity systems incorporating large shares of variable renewable energy and electrified transport. To perform such modelling, data of high temporal resolution on, amongst other, electricity demand and climate data is needed. This project aims to facilitate the better integration of EVs in electricity system modelling, and for this data on the future loads from EVs are needed.

This data is essential for two main reasons:

- For the better representation of the load from EVs in electricity system modelling. With both production from renewables and demand from EVs being variable in time, obtaining data on EV load with high temporal and spatial resolution is crucial when investigating the effect of EV charging on electricity systems incorporating high shares of variable renewable energy.
- To investigate the flexibility provided by EVs. While an additional load, EVs can also contribute to the facilitation of even higher shares of variable renewable energy through:
  (i) Demand side management, which entails shifting EV charging to times of the day with a low demand for electricity, or high supply of variable renewable energy, reducing the effect of this increased demand.
  (ii) Vehicle to grid (V2G), utilising bidirectional charging so that EVs can contribute to the grid by function as batteries for the electricity system.
  (iii) Repurposing EV batteries no longer having the necessary capacity for transport applications as stationary energy storage.

The project work will include collection of data on the electricity load from EVs and the creation of a database containing a collection of yearly EV load data of high temporal and spatial resolution based on different scenarios of EV deployment. Experience with programming for data science, preferably python, and handling of large amounts of data is desirable. The project will be at the Department of Technology Systems located at Kjeller.