Life cycle assessment of electricity grid configurations: off-grid vs grid extension

The electricity systems around the world are currently in a state of transition. The climate crisis drives a shift from fossil to wind and solar electricity as well as an increasing demand for electricity for transportation and industry. In industrialised countries change is multi-faceted including different trends. From a starting point of centralised generation and national distribution solar and wind electricity now enables local generation and local use in small off-grid systems or distribution in various smart grid configurations. At the same time, the varying production of solar and wind power stimulate sharing of electricity in larger networks, super-grids, crossing national borders creating continent wide configurations. In countries with low penetration of electricity network, such as in many African countries, the competition has a different starting point, but basically involves the same alternatives: off-grid and micro-grid solutions or large grids.

The different trajectories are all based on a larger penetration of solar and wind electricity generation technologies but otherwise require increased use of different sets of technologies, such as batteries, or hydrogen storage, and local control systems in the case of off-grid systems and HVDC cables in Super-grid configurations.

This master thesis aims at investigating and comparing the environmental burden of different system configurations in different contexts to support the societal process of technology choice.

The master's thesis is conducted in cooperation with Svea Solar, one of Sweden's largest solar cell installation companies. The project is also linked to the National research program Resistance and power – on smart grids for the many people with collaborators from four Swedish universities and a multitude of connections to Swedish electricity industry and energy authorities.

Examiner and contact person: Professor Björn Sandén, bjorn.sanden@chalmers.se

Time: January – May 2021

Suitable background: Industrial Ecology or Sustainable Energy Systems and completed course in Life Cycle Assessment