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Optimizing the Norwegian power grid to meet European climate targets

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The energy provided by sun or wind changes with time and cannot be regulated. This creates problems currently because society demands energy when it needs it, largely ignoring availability. Transmission grid or energy storage capacity expansion and demand management are proposed strategies to deal with this. They can be used in a mix or can at least partially substitute for one another. By 2050, large amounts of wind and solar power capacity is expected to be deployed in an effort to meet the goals of the EU's "Green Deal" . Norway is in a position to contribute to a stable European grid due to its hydropower resources as well as excellent wind resources allowing for spatial diversification with wind in the rest of Europe and technological diversification with solar in the South of Europe. Spreading out wind over a larger area or combining it with other technologies can reduce the variability. Yet, a conflict of interest is possible from the Norwegian perspective, as increased interconnection might lead to higher power prices in the country.

Previous research has taken transmission capacity expansion into account. A frequent conclusion was that improved transmission capacity requires less energy storage. Yet to our knowledge, no study has examined the optimal level of Norwegian transmission capacities to reach Europe's climate goals in a model that embeds Norway into a representation of the whole European system. Also, the above mentioned tension between the European and the Norwegian perspective has not been discussed.

This work closes the gap by improving the representation of Norway in the MIT licensed European investment and dispatch power system model (highRES-Europe).

Using it, we study the cost-optimal transmission grid in Norway and interconnection to neighbouring countries to meet European Climate targets. This novel approach, allows investigating spatial diversification and technological diversification effects over a large geographical area. The process includes power generation estimates from reanalysis weather data and demand estimates based on historic electricity demand statistics. Being an optimization model, highRES then takes these inputs to design a power system that satisfies the demand at least cost.

The cost-optimal amount of transmission grid expansion to reach European Climate targets is the main expected conclusion.

When looking at the development of system costs in different countries, conclusions about the benefits from grid expansion are expected. Here we also compare the Norwegian perspective to the European perspective to identify possible target conflicts.

It is anticipated that the larger spatial coverage of the model leads to a lower need for storage expansion and that investment into interconnection between Norway and its neighbours are proposed to allow for import and storage of renewable overproduction in other countries.

Further insights into the amount and duration of electricity stored in Norway, supporting the deployment of renewable energy in Europe, are expected.