Energy storage and grid integration Finland

Does Finland's Electricity generation system need hydrogen storage?
Finland's electricity generation system was modelled with and without hydrogen storage using the LEAP-NEMO modeling toolkit. The results showed about 69% decline in carbon dioxide emissions as well as a decline in the fossil fuel-based power accompanied with a higher capability to meet demand with less imports in both scenarios.

Does the heat generation system contribute to electricity production in Finland?
It should be mentioned that the study did not include the heat generation system,which has an outstanding share in power production in Finland and has a role also in electricity productiondue to combined heat and power plants.

Can hydrogen storage be integrated into the energy systems model?
Impact of incorporating hydrogen storage into the energy systems model is analysed. LEAP-NEMO model for Finland's electricity generation system until 2030 is optimized. Integration of hydrogen storage enables seasonal storage of renewables. Hydrogen storage decreases electricity imports and carbon dioxide emissions.

How much electricity does Finland import?
(IEA 2023) Finland is a net importer of electricity,importing about 18-24 TWhof electricity per year during 2018-2022. Thanks to the start of the nuclear reactor Olkiluoto 3 and increasing capacity of renewable generation,Finland´s electricity imports are expected to decrease significantly.

What are alternative energy storage systems?
For electricity storage there are several alternatives that exist like batteries,pumped hydro storage,hydrogen storageetc. Although battery energy storage systems (BESS) efficiently store electrical energy,they have drawbacks for grid-scale storage in comparison to hydrogen storage .

How can energy storage be used to reduce energy imports?
Another possibility is also to use the storage to store curtailed energy from power plants that have a slow ramp-down rate,where it can charge the storage while ramping down. This will allow for fewer electricity imports.

Energy and climate policies that support sustainable development are generating a need for new energy storage solutions. Key drivers in this field include the electrification of transport, the integration of renewable energy production such as wind and solar power, an increased need for grid resiliency and security of energy supply as well as new,

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Additionally, energy storage may bring reliable energy services to areas that have poor energy infrastructure, or are seen as off-grid. Finland represents an interesting case study of future energy systems due to strong diurnal and seasonal variation in variable energy generation (hydro, wind, solar) that is typical of countries at high latitudes.

The potential of large-scale hydrogen storage for renewable energy sources (RES) is growing as a low-cost electricity storage option that can store energy throughout days, weeks, and even months in the near future [9].

The implementation of the battery energy storage system will contribute to a more than 5-fold reduction in the occurrence of power outages in the time interval from 3 min to 1.5 h, which will clearly reduce the System Average Interruption Frequency Index and System average Interruption Duration Index factors.

As Finland is proceeding towards achieving carbon neutrality by 2035, energy storage can help facilitate the integration of increasing amounts of VRES in Finland by addressing the issue of energy supply and demand not matching.

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Finland has received EUR 2.1 billion in funding from the EU to aid its recovery from the COVID-19 pandemic. The approved plan focuses on green transition, with projects related to renewable energy, energy infrastructure, low-emission hydrogen, carbon capture storage, and EV charging points (European Commission).

Renewable Energy"s Impact Grows. The transition of energy system from fossil fuels to renewable energy sources is placing new demands on the power grid and electricity markets. The share of renewable and decentralized energy production is growing significantly in both Finland and Sweden.

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o In terms of the application of electrical energy storage, the most economic potential in Finland lies in

renewables integration. Right after it are ancillary services and peak shaving. Grid deferral and price arbitrage will have much less impact. This report provides an initial insight into various energy storage technologies, continuing with

Child et al. carried out an analysis using the EnergyPLAN tool to identify the role of energy storage in a conceptual 100% renewable energy system for Finland in 2050, assuming installed ...

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