Fully renewable energy system is economically viable in Finland in 2050

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A fully renewable energy system, including all energy consuming sectors, is not only a possible but a viable solution for Finland, according to a new research. Researchers from Lappeenranta University of Technology (LUT) have investigated renewable energy system options for Finland in 2050. Results indicate that a fully renewable energy system is possible, and represents a competitive solution for Finland with careful planning.

In order to achieve the national greenhouse gas reduction targets for

2050, all sectors of the energy system need to be nearly emission free by 2050. Renewable energy system modelling shows that a fully renewable energy system featuring high shares of wind and solar energy includes smart interaction between the electricity, heating/cooling and mobility sectors. Power-to-Gas technology, i.e. converting electricity into gases such as hydrogen or synthetic natural gas, and energy storage solutions, such as batteries, heat storage and synthetic natural gas storage, also have a central role as enabling technologies.

The research includes for the first time the cost and quantified dimensioning of the future energy system for Finland, which means the capacities for each of the production, consumption and storage technologies were defined. The study proposes an economically and technically feasible architecture as first vision for a feasible future energy system for Finland that could be later developed to a roadmap.

This system includes installed capacity of solar power of up to 35 gigawatts and 44 gigawatts of wind power, an amount well above those seen in previous analyses, but supported by an established potential for wind and solar photovoltaics in Finland. This could create more than 166 TWh of electricity annually, approximately double the current level of final electricity consumption. The excess electricity would then be used to create synthetic fuels that can be consumed when needed for variety of purposes. In addition, electricity would directly replace fossil fuels in the provision of many energy services, such as heating and transport. These results include stationary battery storage capacities of up to 20 GWh, three million electric vehicles with respective storage capacities and power-to-gas capacities of up to 30 GW.

In the study total annual costs for 100% renewable energy systems are approximately 25 billion euros, slightly less than scenarios with lower shares of renewable energy and a business as usual scenario (26 billion euros). The same trend was found for scenarios with lower shares and

higher prices of forest biomass, albeit at higher overall annual cost. By comparison, the current energy system has an annual cost of approximately 18 billion euros and is set to rise to 21 billion euros by 2020 using the same method of calculation.

"The main message is the option of a fully renewable energy system must be seen as a valid option for the future, rather than a radical alternative. Finland certainly has an abundance of renewable resources, such as solar, wind, bioenergy and already exploited hydropower, which can be sustainably utilised," says Christian Breyer, LUT's Professor for Solar Economy.

Modelling the components of future energy systems and calculating future costs are important because the Finnish energy system is at a crossroads. The current power generation system is aging, there are responsibilities to mitigate climate change and worries about fluctuating energy prices. At the same time, Finland has goals regarding national energy security as well as the need to retain a competitive industrial sector and meet the needs of a future society. Bioenergy alone cannot solve the energy supply problem.

The current study has concluded that flexibility will be a key, defining feature of future energy systems. By unlocking the full potential of all the flexibility available, more efficient and cost effective solutions can be found.

"Energy technologies will be a big part of these solutions, but let's not underestimate the impact that we can have on our own future. We have the opportunity to be more flexible energy consumers, and many individuals will become more active energy producers at the same time. We can become prosumers," states researcher Michael Child.

The researchers are part of LUT's Solar Economy Group. The research

has been carried out in the NEO-CARBON ENERGY project. The results will be presented at the World Conference "Futures Studies Tackling Wicked Problems" in Turku on June 11th.

Provided by Lappeenranta University of Technology