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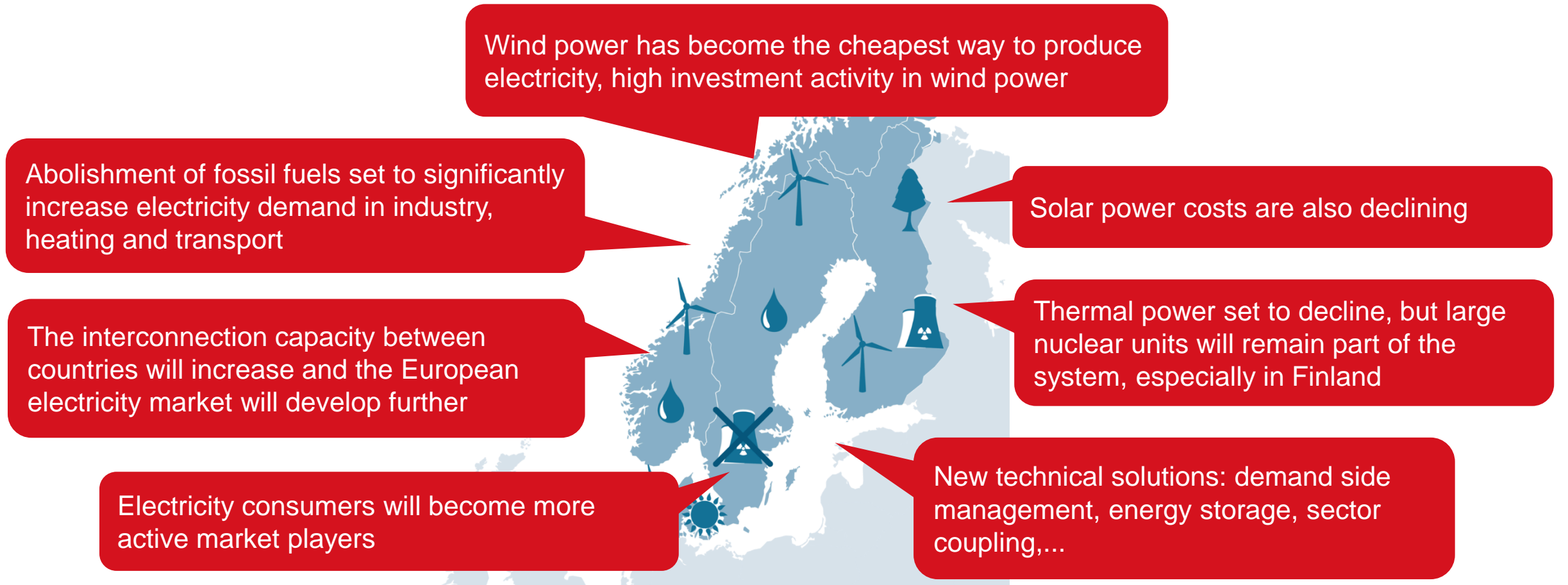
Jussi Jyrinsalo

How to manage the changing electricity system

Aalto Energy Forum 2021

FINGRID

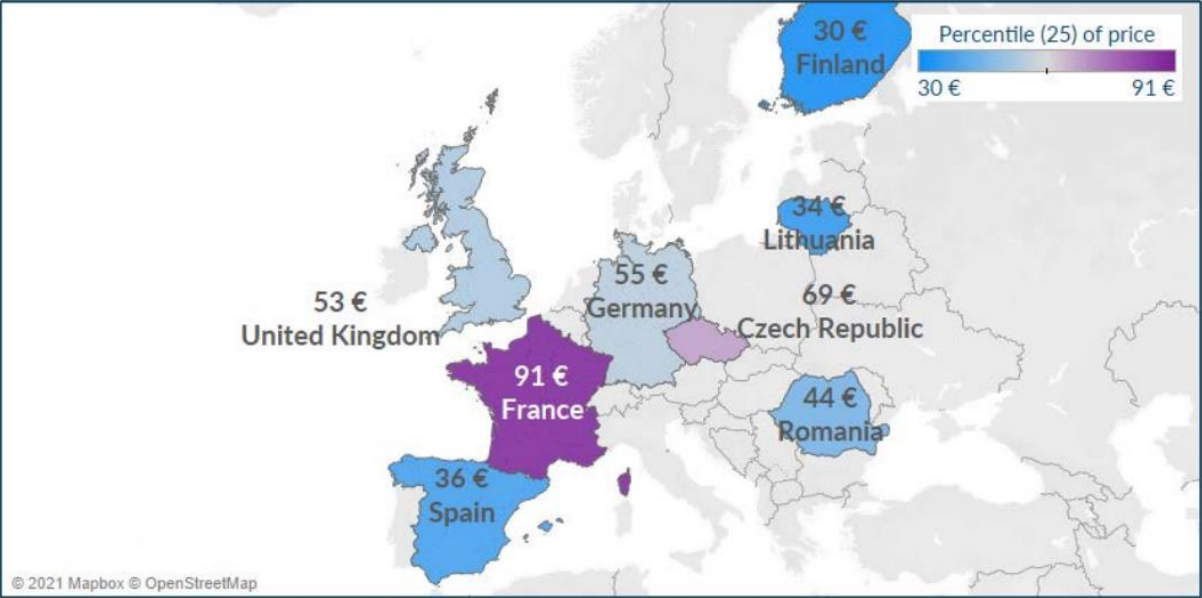
The changing electricity system



Finnish wind power is competitive and growing

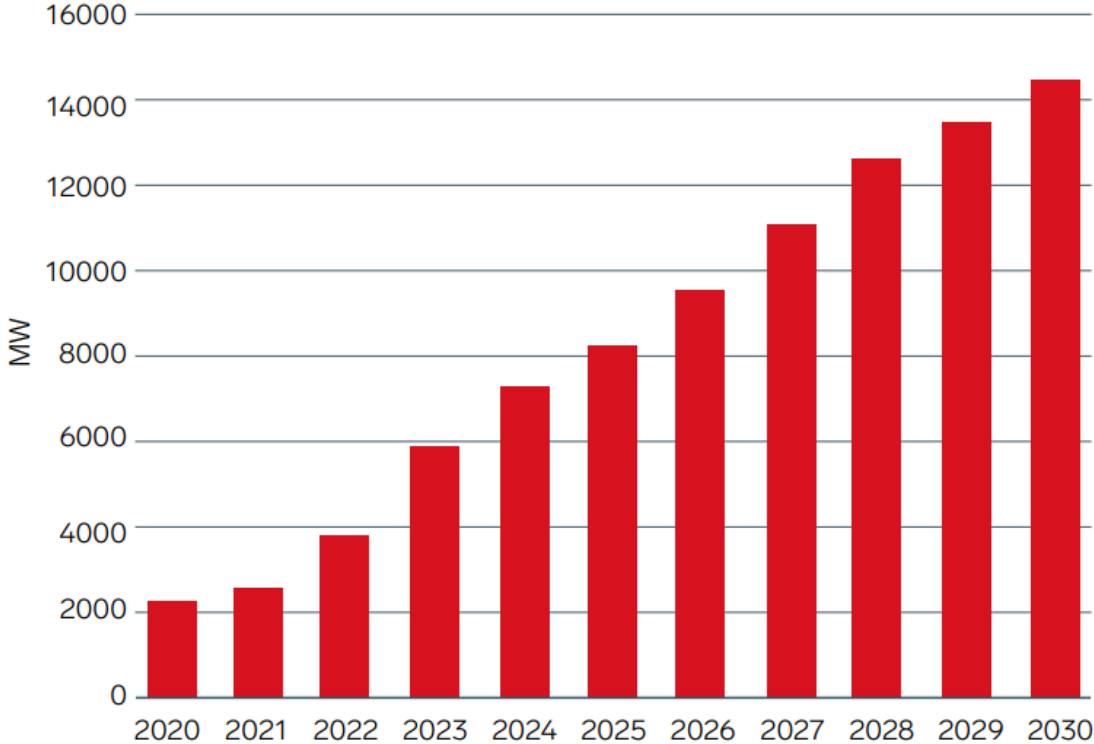
Wind PPA Prices by Country

25th Percentile Offer Prices (€/MWh)



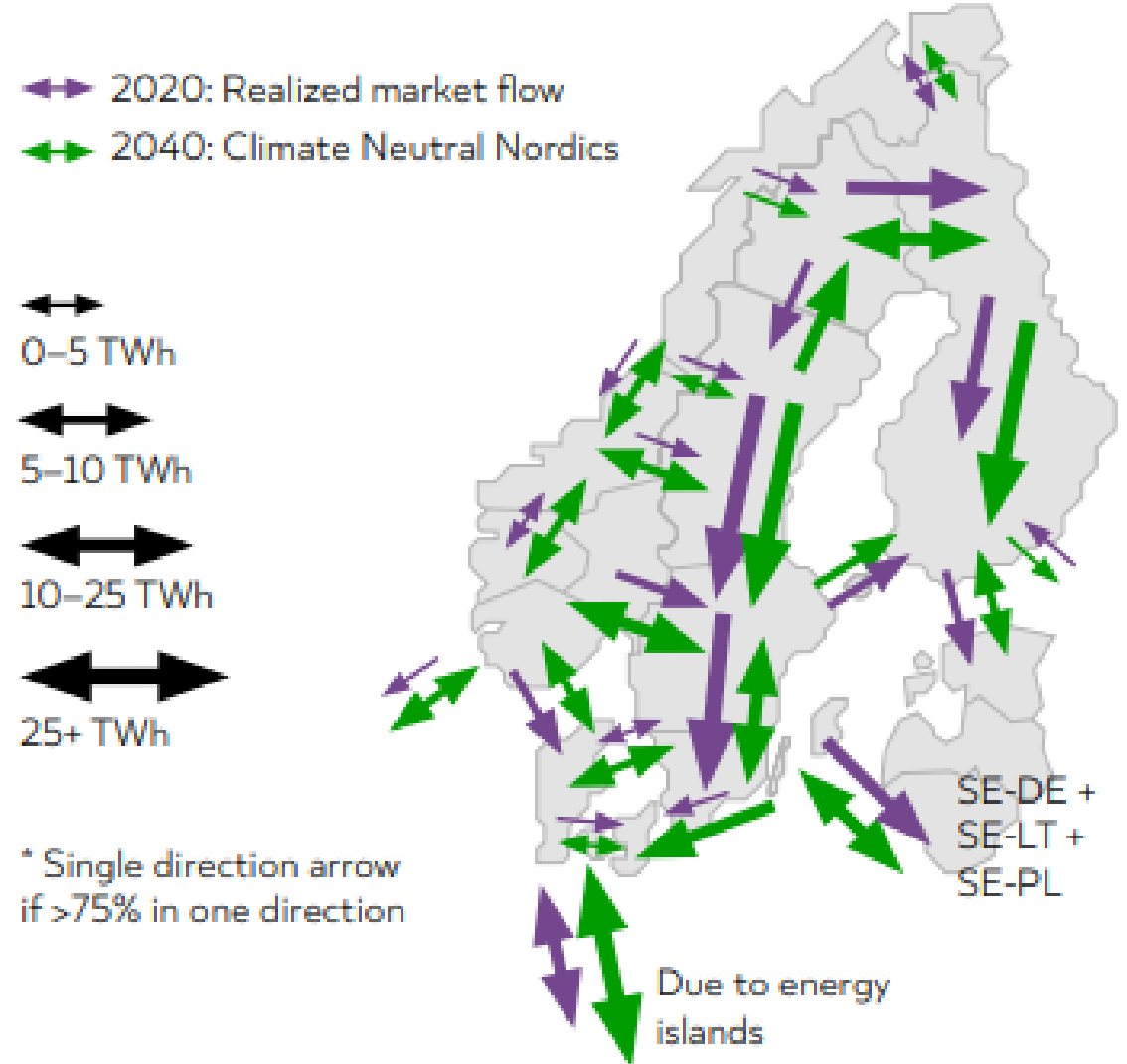
[LevelTen-Energy-European-Q42020-PPA-Price-Index.pdf \(windeurope.org\)](https://www.windeurope.org/LevelTen-Energy-European-Q42020-PPA-Price-Index.pdf)

Fingrid's wind power estimate for 2020's



Finland is not an island

- Most market places for electricity are multinational
- Finland has interconnections towards all its neighboring countries
- Even though our yearly electricity production will exceed the consumption in a couple of years, we will be more and more dependent on interconnections



The change is enormous; we need new operational models, market players and tools

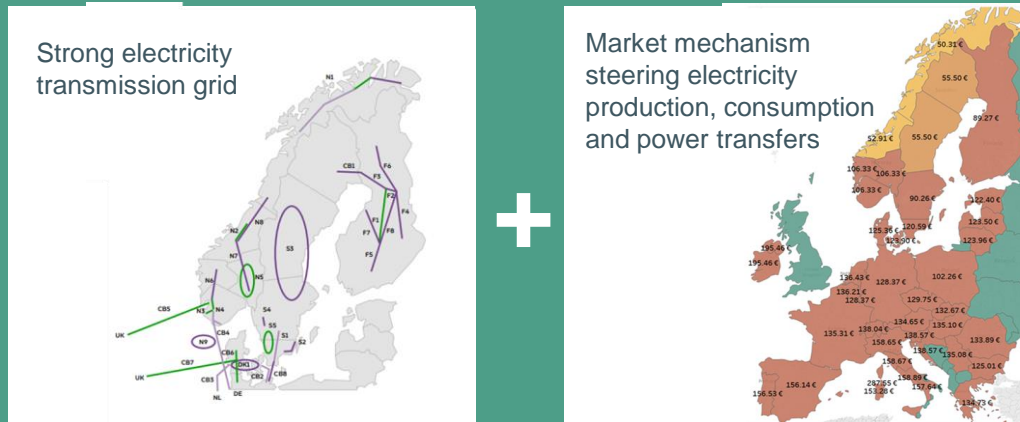


The main challenges arise from the nature of the renewable power production:

- the adequacy of electricity production and transmission capacity (long-term)
- the need for flexibility (mid-term)
- the control of frequency and voltage (short-term)

The role of Transmission System Operators

The platform for the electricity market

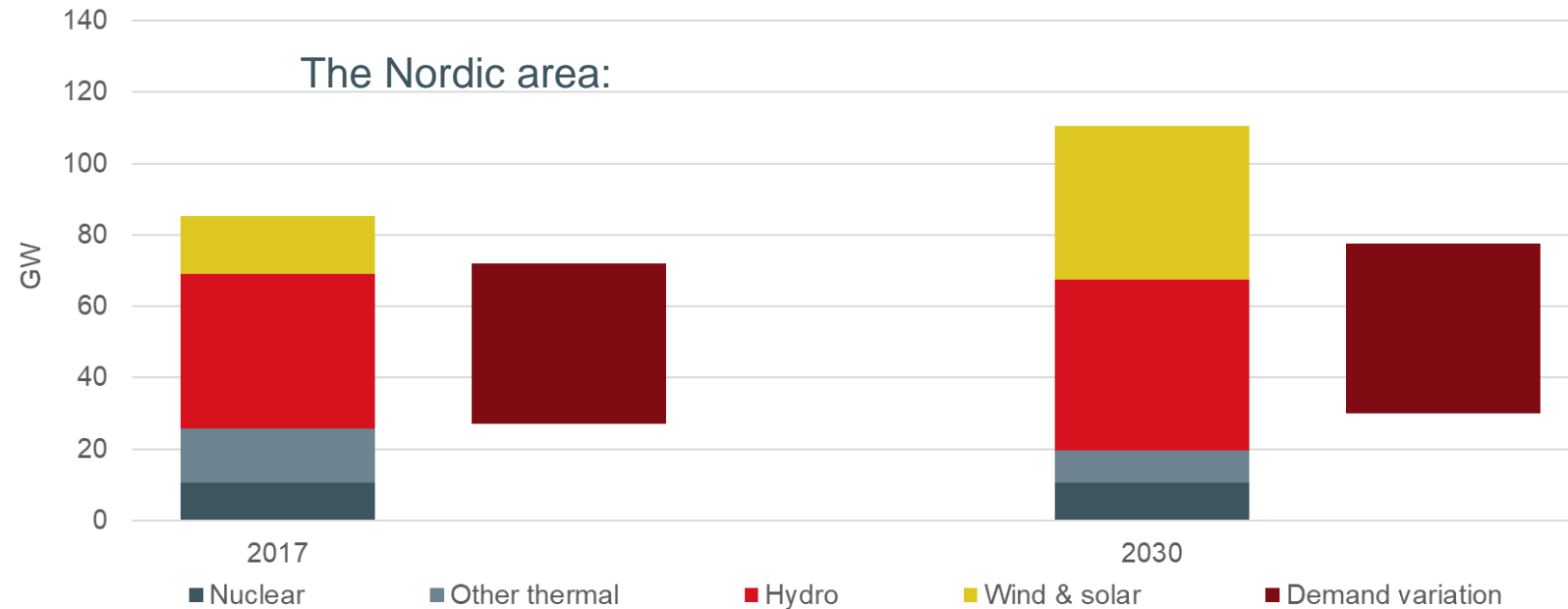


- Connecting customers and transmitting electricity between the connection points
- Developing the power transmission grid
- Promoting the electricity market:
 - Giving the transmission capacity to the market to use
 - Developing the market according to the goals set by EU
 - Sharing information to market players
- Running the power system and keeping it secure in all situations

Co-operation across the borders:



Do we have enough electricity?



=> Enough energy, but not power at all times: we also need power import

How to secure adequacy:

- Functioning, European-wide electricity market giving the right price signals
- Coordination between countries to ensure a level playing field for all the market players
- Enough interconnection capacity and long-term, open planning process of the grid as well as the market

Do we have enough transmission capacity?

Finland to be kept as one price area!

Most of the new wind power is concentrated on western parts of Finland, especially Ostrobothnia.

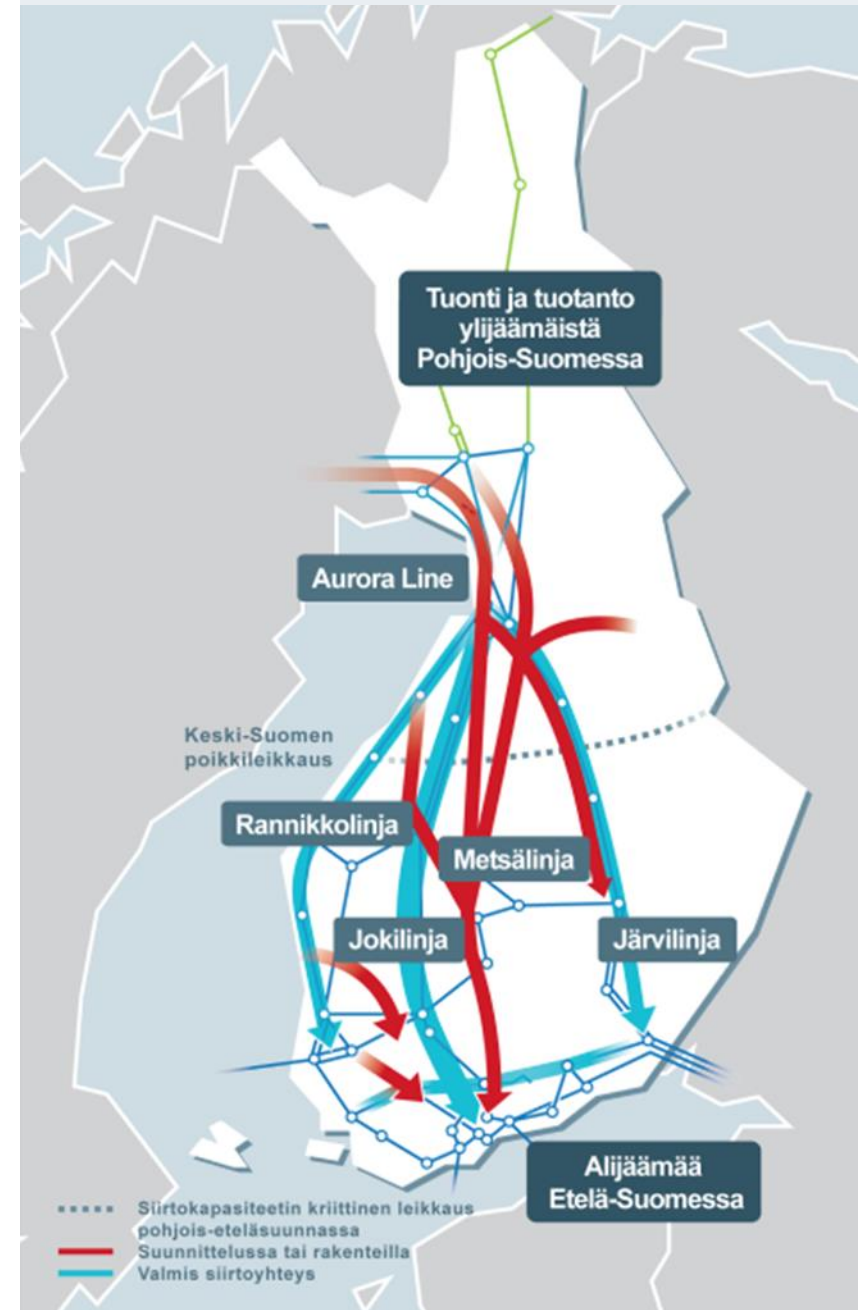
Increasing transfer needs.

Consumption is growing in southern parts of Finland and thermal power plants closing down.

Keski-Suomen poikkileikkaus

50% of the load

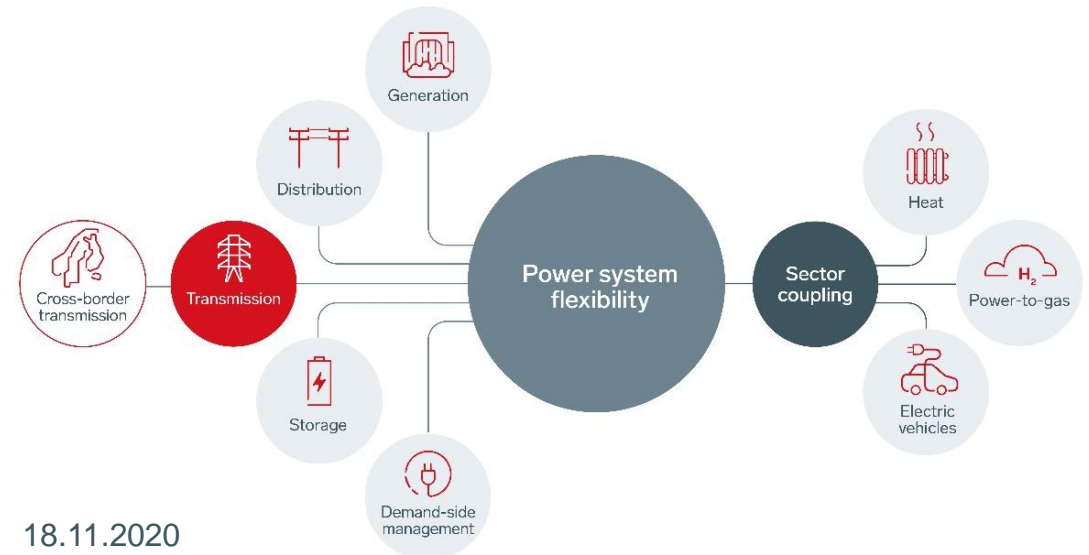
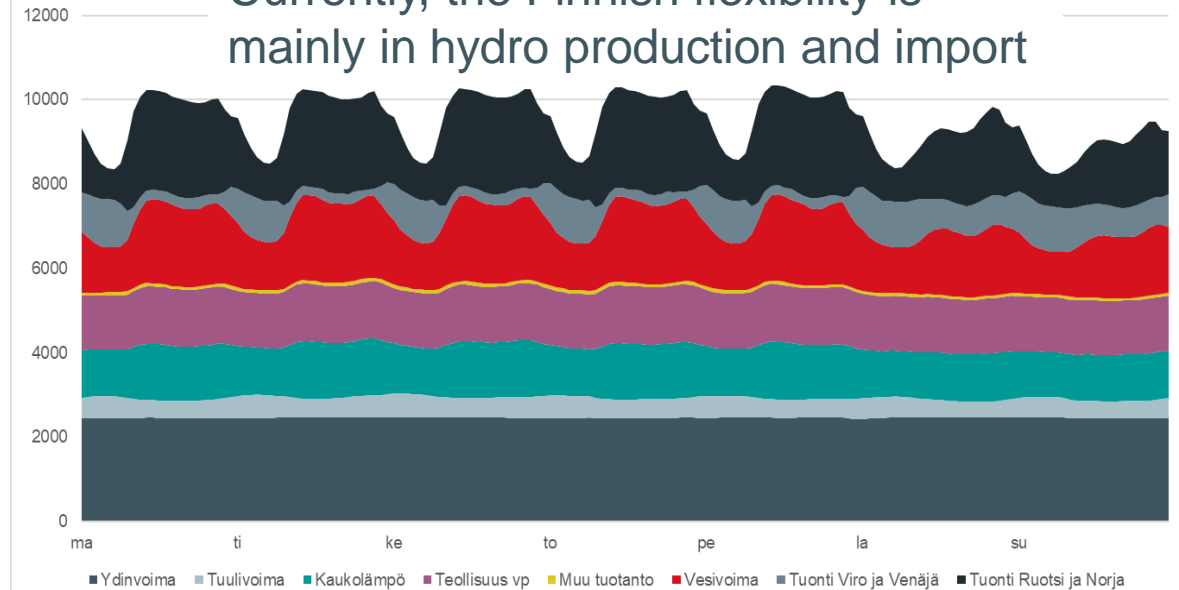
Main 400 kV reinforcements by 2030



Do we have enough flexibility?

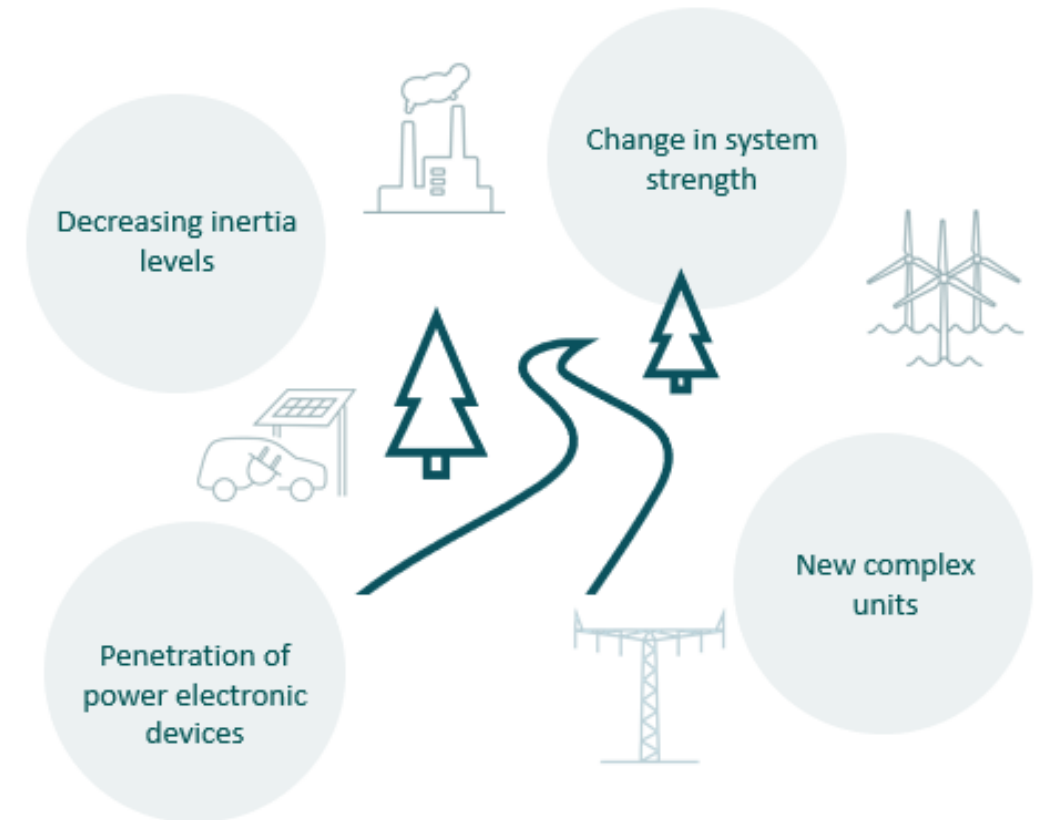
- The need for flexibility is increasing, both in the day-ahead market and in the operational hour
- At the same time, the flexibility provided by existing hydro plants is limited and the thermal production capacity is declining
- We need shorter market periods (15 minutes in 2023) and new sources to balance the system:
 - sector coupling
 - energy storages
 - flexible loads
 - electrical cars
 - ...
- The flexibility will also need a locational element to be used for alleviating grid congestions

Currently, the Finnish flexibility is mainly in hydro production and import



Are we able to control the frequency and voltage?

- The number of synchronously rotating machines will decrease and be replaced with converter connected generation: less inertia and short circuit power as well as reduced access to reserves
- We need new market places and technical solutions:
 - Exchange of reserves between countries
 - New types of reserves, faster than before
 - New technologies and market places
 - New connection requirements for converters and new planning principles for grid, it's protection and control



Reserve market places in Nordics

– we need more and faster reserves

Growing importance

New



	Fast Frequency Reserve In Nordics, total 0-300 MW (est.)	Frequency Containment Reserve for Disturbances, 220–265 MW In Nordics, total 1 200 MW	Frequency Containment Reserve for Normal Operation, 138 MW In Nordics, total 600 MW	Automatic Frequency Restoration Reserve, 70 MW In Nordics, total 300 MW	Manual Frequency Restoration Reserve
Activated	In large frequency deviations, only when the level of inertia is low	In large frequency deviations	All the time	During certain hours	If necessary

Activation speed

In a second



Seconds



A couple of minutes



A couple of minutes



Fifteen minutes



Summary: how to control the changing system?



European-wide market places and strong interconnections



Market places that correspond to physics of the power system



All market players, including consumers, steered by the market prices



All flexibility - old and new solutions - utilised for balancing and reserves

Any questions?

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