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Hydrogen & electricity transmission network

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Hydrogen Breakfast Series - Energy networks for the
Hydrogen Economy

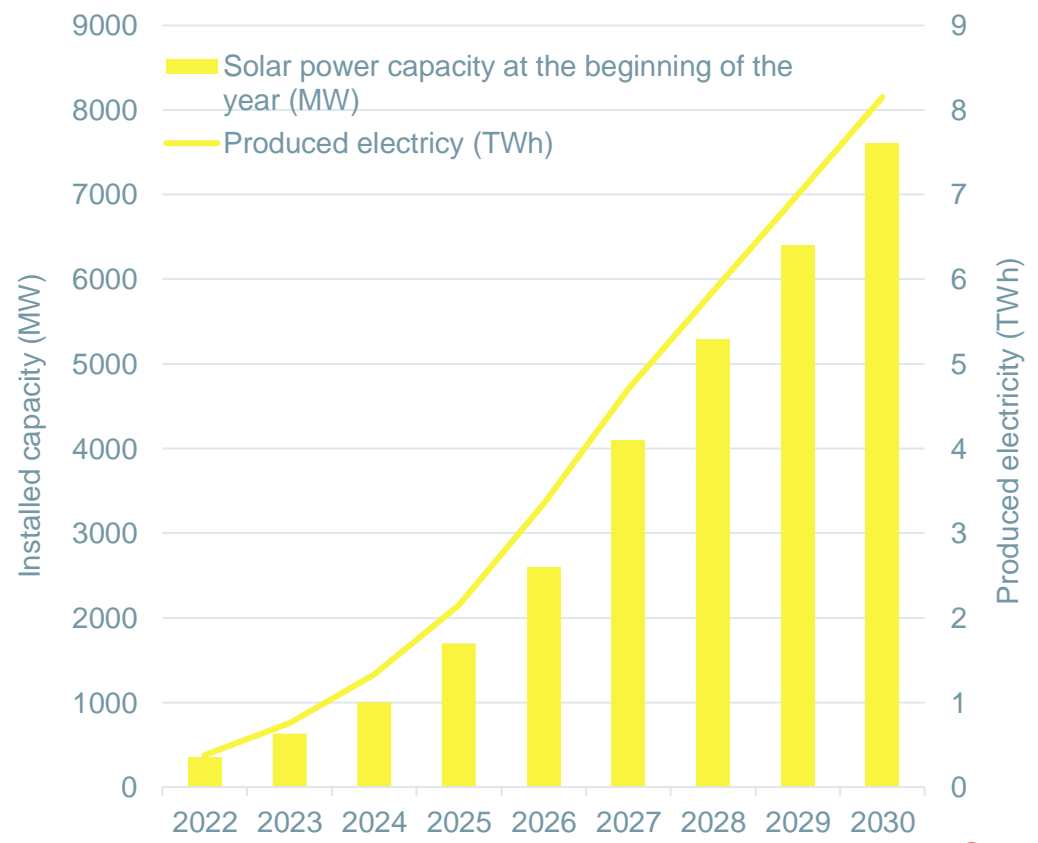
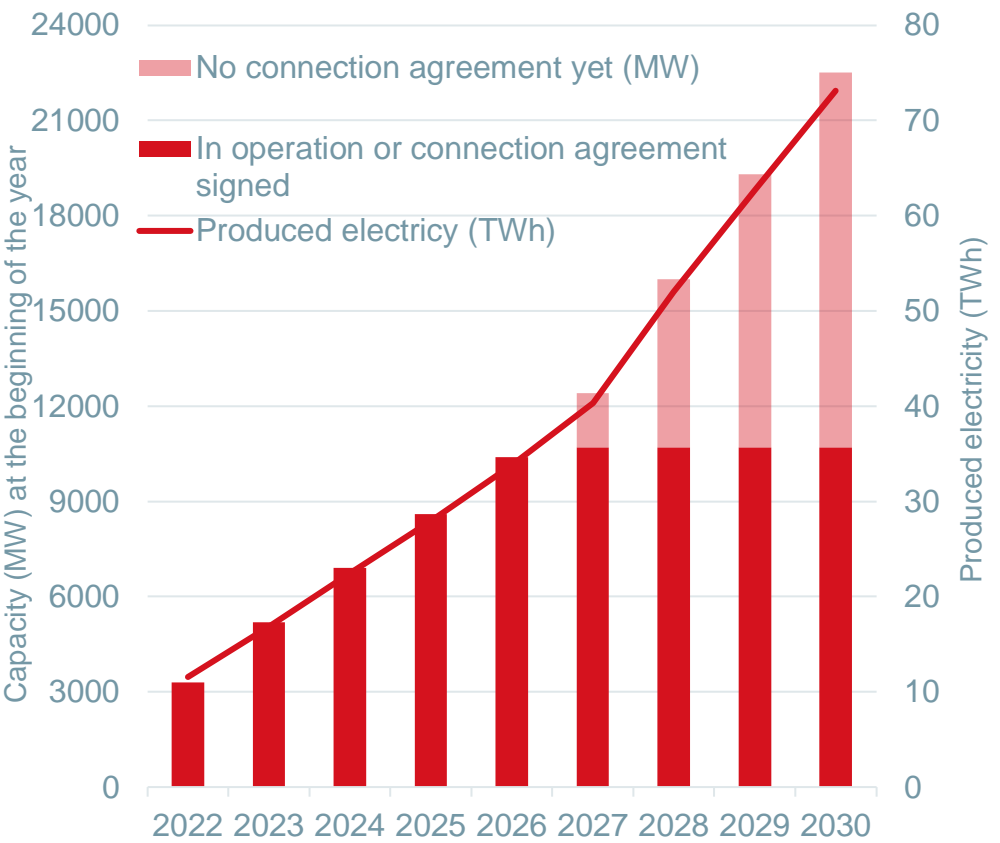
A?

Aalto University
School of Electrical
Engineering

FINGRID

Growth of renewable energy is accelerating

Fingrid has received ~360 GW of grid connection inquiries!
 175 GW onshore wind, 95 GW offshore wind, 91 GW solar power

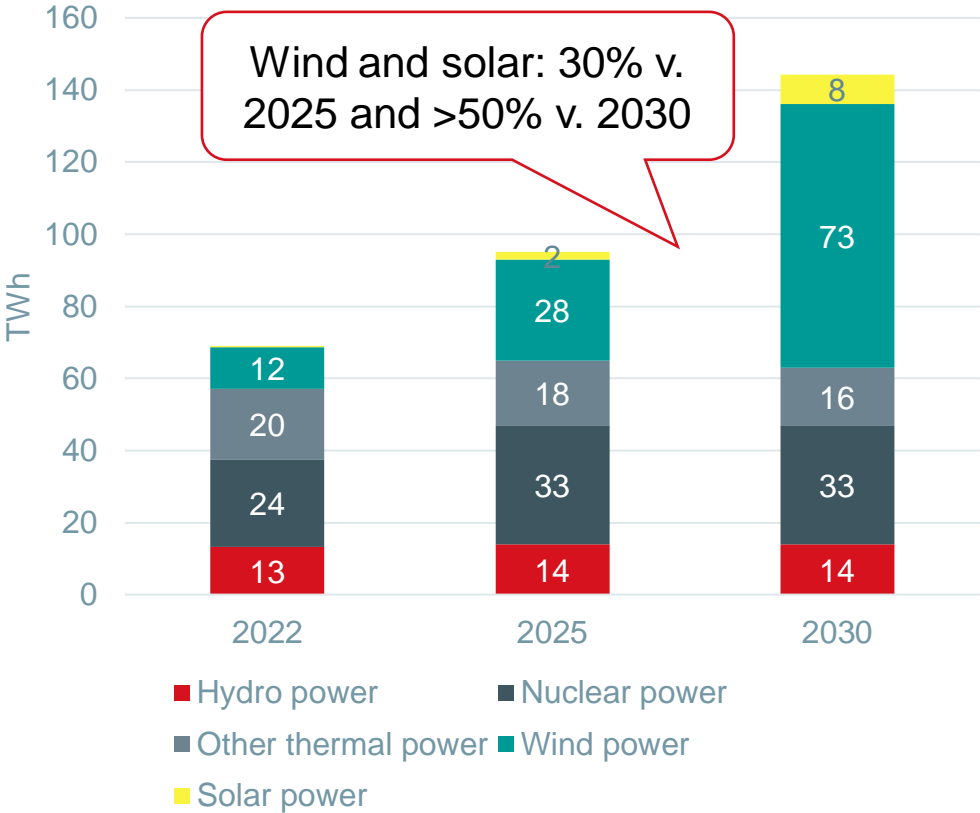


Source: Fingrid's production and consumption forecast Q3/2023

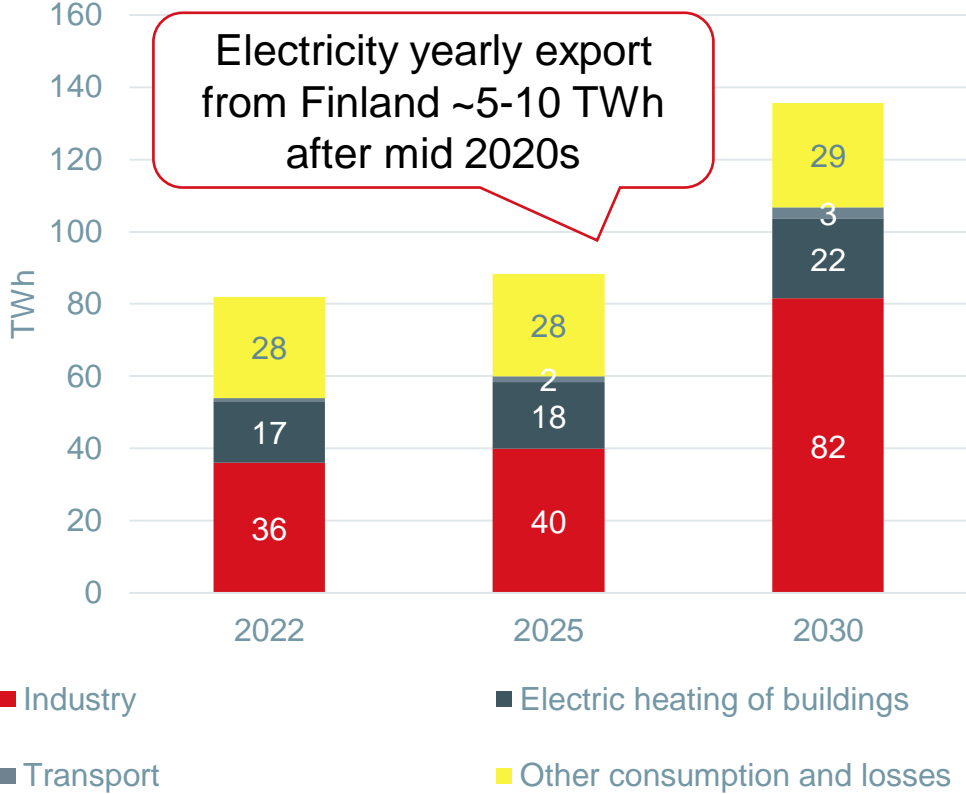


Both electricity production and consumption are increasing in Finland

Production



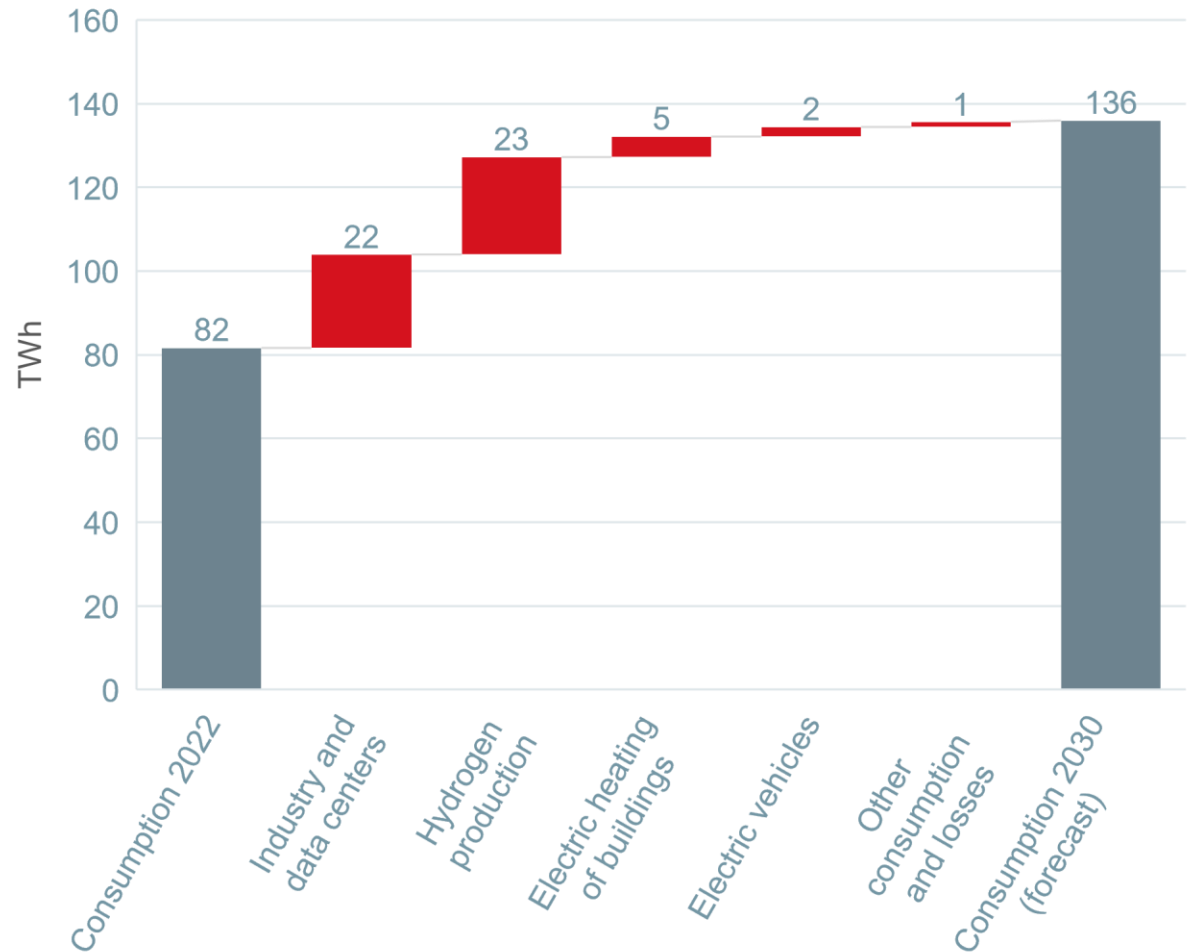
Consumption



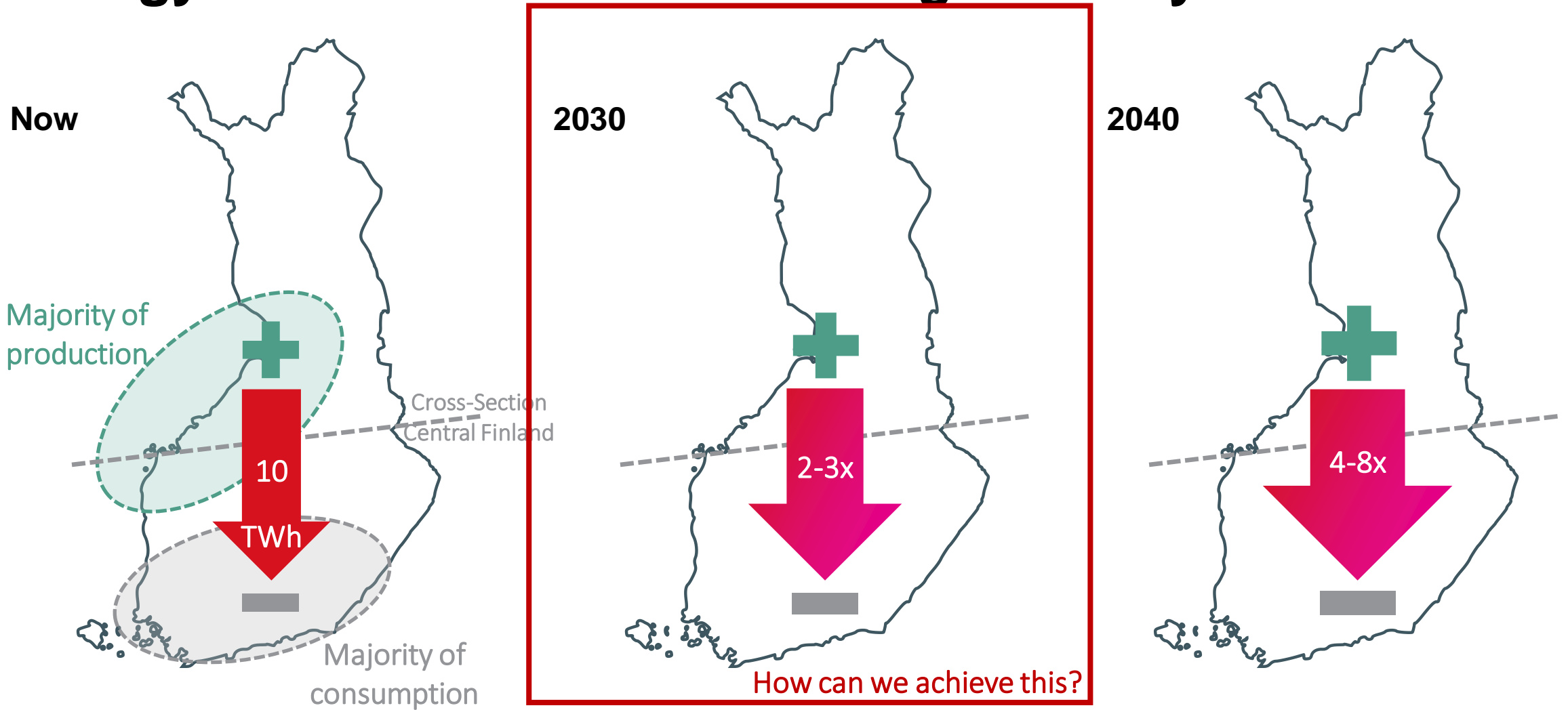
Increase of electricity consumption is based on multiple factors

- New electrification of industry
- Hydrogen production – huge potential!
- Data centers
- Electrification in district heating
- Electrification in transport sector

- Fingrid has received about 26 GW of connection inquiries for consumption!



Energy transfer needs increase significantly in the future

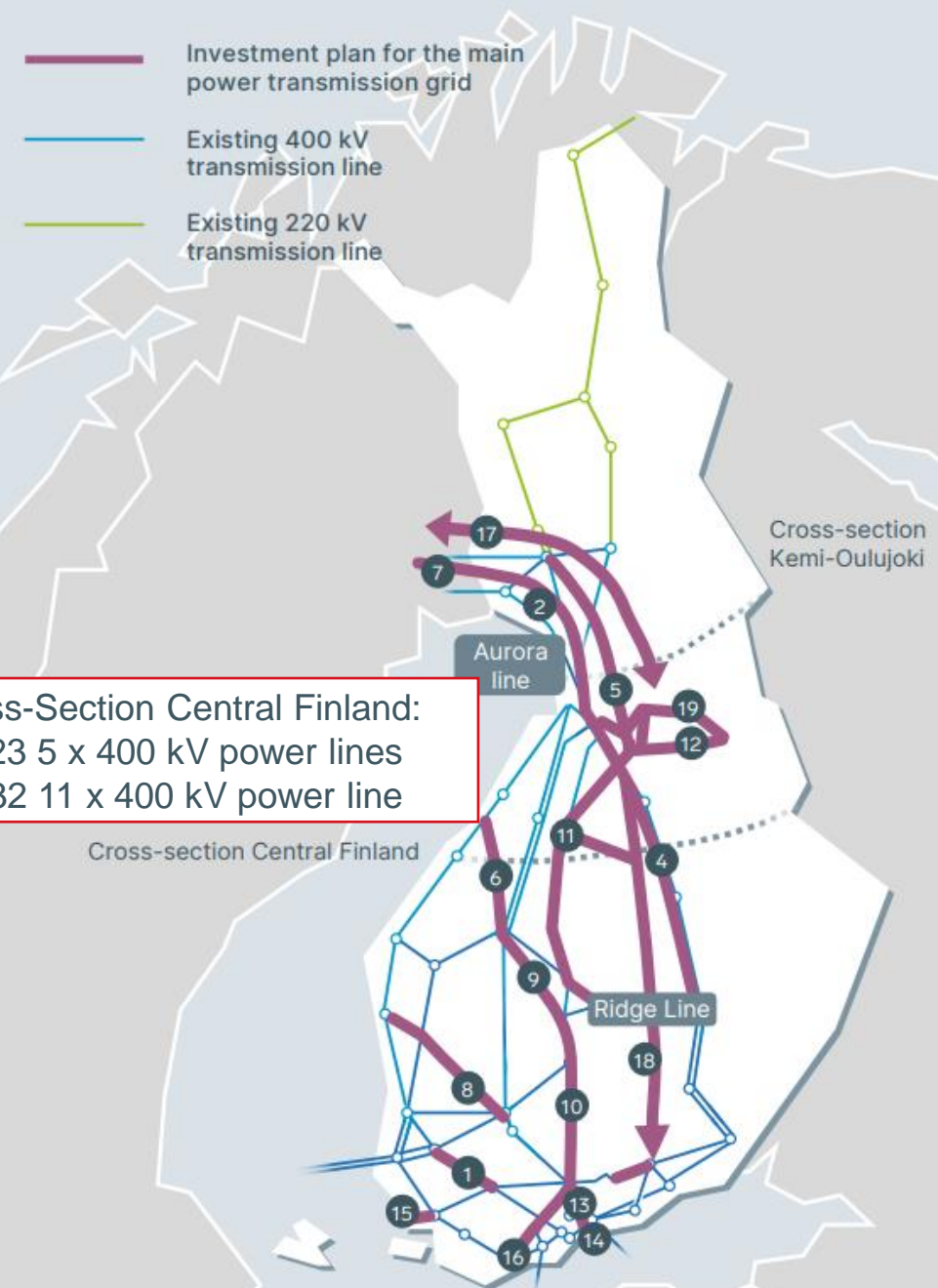


Fingrid invests 4 billion euro in the next 10 years

- Grid will be reinforced especially in north to south direction
 - 3800 km of 400 kV transmission lines
 - 2300 km of 110 kV transmission lines
 - 128 substation projects
- New interconnectors constructed and planned
 - Aurora line (SE1-FI) in 2025
 - Aurora line 2 (SE1-FI) in 2032
 - Estlink 3 (EE-FI) in 2035
 - Fenno-Skan 3 (SE3-FI) late 2030's
 - Back-to-back HVDC (NO4-FI) early 2030's

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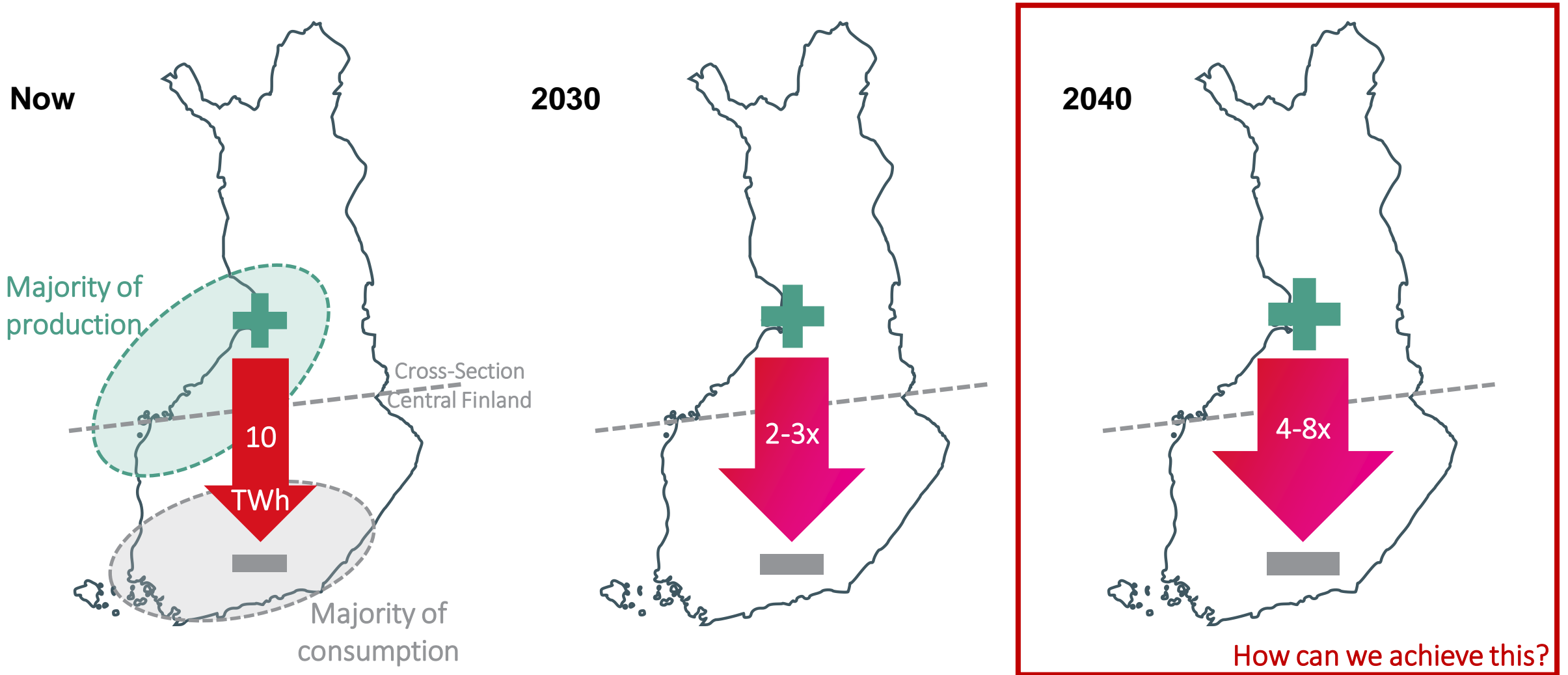
+ Hydrogen pipelines?



Source: Fingrid's Main grid development plan 2024–2033

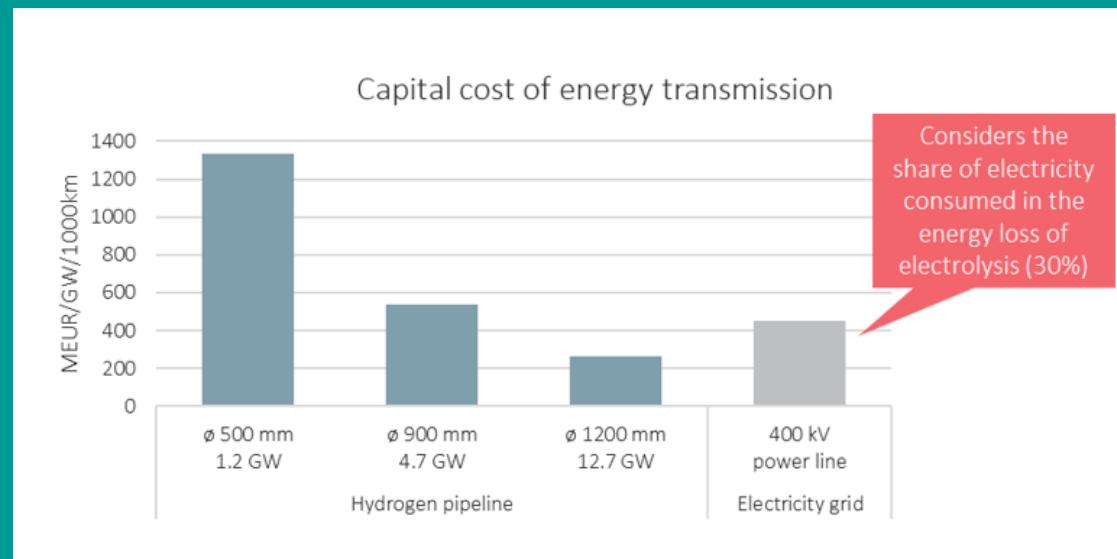
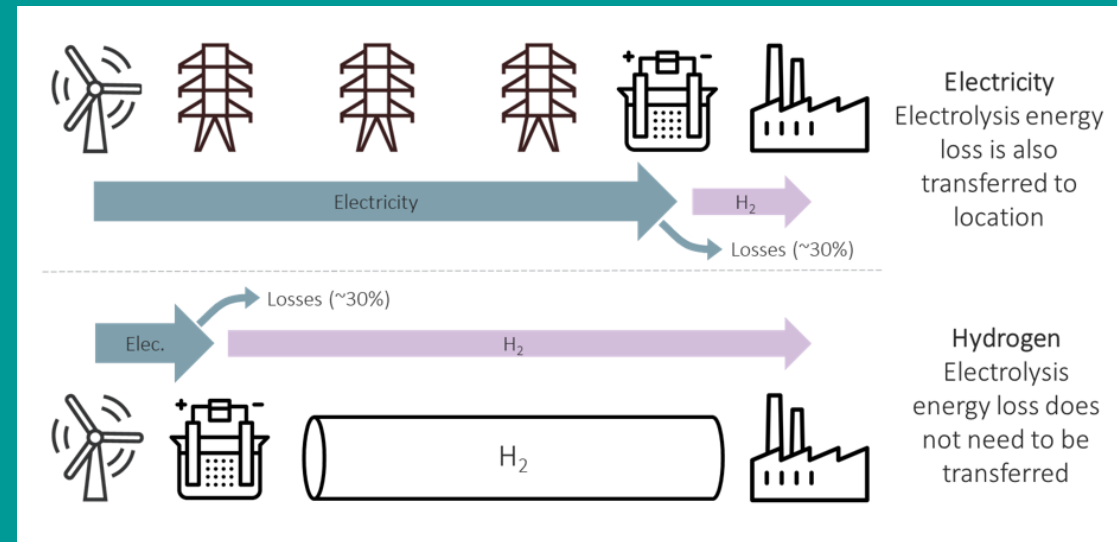
(https://www.fingrid.fi/globalassets/dokumentit/fi/kantaverkko/kantaverkon-kehittaminen/fingrid_kehittamissuunnitelma_syksy23_en.pdf)

Energy transfer needs increase significantly in the future



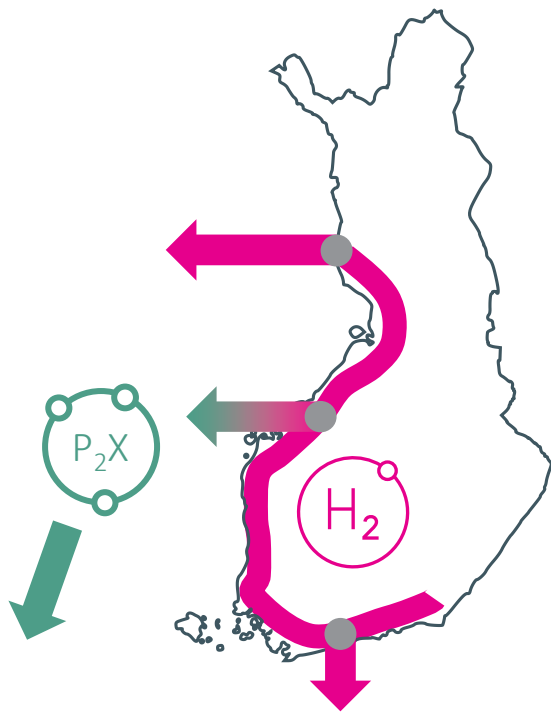
Hydrogen transmission infrastructure would support utilization of renewable energy

- Hydrogen transmission infrastructure would enable electrolyzers to be located near electricity production sites, thus reducing the need for electricity transmission
- In particular, north-south hydrogen transmission infrastructure would contribute to the full utilisation of Finland's wind power potential
- Infrastructure would also act as a storage and support balancing of electricity system

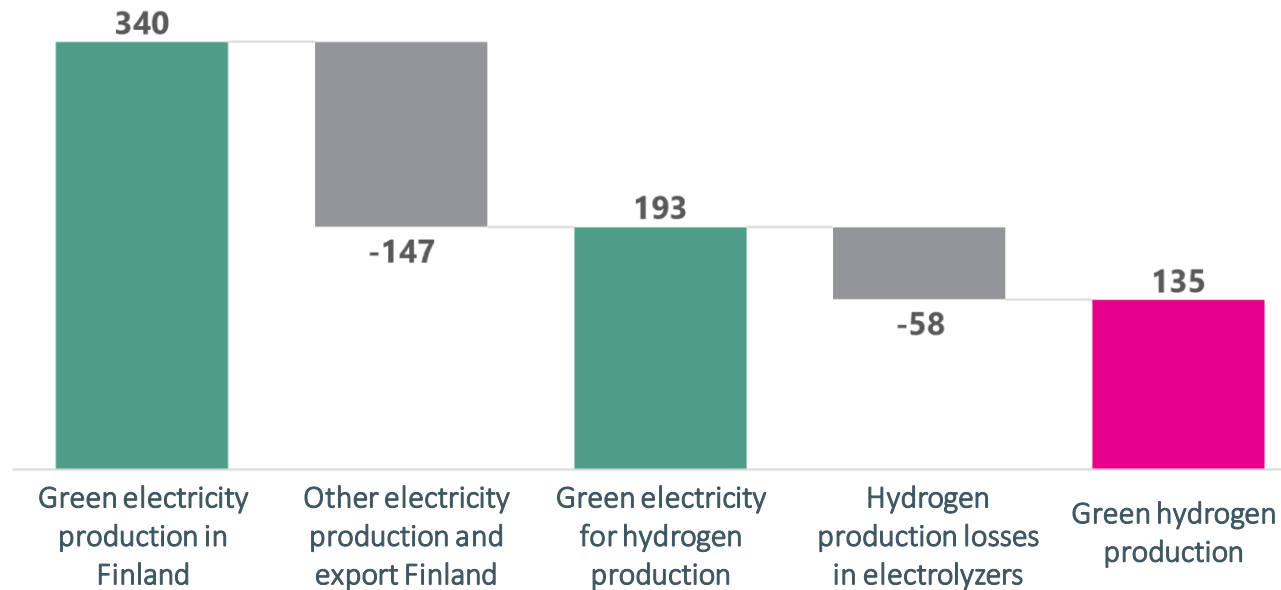


Source: Intermediate report: Energy transmission infrastructure as enabler of hydrogen economy and clean energy system. Fingrid & Gasgrid Finland

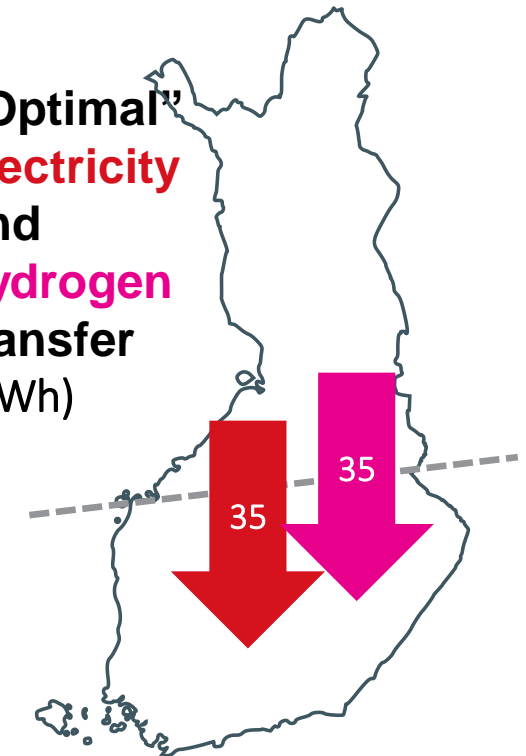
“Vetytalouden kärkimaa Suomi” high growth scenario



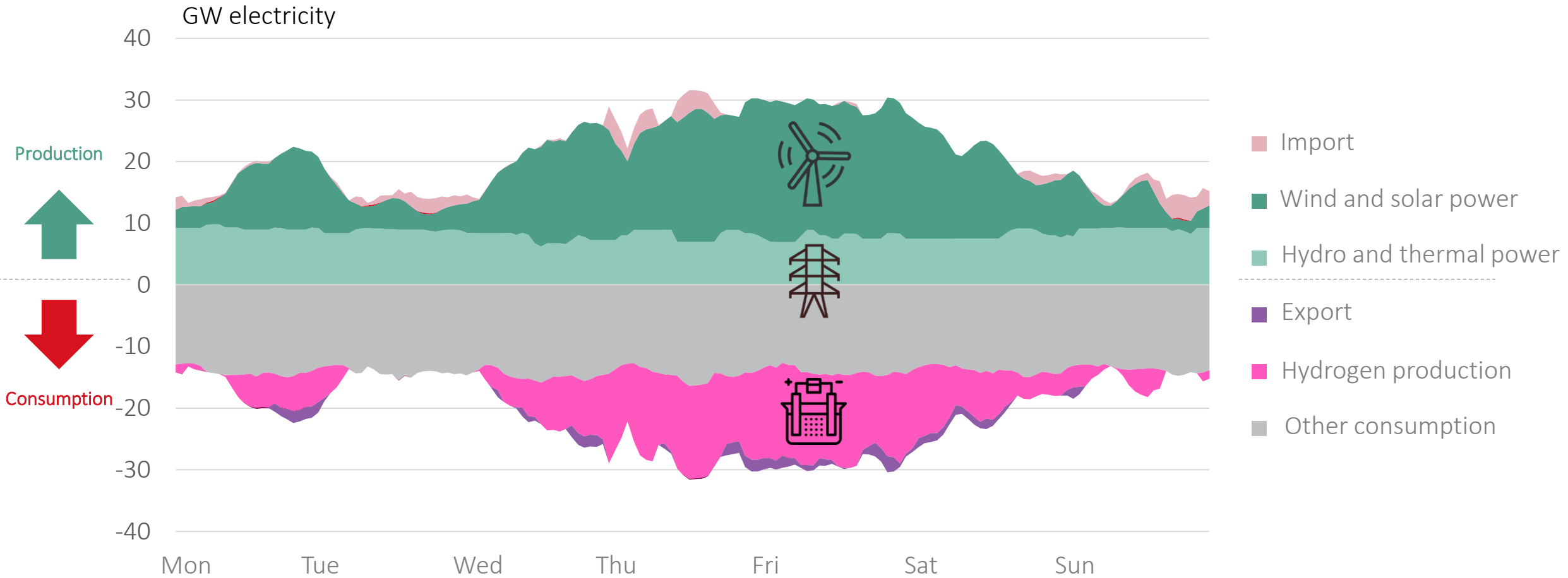
Electricity and hydrogen production/consumption in the scenario in 2040 (TWh electricity/hydrogen)



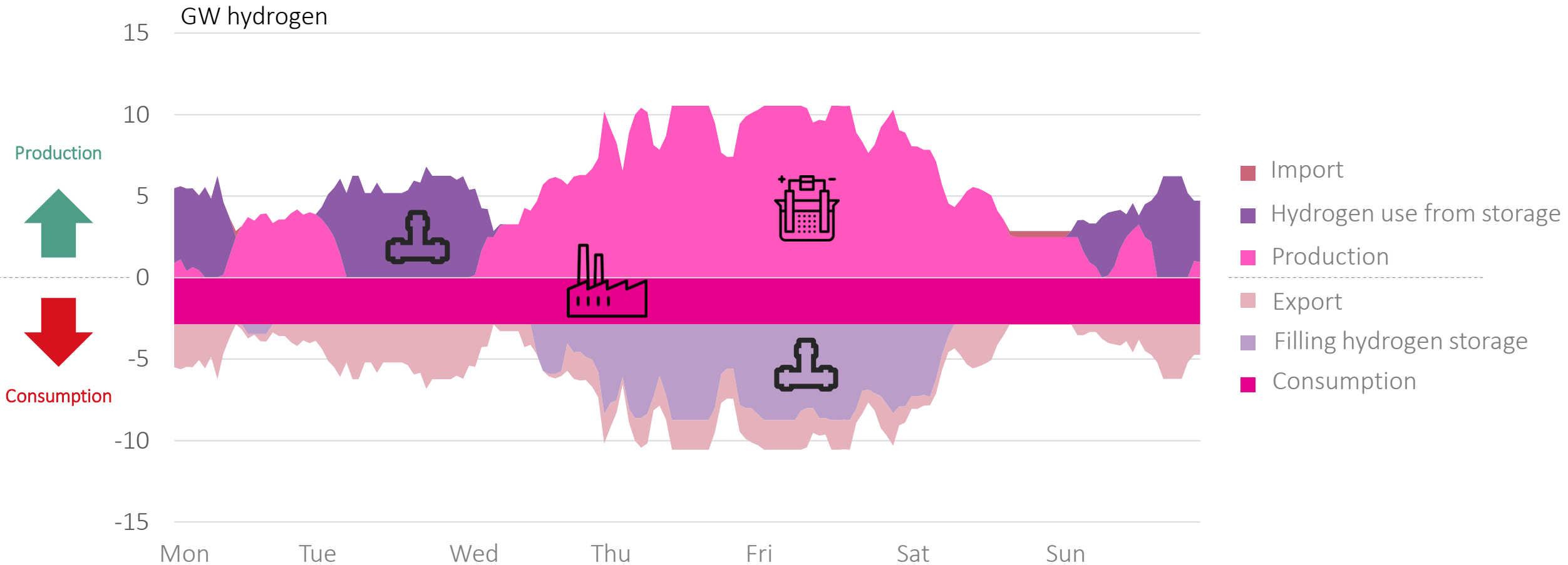
“Optimal” electricity and hydrogen transfer (TWh)



Hydrogen is produced when the price of electricity is low



Hydrogen production is flexible, however, due to hydrogen transfer and storage, the end user gets a steady supply of hydrogen



Conclusions

- 1) Finland has excellent possibilities to become the front runner of hydrogen economy
 - Strong transmission grid
 - Large potential for renewable electricity production
- 2) The development of electricity and hydrogen infrastructure enables the growth of hydrogen economy
 - Proactive development of electricity and hydrogen transmission grids for customer needs
 - Interplay between both infrastructures is important – location matters!
- 3) Skilled work force and companies needed for different parts of the hydrogen value chain
 - Quality education is highly important!

