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Current developments in the Nordic power market

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Det **grønne** taktskiftet

The Norwegian power system

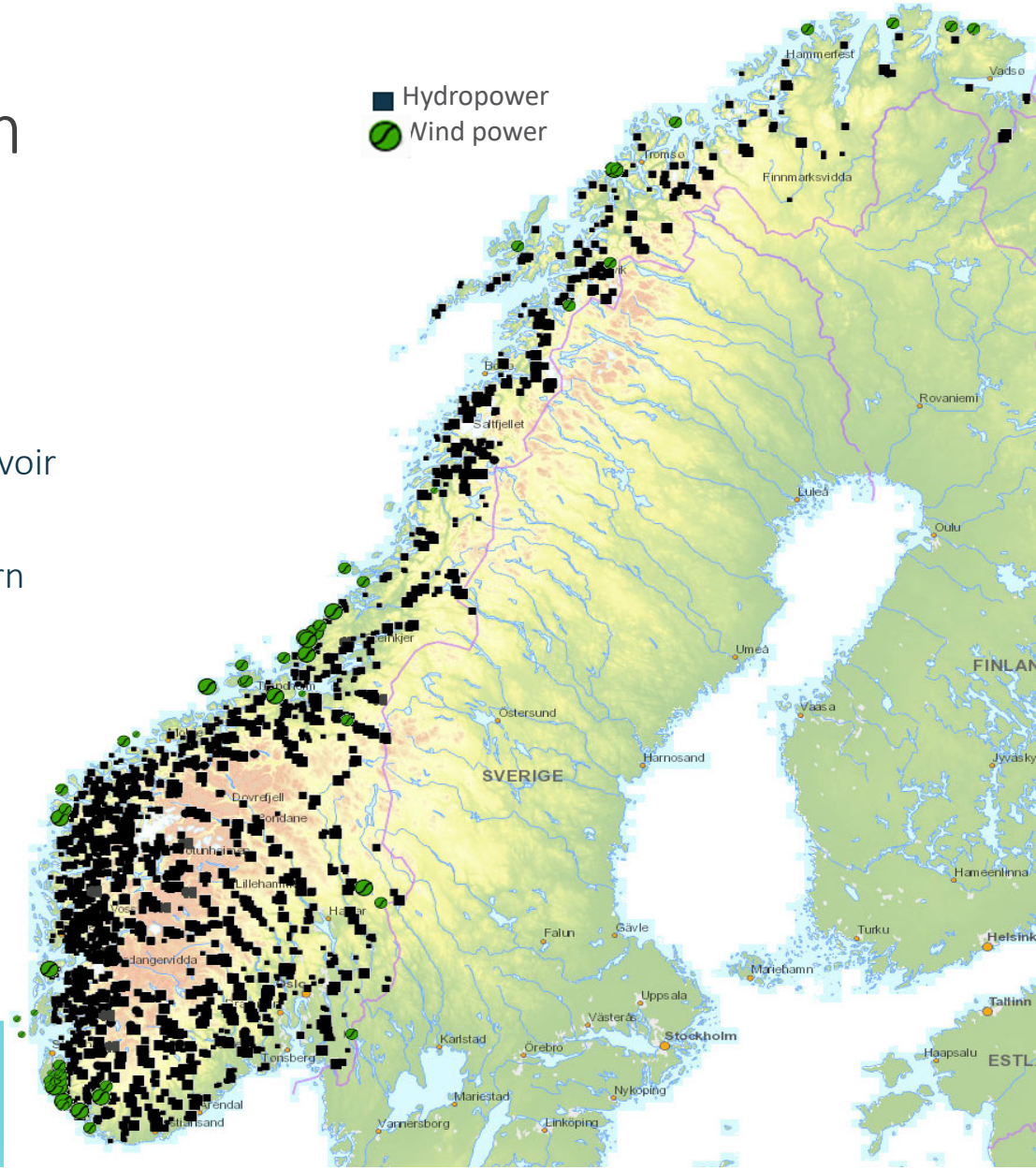
- **Highly distributed generation**

  >1,700 hydro power stations

  Installed capacity 33.4 GW. Peak load 25.2 GW.

  >1,000 hydro power reservoirs, 50% of Europe's reservoir capacity.

  Largest power stations located in western and northern part of the country.



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The Nordic synchronous area

- **Currently consisting of 15 bidding zones**
  - 5 in Norway; 4 in Sweden; 2 in Denmark; 1 in Finland; 3 in the Baltics
- **Relatively weak grid**

  Especially in central and northern parts of Norway. The strongest connections are found in direction west–east in Norway and north-south in Sweden.

  Highest consumption in Eastern Norway and Southern Sweden, but also a lot of distributed energy intensive industry.
- **Highly interconnected with European energy market**
  - Netherlands: 700 MW (DC)
  - Poland: 600 MW (DC)
  - Germany: 4.400 MW (AC + DC)
  - Great Britain: 1.400 MW (DC)

➢ *The German power market is the most important external market that has a big impact on Nordic prices*

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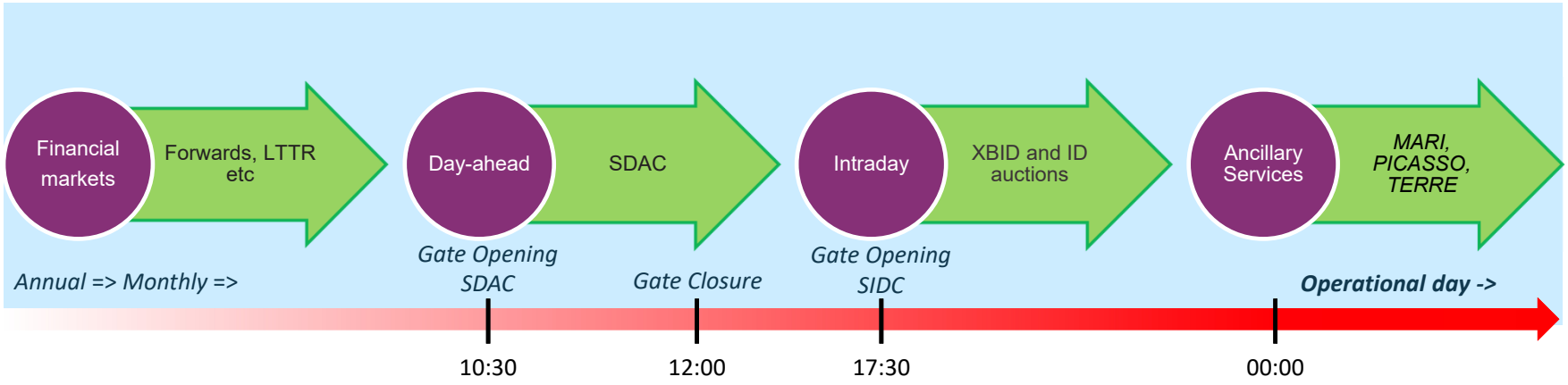
The European *Internal Energy Market (IEM)* consists of a number of market solutions in sequence



Long-Term Transmission Rights (LTTR)
- PTR - Physical Transmission Rights
- FTR - Financial Transmission Rights

Single Day-Ahead Coupling (SDAC)
- The main auction that sets the spot price for the next 24 hours

Single Intraday Coupling (SIDC)
- Continuous trading - XBID
- Intraday auctions - IDA

TSO-TSO trading and ancillary services
- Countertrade / Redispatching
- mFRR – Manual frequency reserves (MARI)
- aFRR – Automatic frequency reserves (PICASSO)
- RR – Replacement Reserves (TERRE)
- etc

The need for flexible resources is increasing

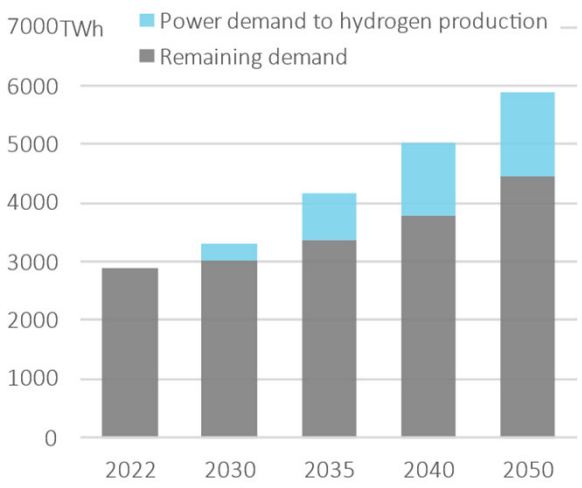
- The European power system is currently going through a major transition
  - More renewable sources give larger and faster changes in flow patterns and balancing
  - Common European regulations for markets and system operation are being implemented
  - 15 minute time resolution in energy markets, more digitalization and automated system operation

➢ *Sufficient flexibility in the power system is crucial for balancing, congestion relief and incident handling, but also to facilitate faster industrial development and postpone or reduce the need for grid expansion*

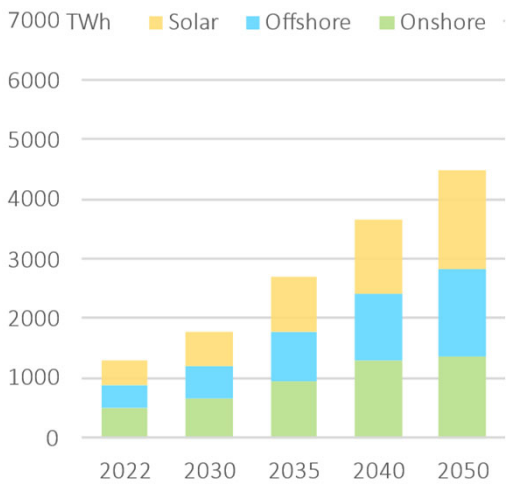
- In Norway, hydro power is our main instrument to ensure a reliable power supply. Historically, dispatchable hydro power is the largest contributor to balancing of the Norwegian power system.
- Flexibility from other resources (new renewable generation, demand and batteries) are becoming more important and valuable due to the ongoing transition of the power system

The European power system will be dominated by solar, wind and flexibility

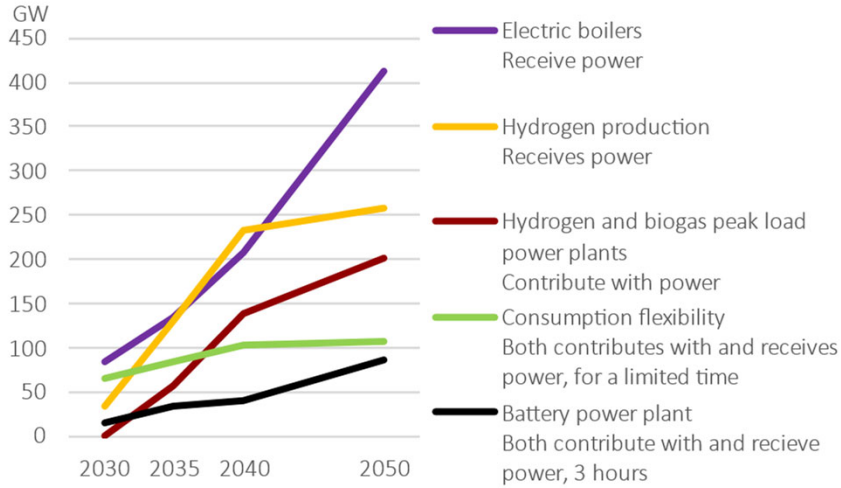
Electricity demand in Europe incl. Nordics doubles



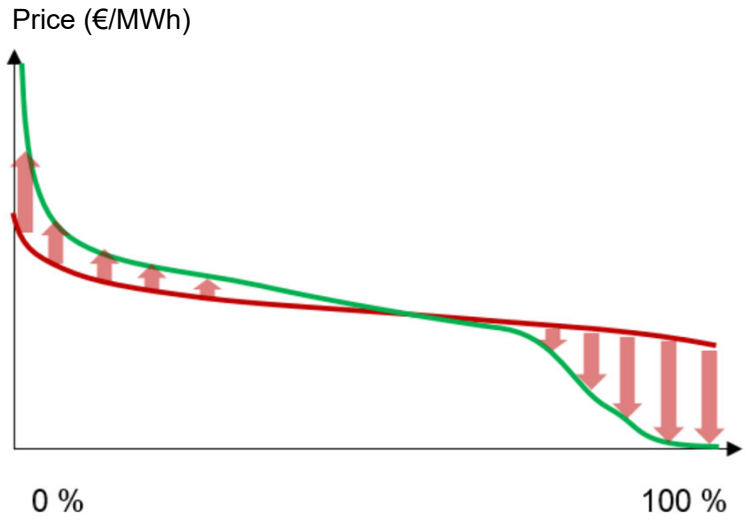
Generation increase largely from solar and wind



Large volumes of new flexibility will be needed



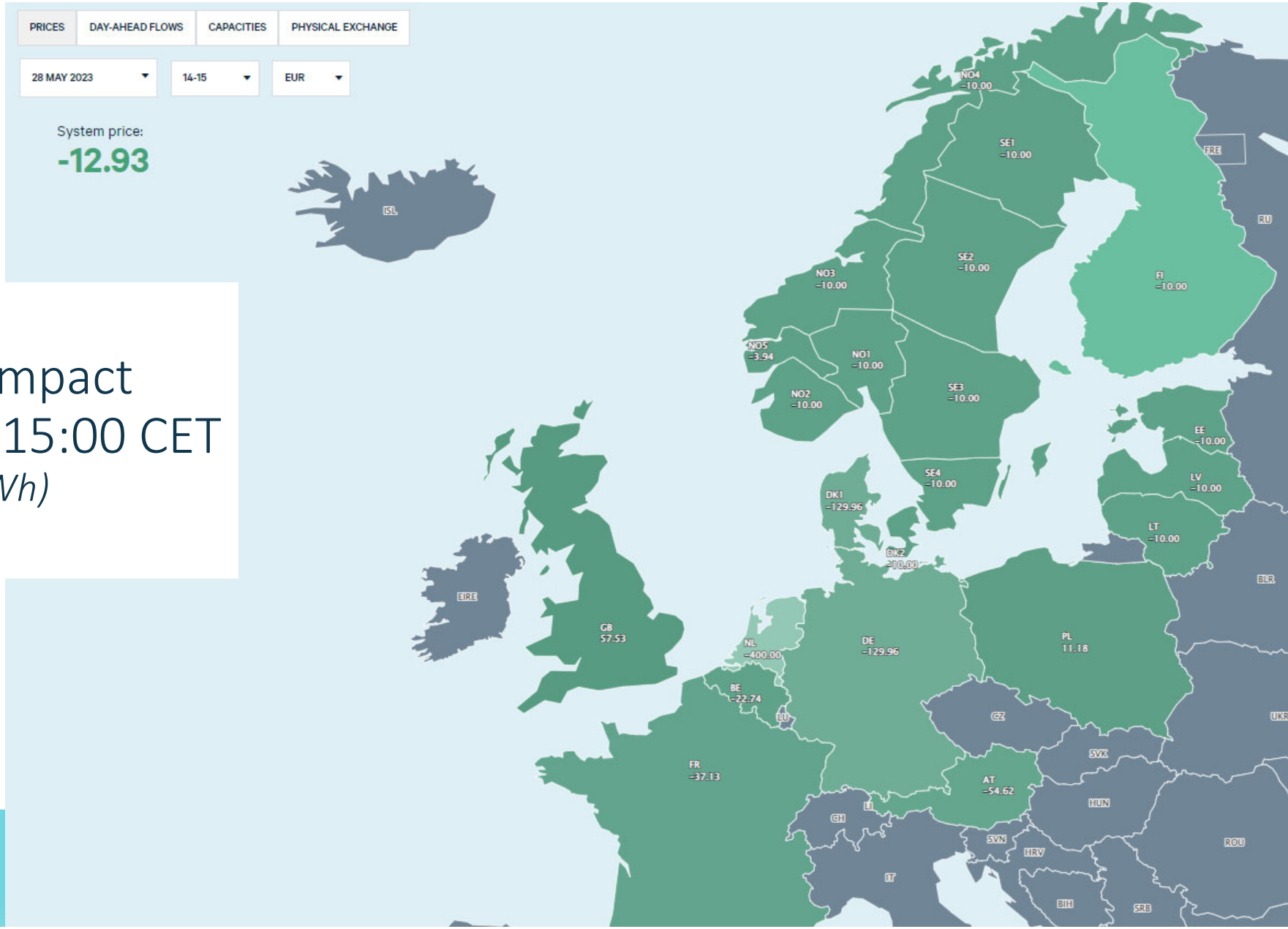
Market development will create incentives for new flexibility



- Surplus of renewables will give more hours with very low prices –> will give incentives for **electrolysis, boilers and storage**
- Shortage of renewables will give more hours with very high prices–> will give incentives for **storage, peak generation and demand flexibility**

Solar power impact 28th May 14-15:00 CET

(prices in EUR/MWh)



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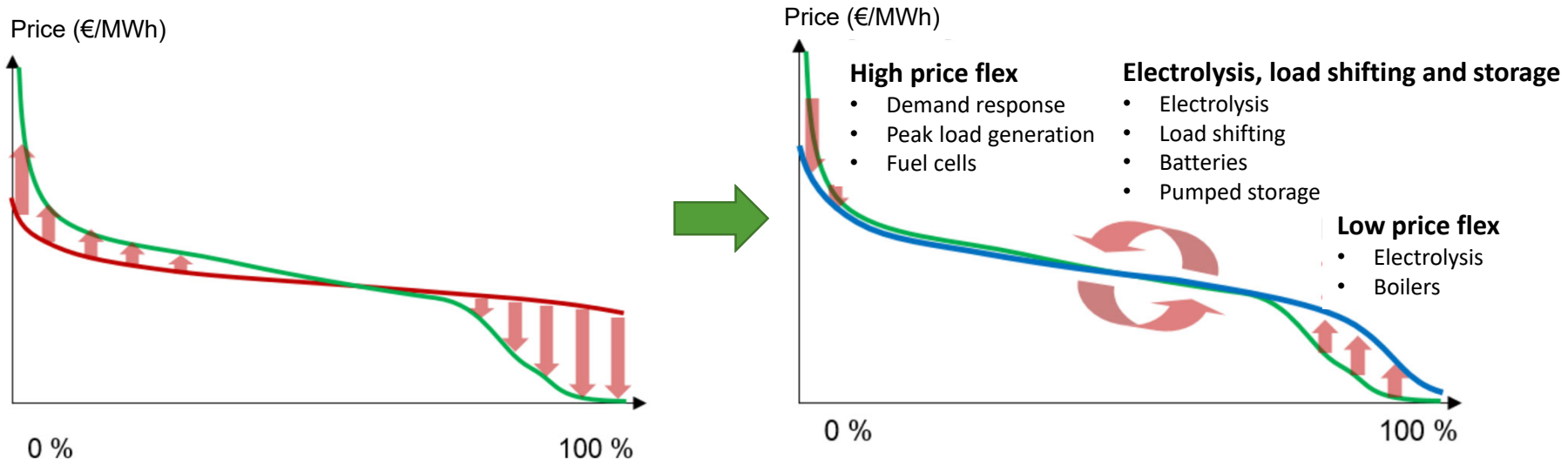
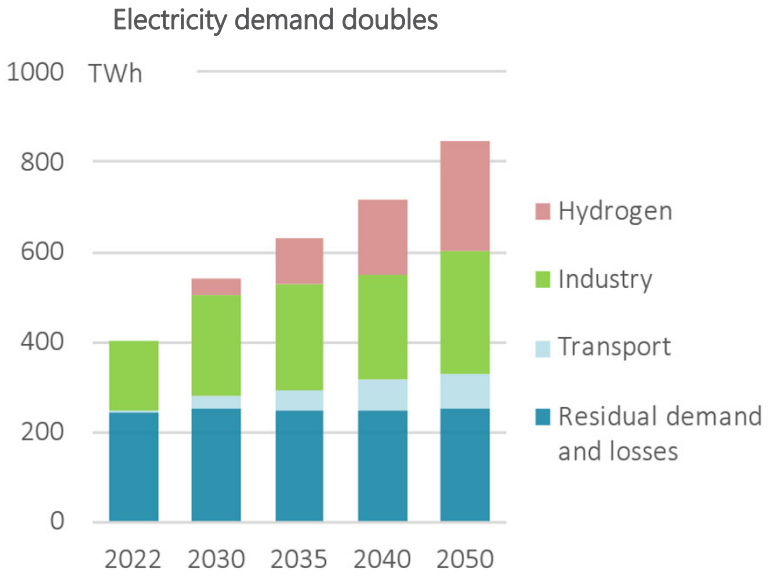
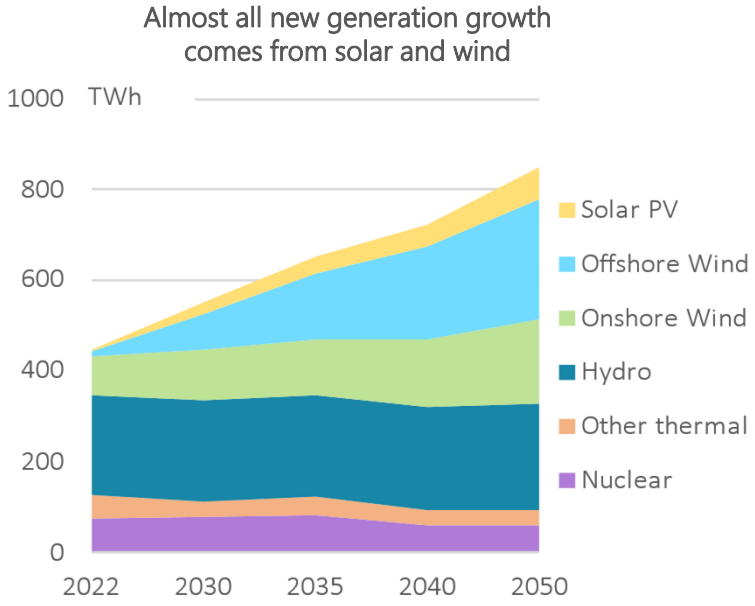
Over time, the market balance will limit the profitability of flexibility



- Surplus of renewables will give more hours with very low prices –> will give incentives for **electrolysis, boilers and batteries**
- Shortage of renewables will give more hours with very high prices–> will give incentives for **batteries, peak generation and demand flexibility**
- More flexibility will reduce price volatility –> profitability of new flexibility will be reduced
- Reduced price volatility will increase profitability for new renewables, which will again give higher price volatility etc.....

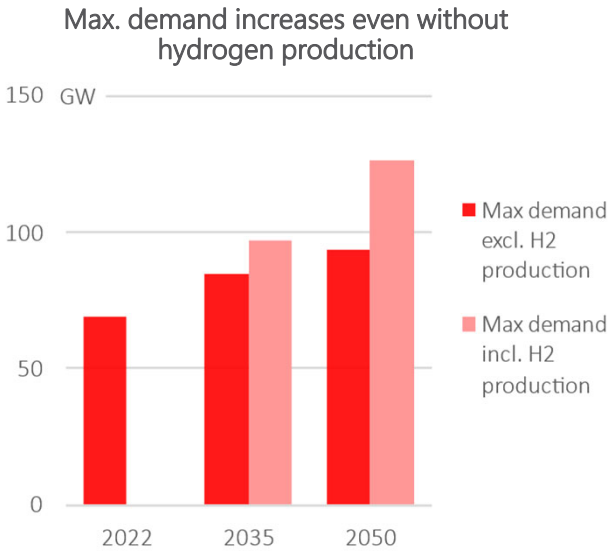
Nordic electricity demand can double

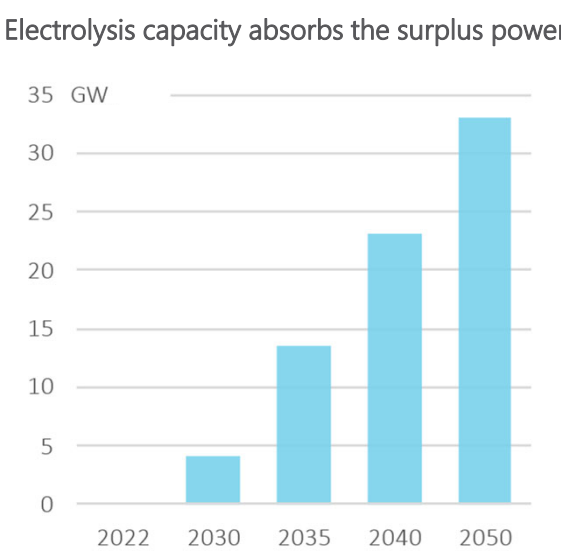


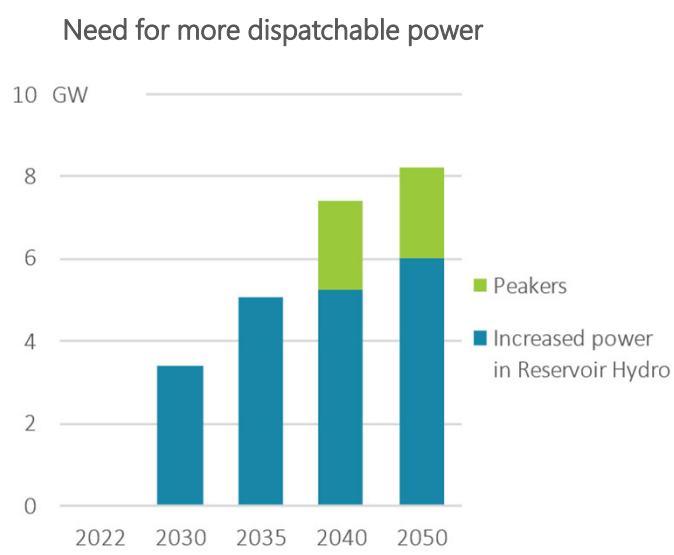


- Electrification of new industry and hydrogen production account for the largest shares of demand growth
- The pace of solar and wind build-out is approximately in line with demand growth

Need for more dispatchable power – and flex to absorb the surplus

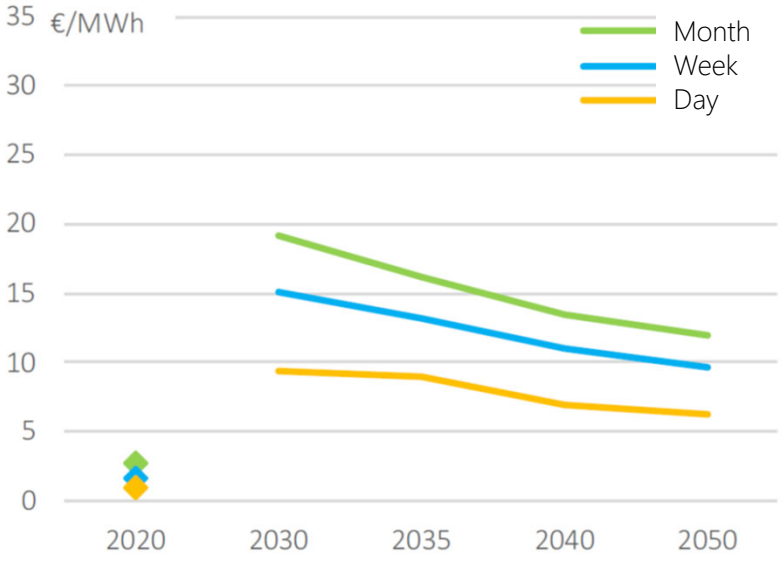




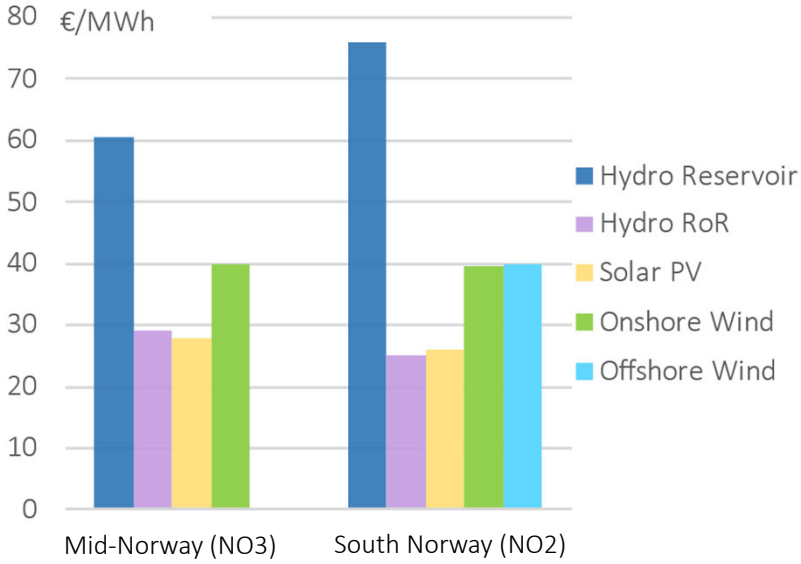


Large variation in capture price for different types of consumers and producers

Average variation in hourly prices in Southern Norway (NO2) over different time frames



Capture price for different types of generation in 2030



Development of the need for flexibility in the Nordic Power Market

- More renewable generation (wind and solar) will cause increased imbalances
- Increased reserve volume requirements according to System Operation Guideline
  - From Nordic balancing to Bidding Zone balancing
- 15 minute time resolution in energy markets will cause more frequent scheduled activation
- Automatic activation is expected to use a larger part of the bid curve
- Increased imbalance cost may incentivize parties to keep their own balance

Further reading (in Norwegian)

- Long term market analysis 2022-2050:
  - https://www.statnett.no/for-aktorer-i-kraftbransjen/planer-og-analyser/langsiktig-markedsanalyse
- Short term market analysis 2022-2027:
  - https://www.statnett.no/for-aktorer-i-kraftbransjen/planer-og-analyser/kortsiktig-markedsanalyse/
- Norwegian demand forecast 2022-2050:
  - https://www.statnett.no/globalassets/for-aktorer-i-kraftsystemet/planer-og-analyser/lma/forbruksutvikling-i-norge-2022-2050---delrapport-til-lma-2022-2050.pdf
- Reserve markets
  - https://www.statnett.no/for-aktorer-i-kraftbransjen/systemansvaret/kraftmarkedet/reservemarkeder/