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Long-term Market Analysis 2018-40

User meeting 13th March 2019

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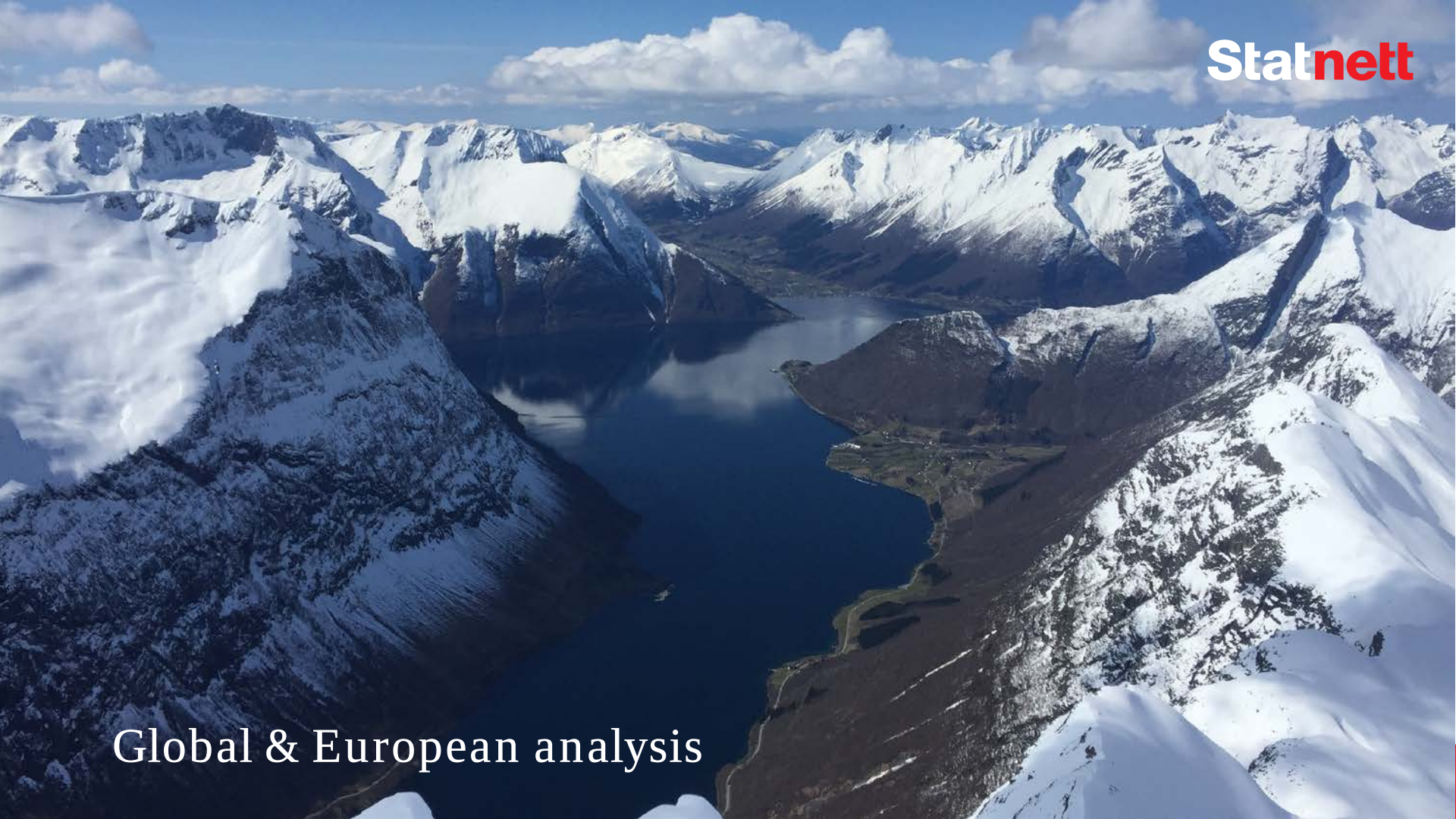
Why and how we make LMA?

- Why?
  - Understand and quantify long term development
  - Understand challenges and opportunities early – better decisions
  - Support for Network Development Plan (NUP) and other analyses
  - Transparency for open discussions about our assumptions

- How?
  - Assemble knowlegde and data from other sources
  - Create scenarios in BID3 and Samnett
  - Simulating 250,000 conditions in the European power system with fluctuations in wind, hydro, solar…
  - Consistent and realistic datasets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Global & European analysis

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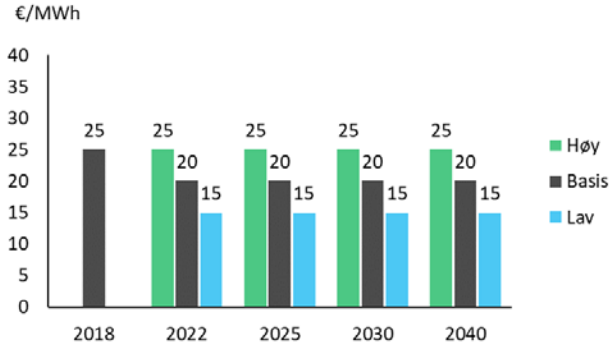
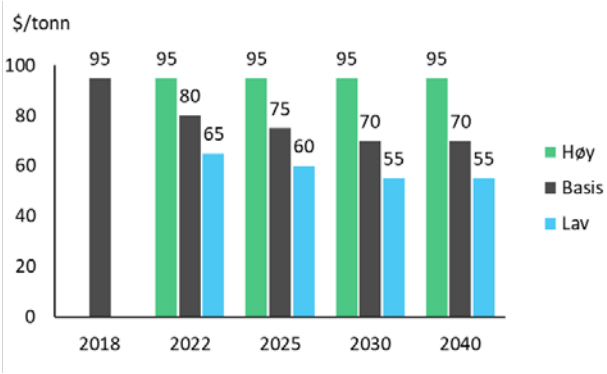
Small changes in long-term coal and gas prices

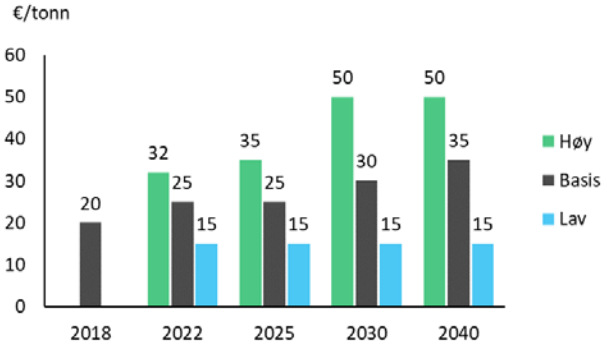
Gas



Coal

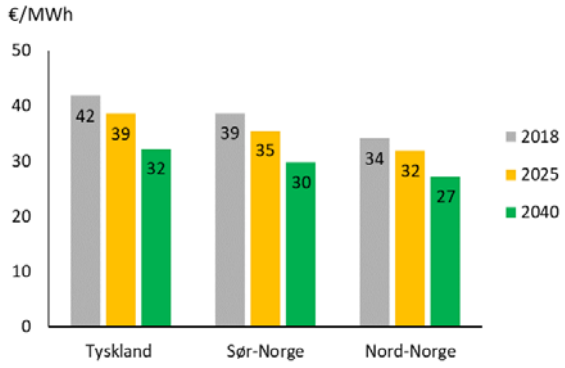


CO_2

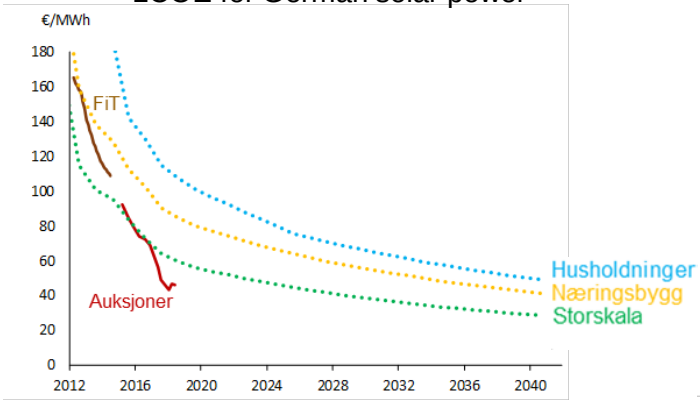


Wind power, solar power and batteries still getting cheaper

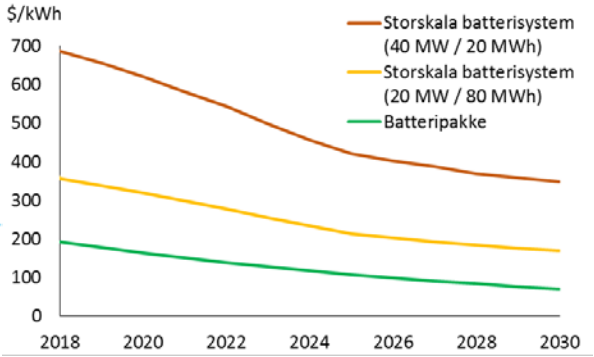
LCOE for onshore wind power



LCOE for German solar power



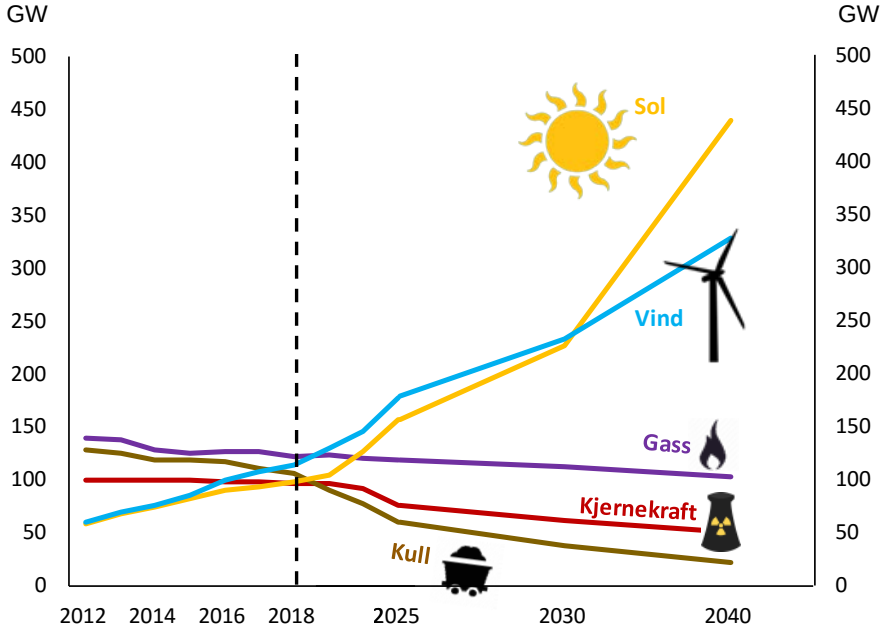
Battery investment costs



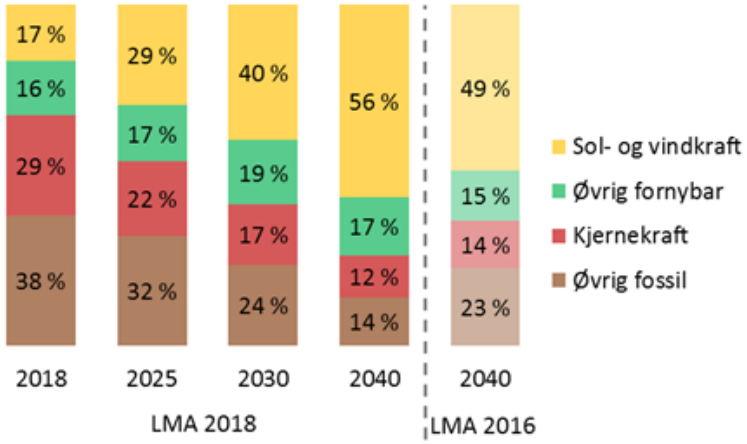
Kilde: BNEF

Green revolution in the power system towards 2040

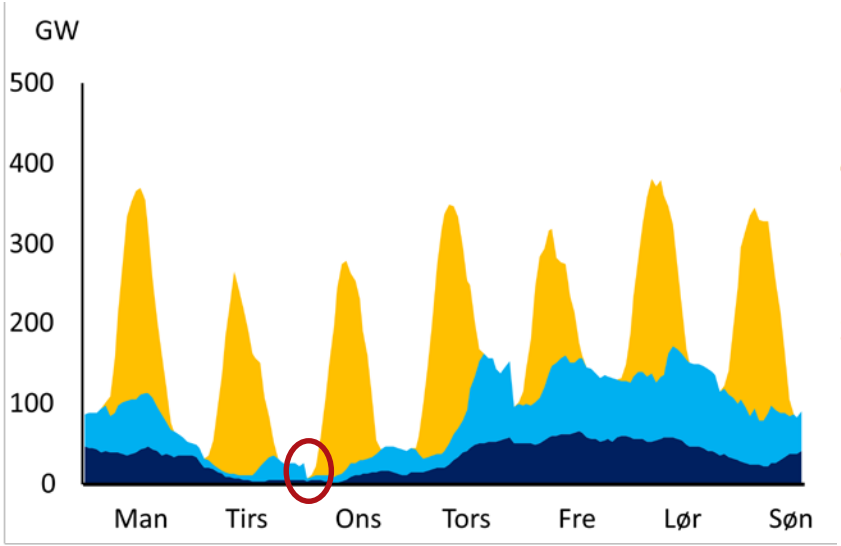
Capacity mix EU11

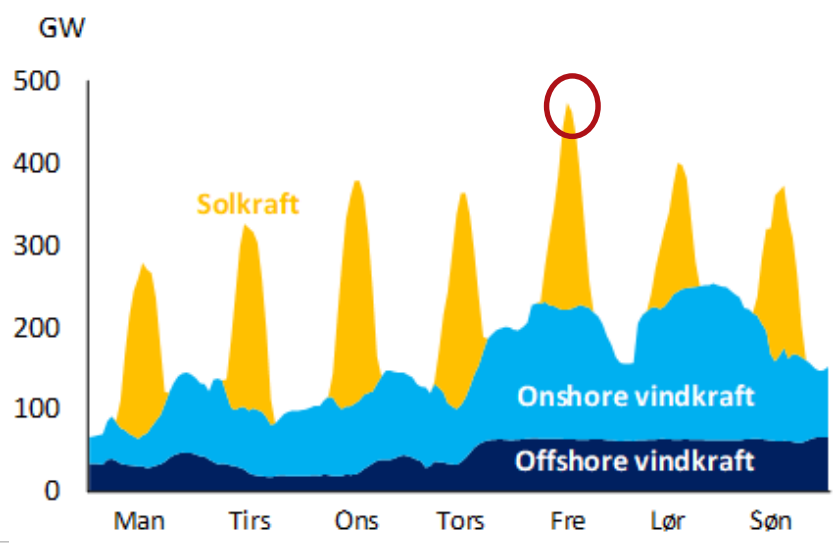


Generation mix EU11



Huge variations in solar and wind generation

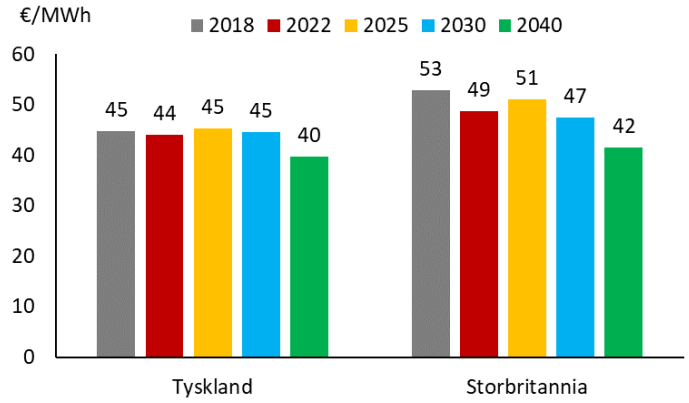




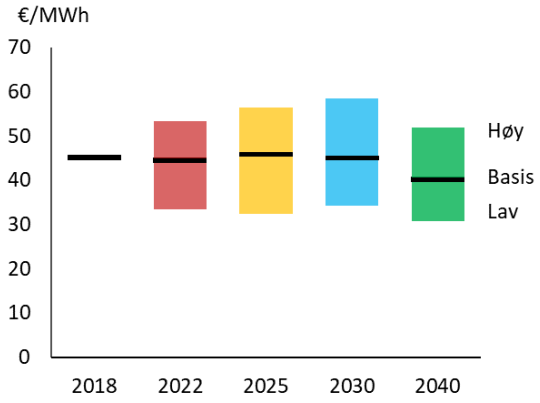
Lower average prices towards 2040, but very uncertain

- Stable prices the next 10 years, renewables pushes prices down to 2040
- Price range of 30-60 €/MWh – renewables curbs upside potential to 2040
- Gas and CO_2 prices are most uncertain factors for average power prices

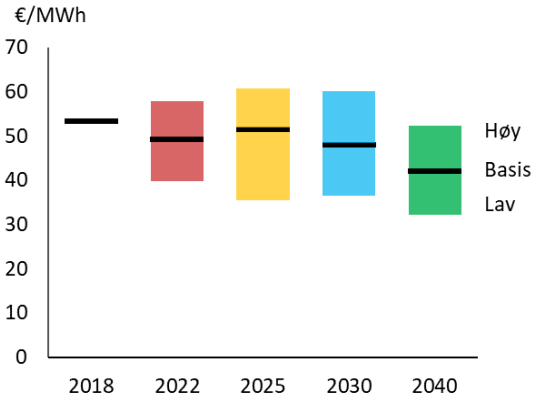
Average prices in Base scenario



German price range



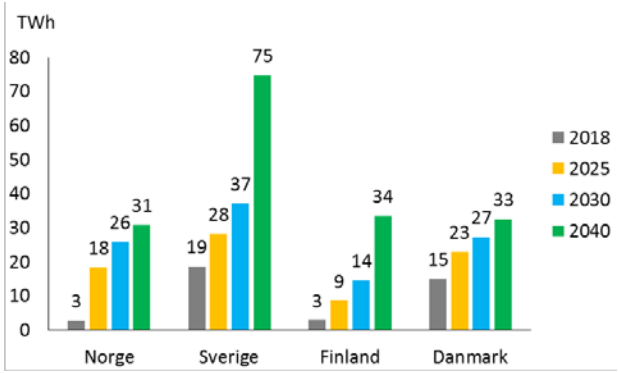
British price range

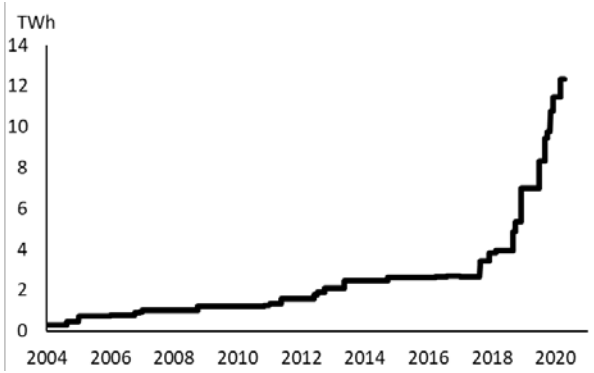


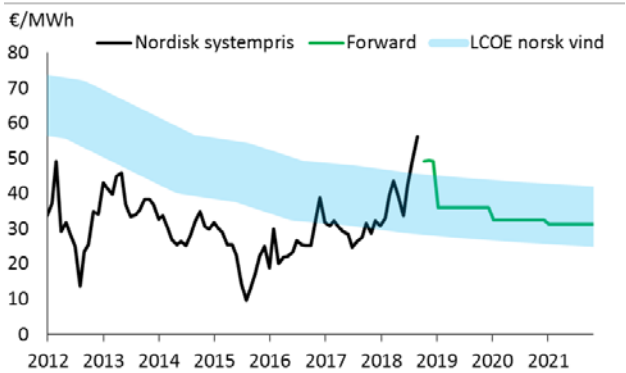
Norway and the Nordics overview

Huge growth in wind power

- Nordic wind power increase towards 145 TWh in 2040
- 14 TWh in Norway in a few years – profitable to build more without subsidies
- Sweden builds more wind power to cover up for less nuclear power
- Need for wind power due to demand growth and nuclear decommissioning

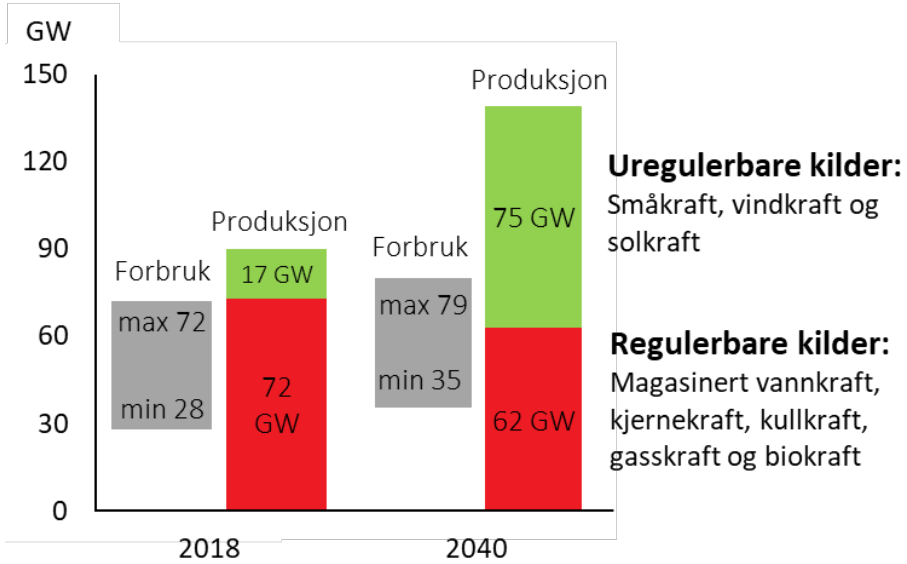






Intermittent generation become dominant in the Nordics

- Maximum intermittent generation may rise above consumption
- Other hours with maximum consumption is higher than available capacity



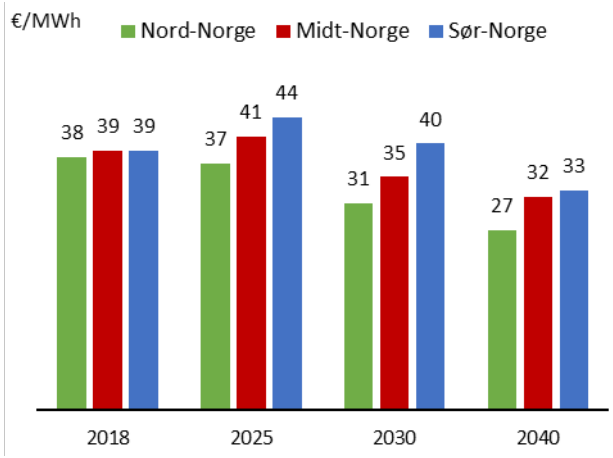
Analysis of Norway

Increased wind power, consumption, price differences north/south and price areas

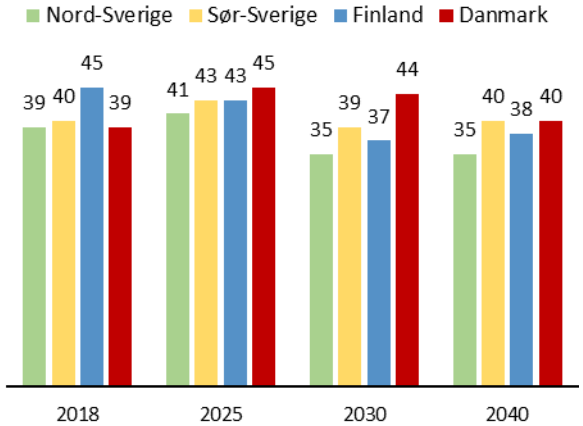
More renewables reduce prices

- The price in Southern Norway rises until 2025, then more wind power lowers them
- Bottlenecks out of Northern Norway result in lower prices
- Price in Middle Norway (NO3) stays in between Northern and Southern prices
- Larger price differences internally in Sweden

Norwegian prices



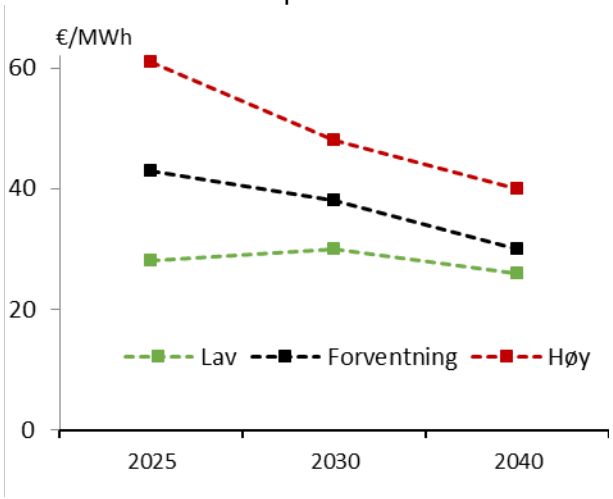
Nordic prices



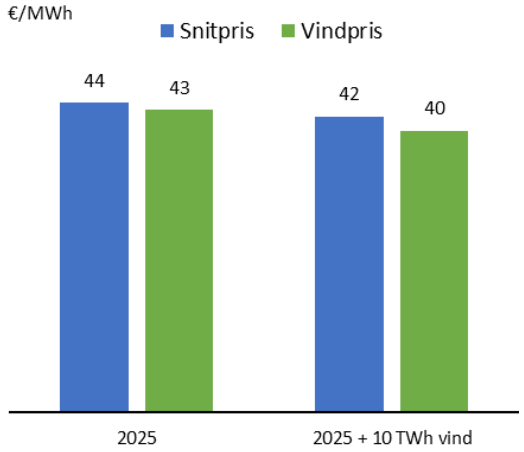
A lot of wind power in Southern Norway becomes profitable

- Large profits from new wind power early in the period, but less towards 2040
- Power prices in Southern Norway are not very sensitive to more wind power
- European prices are uncertain and important to profits

Wind power revenues

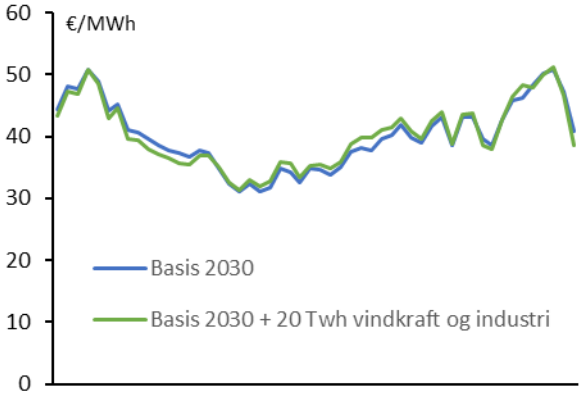


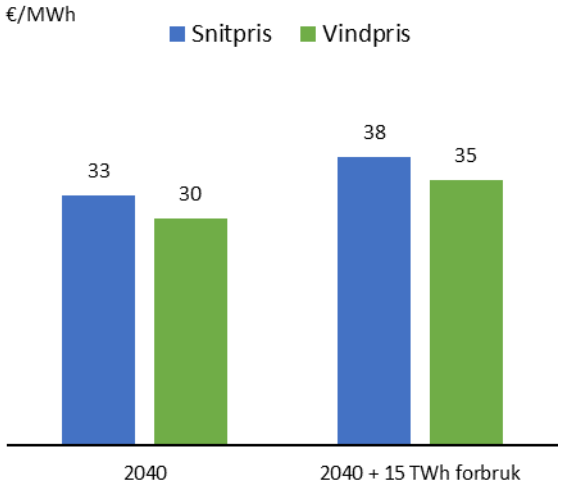
Southern Norway prices are robust to more wind power



Dynamic relation between wind power and consumption

- Wind power and consumption balance each other due to available hydro power
- Lets wind power maintain high revenues despite increasing share of production
- Large surplus in our 2040 dataset – consumption growth increases profitability

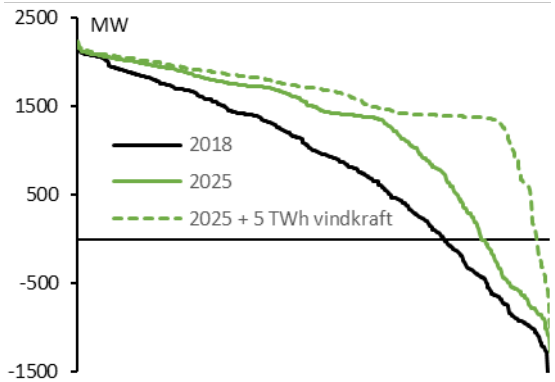




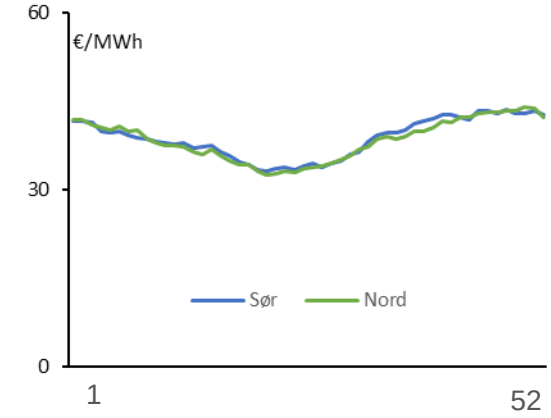
Lower prices in north than mid and south towards 2025

- Increased congestion out of Northern Norway with wind power under construction
- General market development also lead to increased price differences
- Additional wind power will lead to further increased congestion

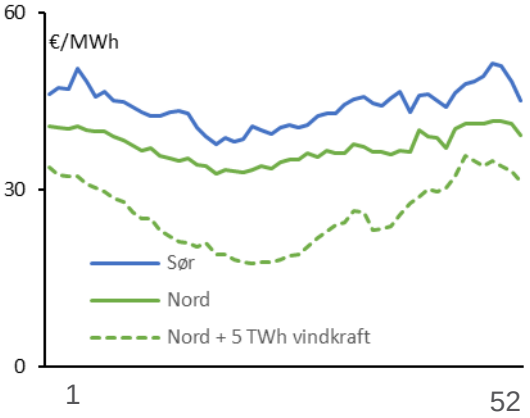
Flow out of NO4



Average price per week in 2018



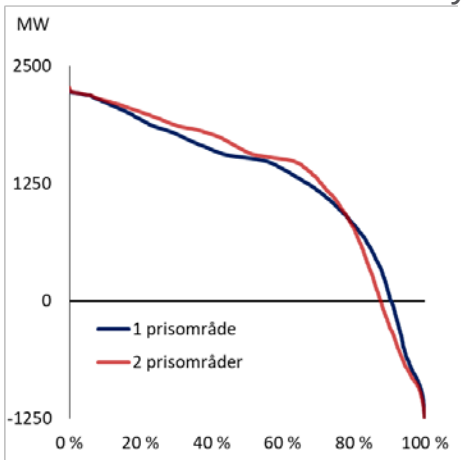
Average price per week in 2025



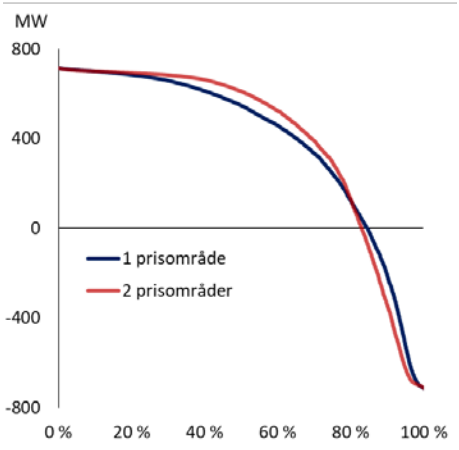
Splitting NO4 utilizes the grid better

- Easier to cope with bottlenecks and grid operations by splitting NO4 in two areas
- More information on placement of production and balance in the market clearing
- Only a small price difference between the areas after splitting
- Most likely after flow-based market coupling (FBMC)

Flow out of Northern Norway

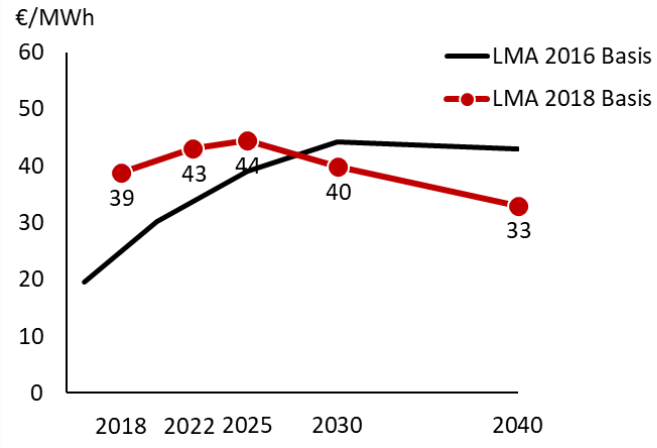


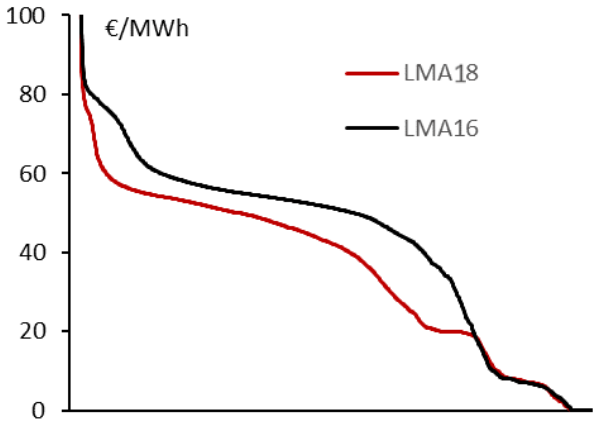
Flow on Ofoten-Ritsem



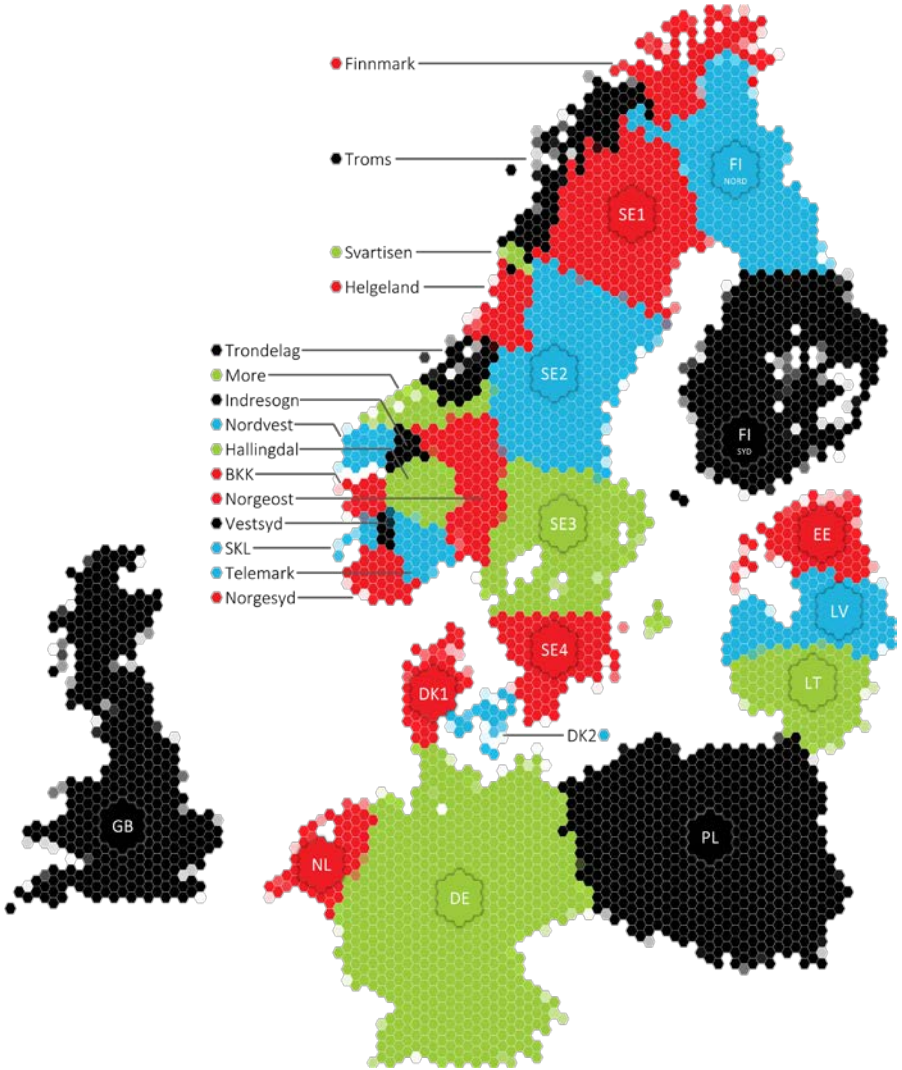
Lower prices than in LMA 2016

- Earlier increase in continental prices pushes Norwegian prices up
- In the long term, more renewables results in lower prices





Doing LMA with Samnett



Samnett

- Norway
- Sweden
- Finland
- Denmark
- Baltic

Price coupled areas:

- *Germany*
- *Great Britain*
- *Netherlands*
- *Poland*
- *Russia*

BID3

- Nordic
- Baltic
- Germany
- Great Britain
- Netherlands
- Belgium
- France
- Switzerland
- Austria
- Poland
- Czech Republic
- Slovakia
- Italy

Weather from modelled from 1988 to 2016 detailed series for inflow, wind, temperature and PV

Complete power system simulations with Samnett

- LMA important for Statnetts mission – find good solutions for future challenges
  - A TSO must understand both market and physics and how they work together
  - Especially important in long term analysis where the world is different from today
  - We need a model which is able to quantify bottlenecks and predict the grid flows
- Strengths and weaknesses
  - Use of tools outside the model
  - Quick with low time resolution
  - Version 10 API is an important improvement

EMPS

- 32 areas
- 55 connections
- 1357 hydro power modules
- 250 thermal/industry steps
- 114 wind/solar plants/series

Samnett

- 2665 nodes
- 2948 power lines
- 538 transformers
- 78 internal restrictions