



THE NORWEGIAN GRID

Stronger and smarter together

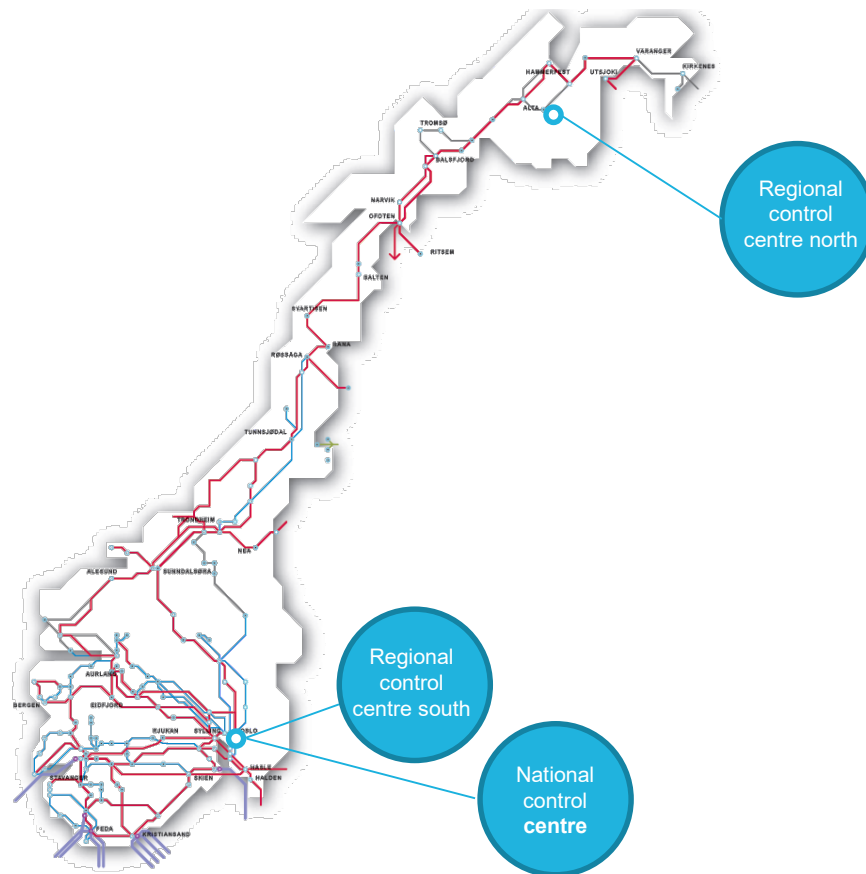
Thor Erik Grammeltvedt, SVP Strategy and tariffs

Smart Energy, Sion August 2019

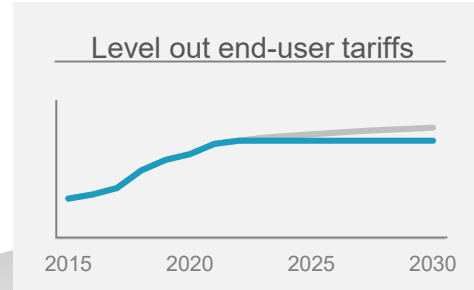
Statnett

This is Statnett

- ✓ Statnett is the system operator and responsible for the balance of the Norwegian power system
- ✓ Statnett operates and owns approximately 11,000 km of power lines and cables, with about 150 substations across the country
- ✓ The National and Regional Control Centres continuously monitor the grid to ensure stable power supply
- ✓ Statnett is also responsible for interconnectors to Sweden, Finland, Denmark and the Netherlands.



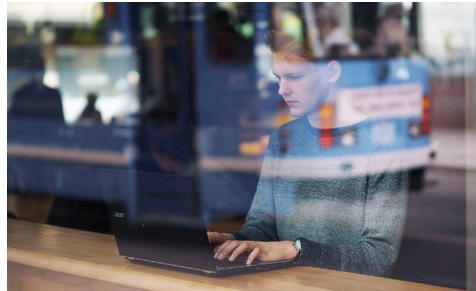
Our strategy



Efficient



Smart

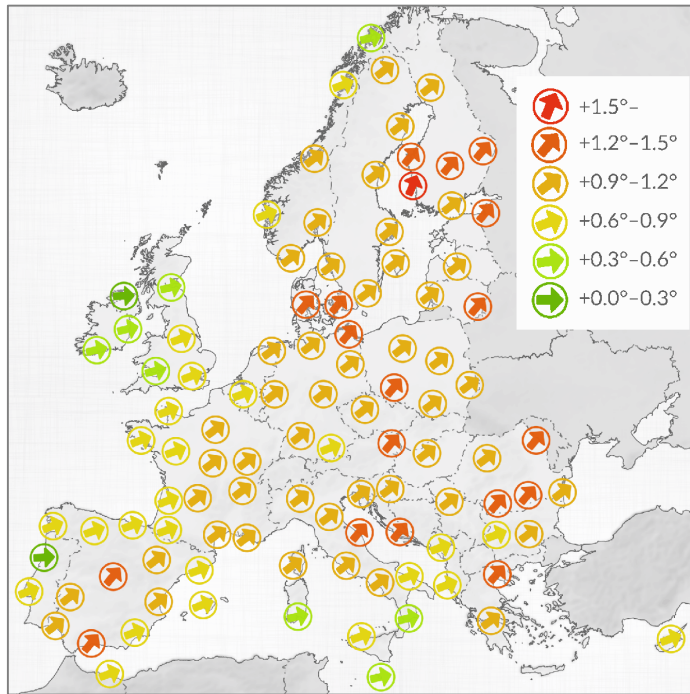


Safe



THE CLIMATE CHALLENGE

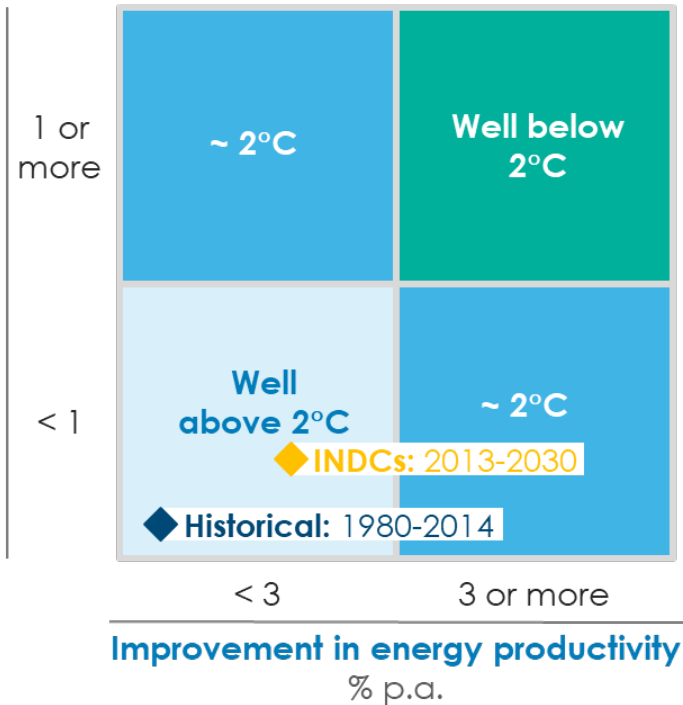
We must accelerate the transition to low-carbon society



SOURCE: European Data Journalism Network (2018)

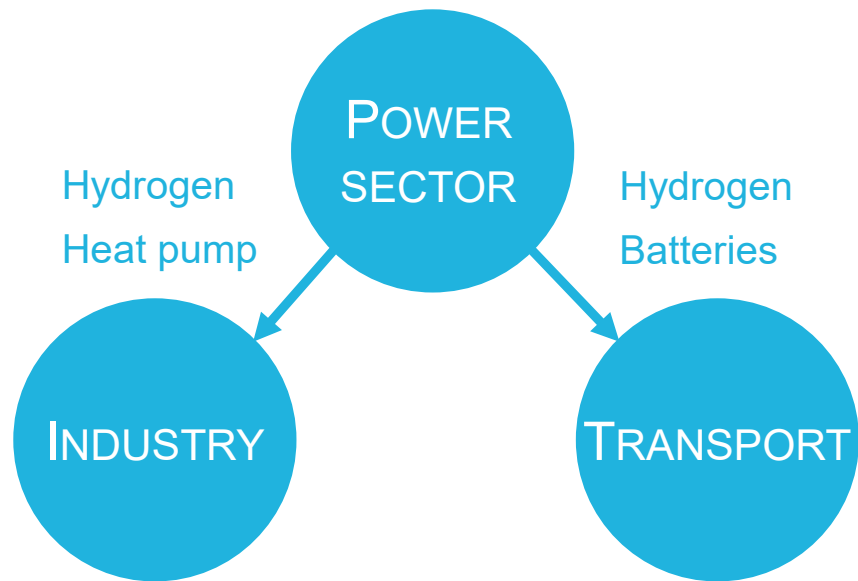
The future is **electric**

**Increase in
share of zero-
carbon¹ energy
% points p.a.**



SOURCE: Enerdata (2015), Historic actuals

A decarbonized power sector will drive the energy transition



– and disrupt industries

Enabling the electric future in Norway

Extensive electrification: 30-50 TWh



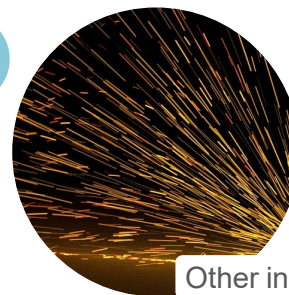
Oil & gas



Transport



Households,
primary &
service industry



Other industry

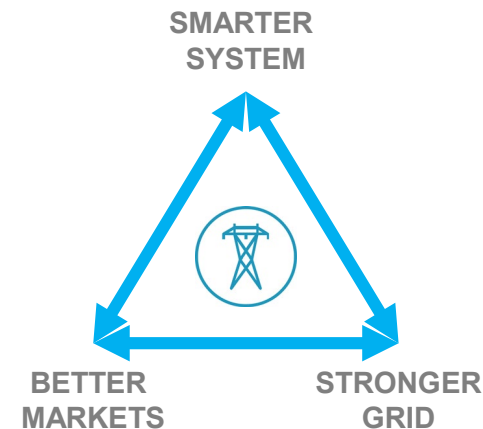
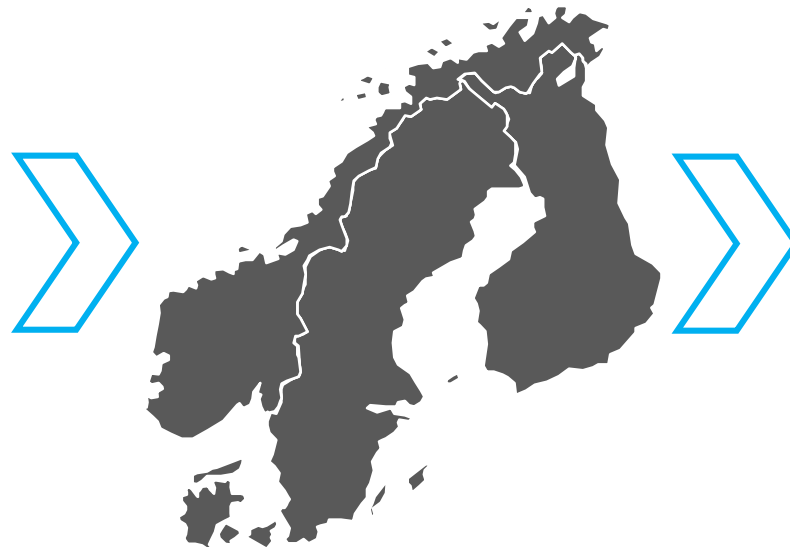
H₂

Hydrogen replacing fossil
fuels in industry and transport

40 TWh

Facilitating the energy transition

-  More renewables
-  Climate change
-  New technology
-  More interconnection
-  Active consumers
-  European regulations

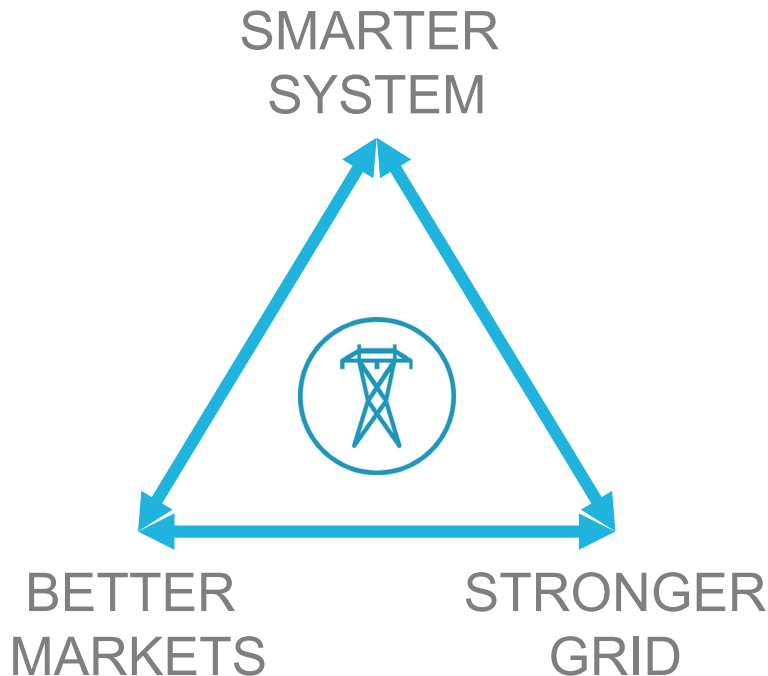


 HIGH DEGREE OF DIGITALISATION AND COOPERATION

The importance of markets

We should use the market as a **problem solver**

Innovations must play into the market and the existing system
– **smart market design is crucial!**



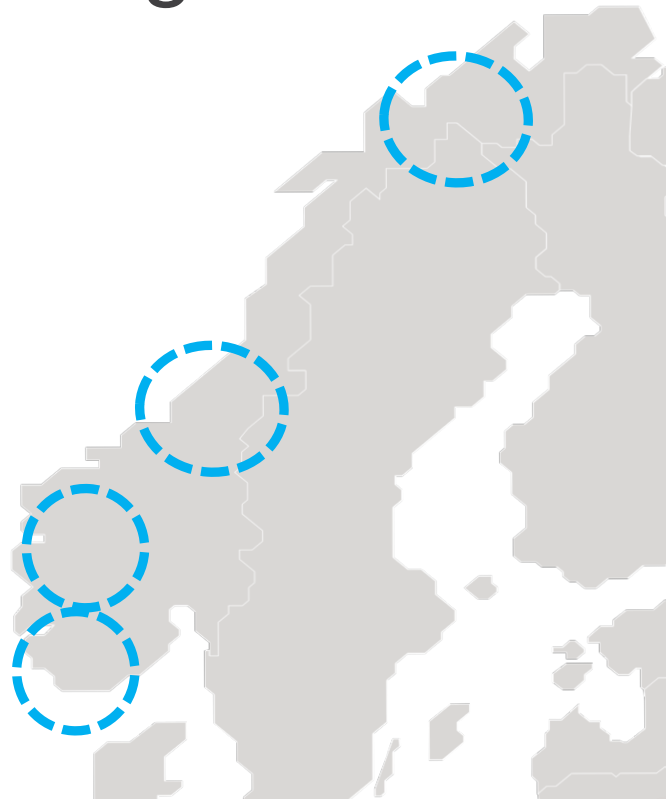
Statnett is reinforcing the internal grid

Statnett's investments

35-45 billion NOK
next five years*

- Security of supply
- Value creation
- Electrification

* Including interconnectors



Statnett is connecting markets

Nordics: 50% increase in interconnector capacity by 2025

NordLink: approaching Danish waters. Ongoing construction of converter stations and DC overhead line. In operation from 2020. 1,5-2 billion €*

North Sea Link: Ground works completed on the Kvilldal site (NO), ongoing in Blyth (UK) In operation from 2021. 1,5-2 billion €*

*Statnett's share is 50 %



...this gives a flexible system in 2022



R&D is key



Statnett will spend

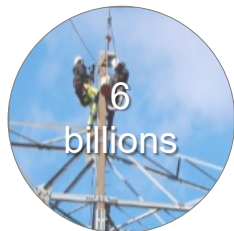
120 MNOK

a year on R&D in 2020-2023*

>10,5 BN

NOK saved since 1997

...in addition to an increased level of safety, digitalization and know-how



6
billions

Voltage
upgrading



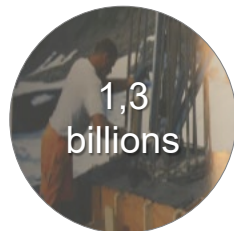
35
millions

Live line work



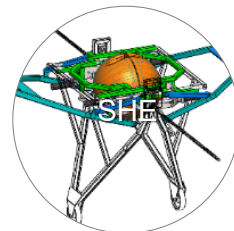
500
millions

Minimum electrical
clearances



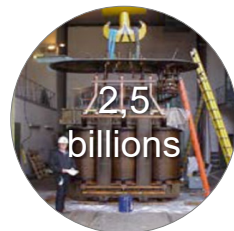
1,3
billions

Concrete tower
foundation



SHE

Installing aircraft warning
markers using a robot



2,5
billions

Transformers
lifetime utilization



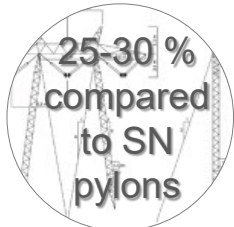
500
millions

Pre-fabricated
steel foundation



89
millions

High
temperature lines



25-30 %
compared
to SN
pylons

M pylon –
External guy-wires



Top 3
Innovation
Challenge

AutoDig



20 millions
per station

Digital Station

Our areas of digitalization

Robots



Self-diagnosis



Digital infrastructure



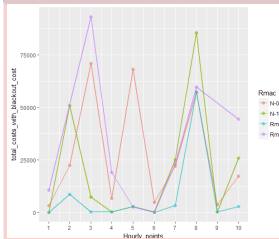
Cyber physical security



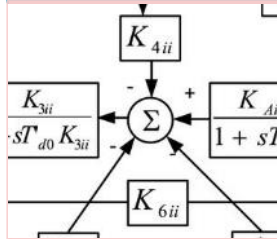
Faster response



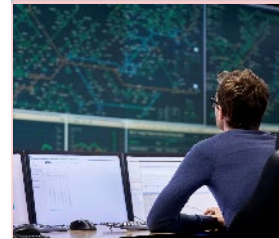
Prediction



Model development



User interface



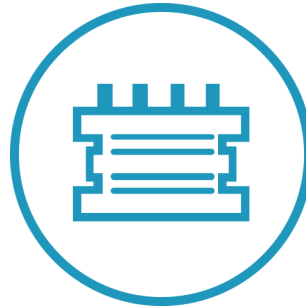
SMARTER SYSTEMS

Real time. Automation. Machine learning

BETTER MARKET
PLATFORMS



DATA MANAGEMENT
AND ANALYTICS

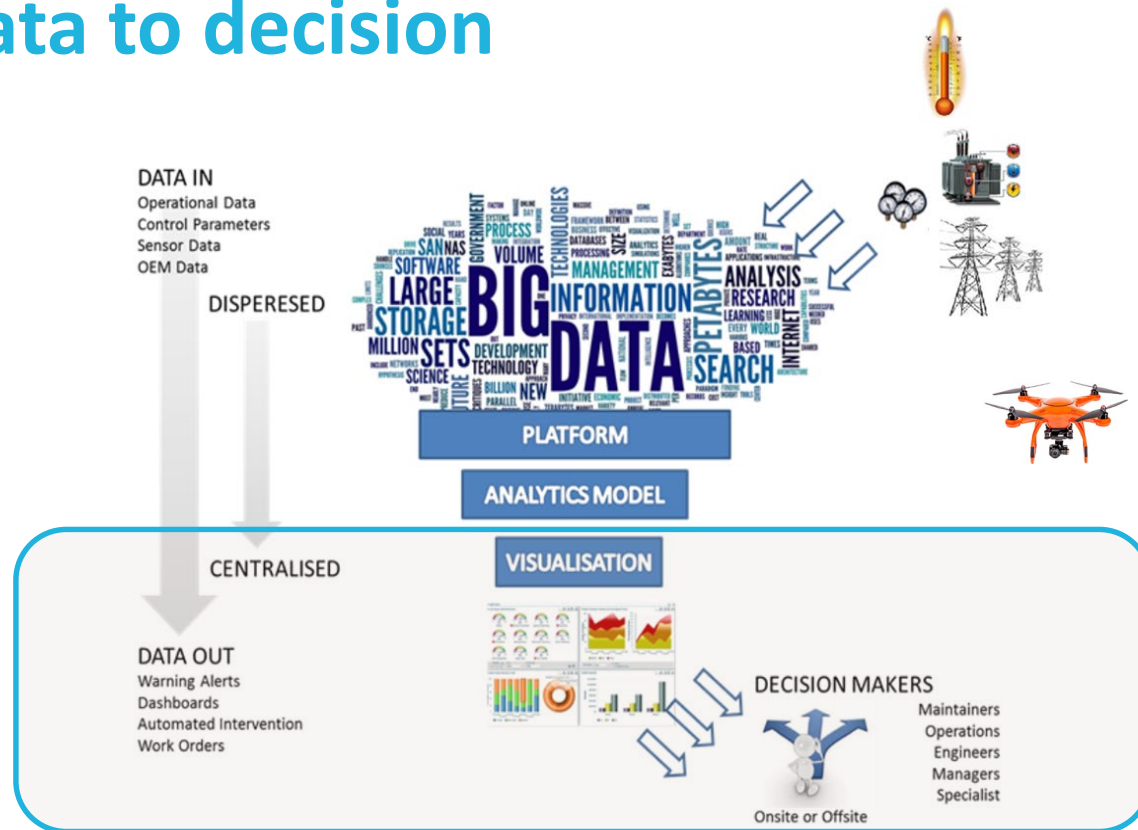


SMARTER
OPERATIONS



RISK BASED ASSET MANAGEMENT

From Data to decision



DATA MANAGEMENT AND ANALYTICS

Real time failure probability forecast

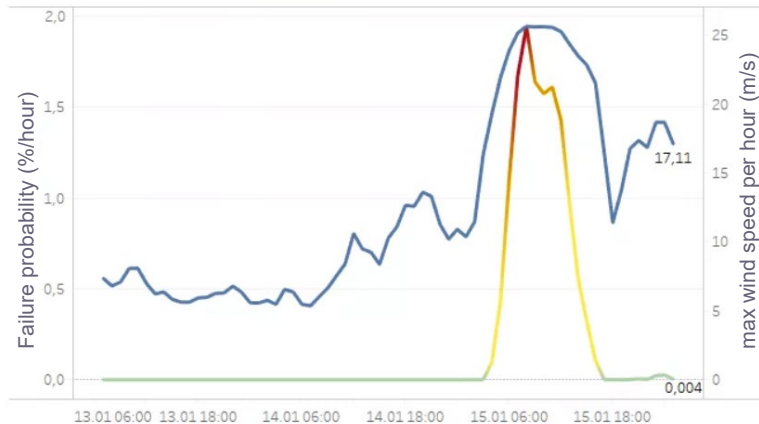
Failure probability
prior to major storm

99,97 %



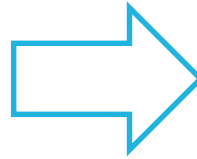
Overview of main system state

Adamselv_Varanger



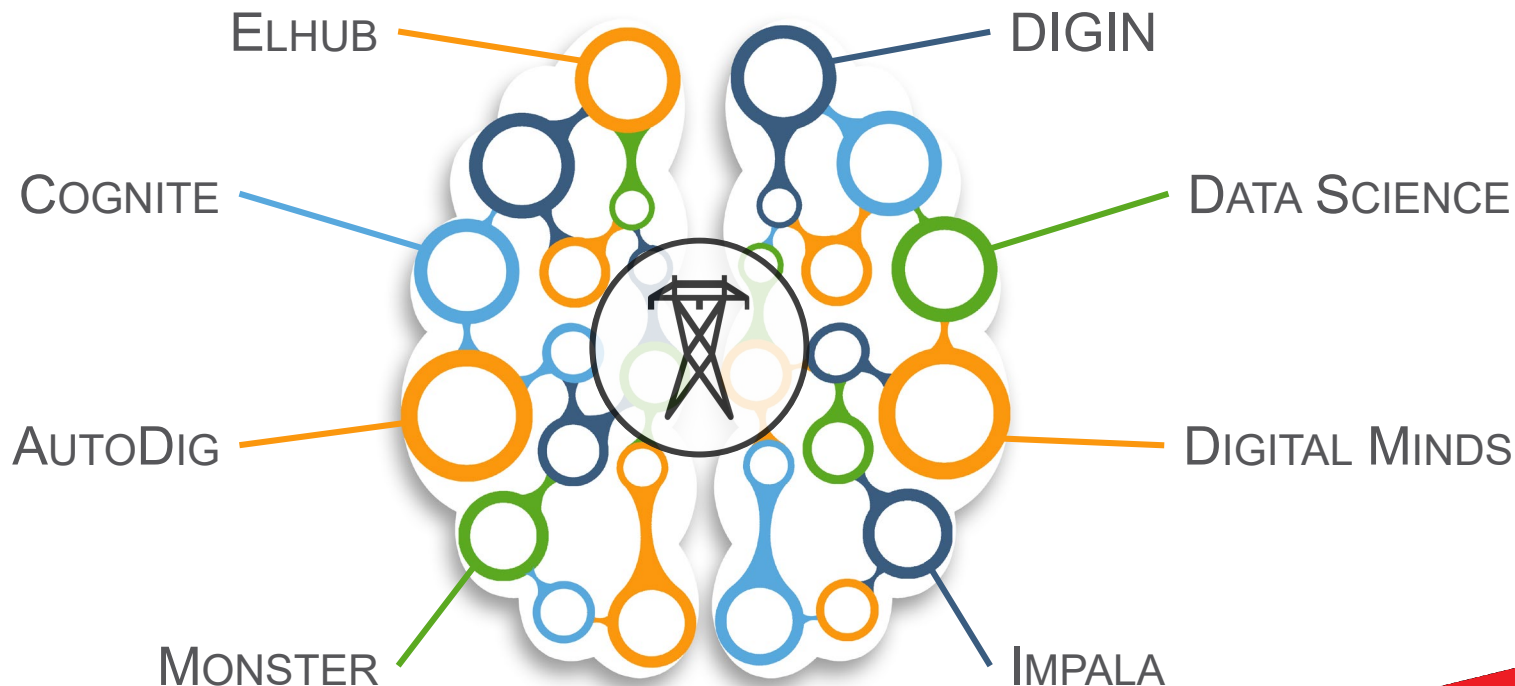
SMARTER OPERATIONS

Towards a "self driving" system



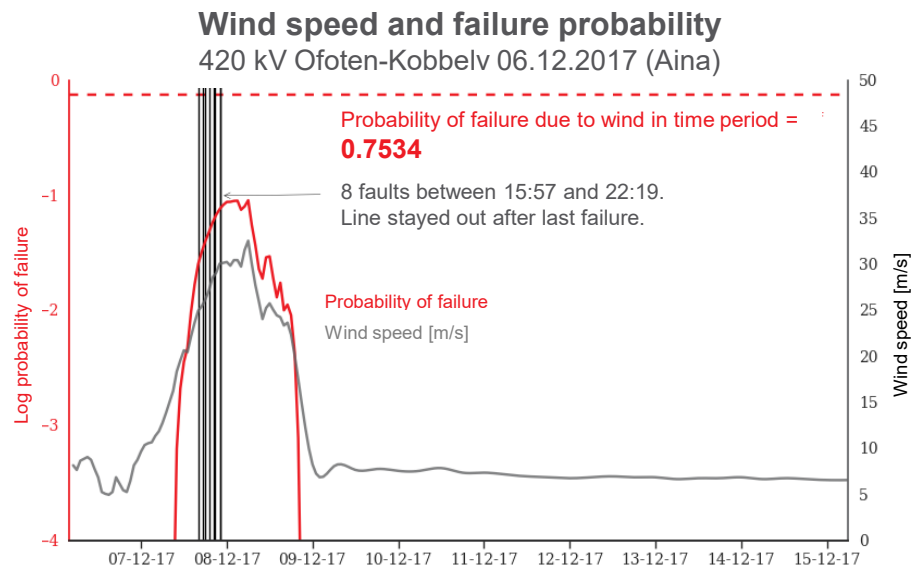
A digital Statnett

REAL TIME. AUTOMATION. LEARNING.



DATA SCIENCE:

Real time failure probability forecast



DIGITAL MINDS

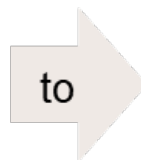
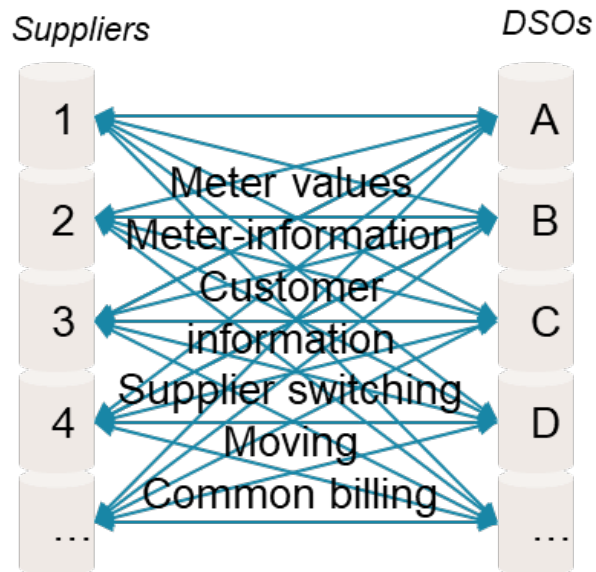
- Increase digital skills and knowledge in the organisation
- Full-time 3 month program
- First class finished June 1st
- Evaluation in progress, further roll-out to be decided



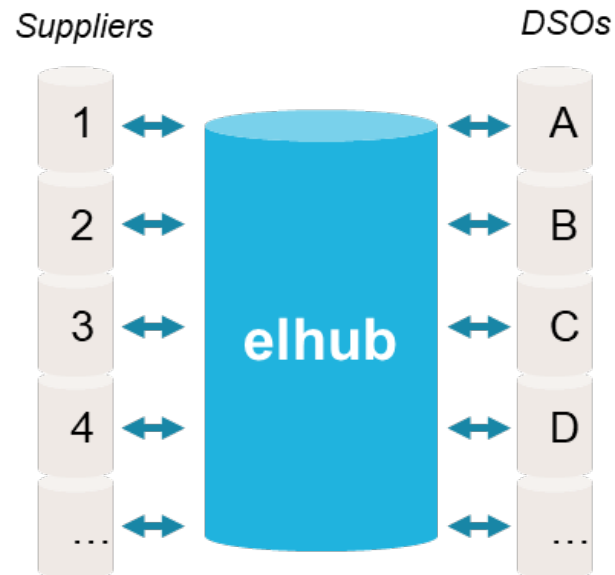
ELHUB:

Digitalising the power sector

«Everyone speaks to everyone»



«Everyone speaks with Elhub»



The importance of **cooperation**

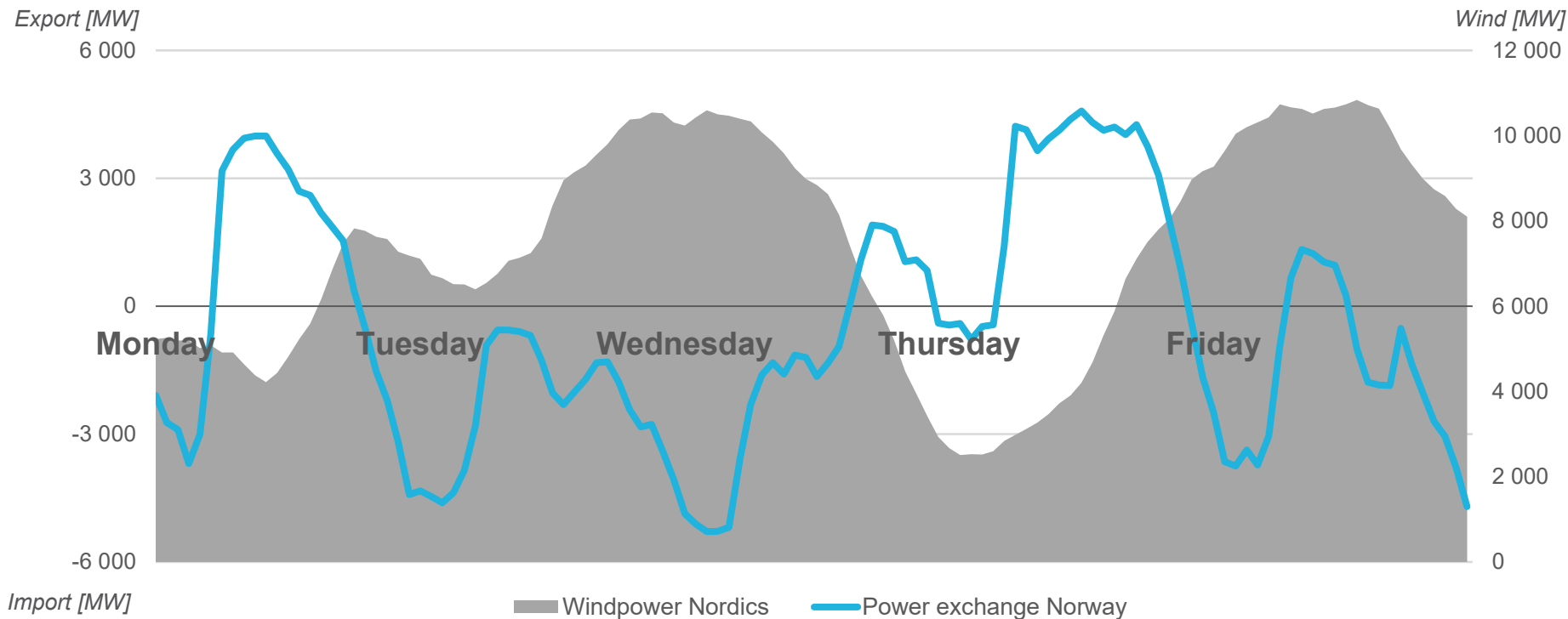
Long history of **cooperation** in research and system operation in Norway and the Nordics

But it is becoming even more important as the system is getting **more complex**



Cooperation in a changing system

Wind power production (Nordics) and power exchange (Norway) in week 2 2019





THE FUTURE IS ELECTRIC