



**Statnett**  
FoU og Teknologit utvikling  
Center for RD&I

# Research plans and needs

**The view from Norway**

'The cloud' 11 november 2020 - prof.dr.techn.ir. Sonja Monica Berlijn MBA

**Statnett**

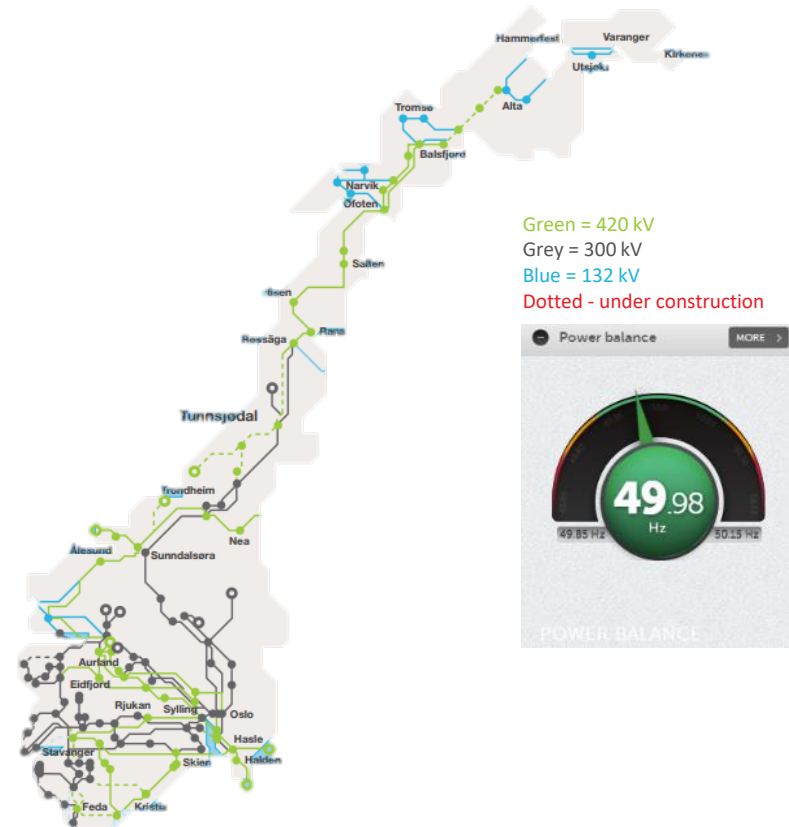
# Sonja Berlijn



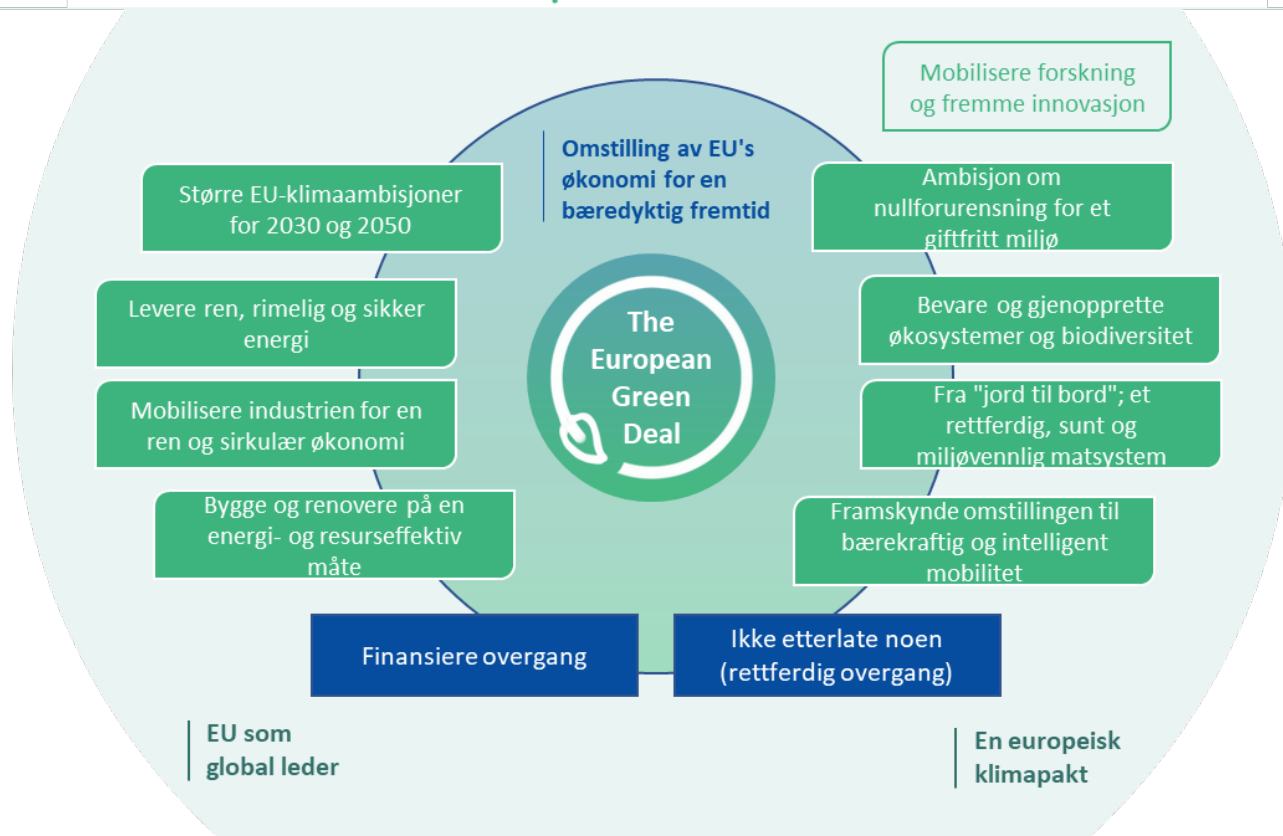
- Professor II NMBU
  - FoU direktør Statnett
  - Master grad: TU Eindhoven
  - Dr grad: TU Graz
  - MBA: Univ. Melbourne
  - Senior Member IEEE
- 
- <https://www.facebook.com/prof.Sonja.Berlijn/>
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# This is Statnett

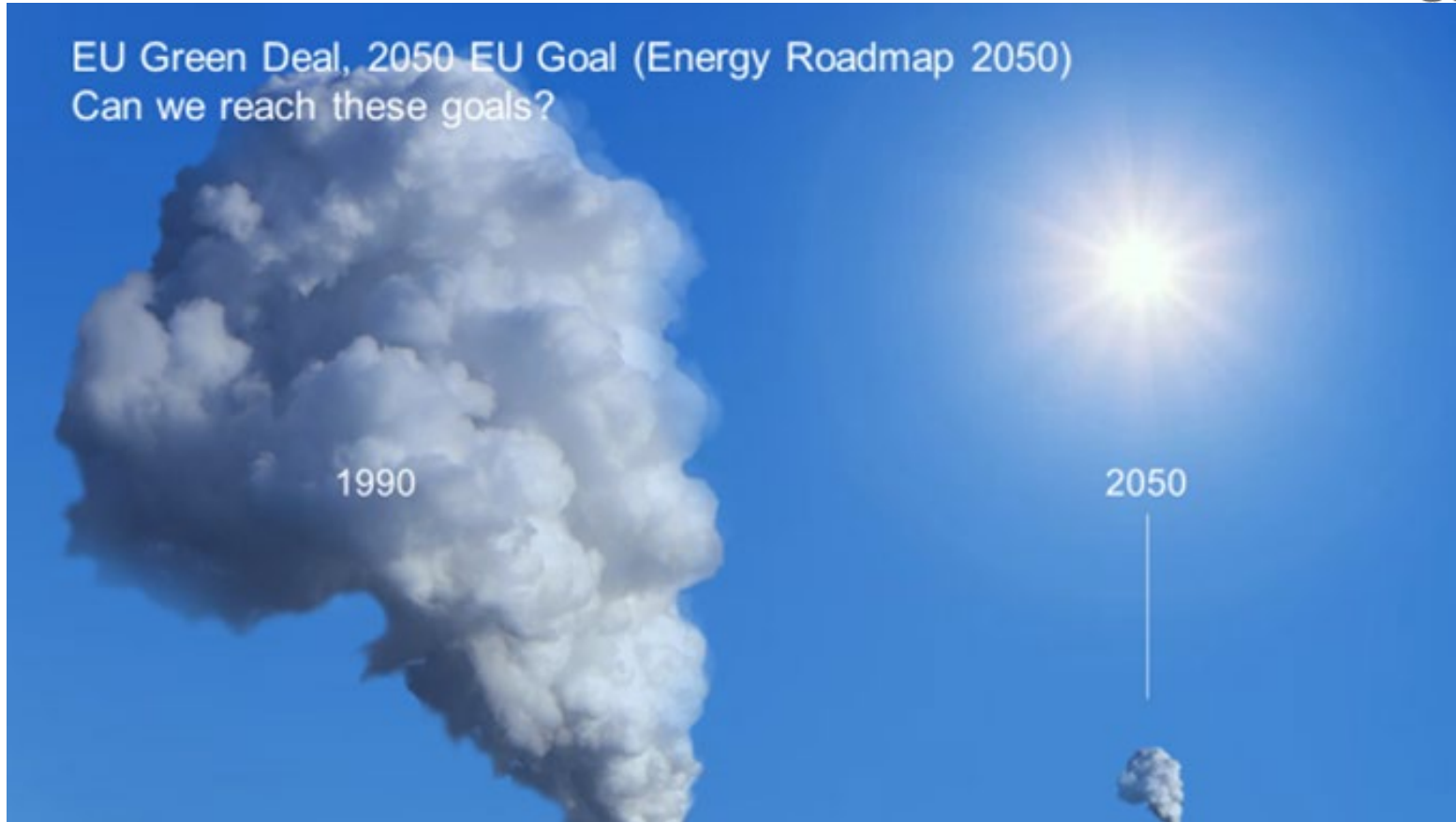
- Statnett is the **Transmission System Operator** in the Norwegian energy system
- Statnett operates and owns about 11 000 km of lines, 1400 km cables and approximately 166 transformer stations throughout Norway
- Operations are **monitored continuously** by one national control centre and two regional control centres
- Statnett is also responsible for interconnectors to Sweden, Denmark and the Netherlands



# The European Green Deal



EU Green Deal, 2050 EU Goal (Energy Roadmap 2050)  
Can we reach these goals?



# Yes we can!

**GLOBAL WARMING** WELL BELOW 2°C

**MISSION POSSIBLE** To limit global warming to well below 2°C and as close as possible to 1.5°C, the world must reach net-zero CO<sub>2</sub> emissions by mid-century.

**CARBON EMISSIONS** NET-ZERO CO<sub>2</sub> BY MID-CENTURY

THE BIGGEST CHALLENGE IN MEETING THE PARIS AGREEMENT LIES IN THE MAJOR HARDER-TO-ABATE SECTORS

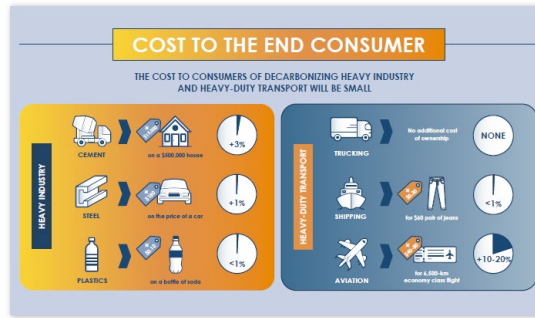
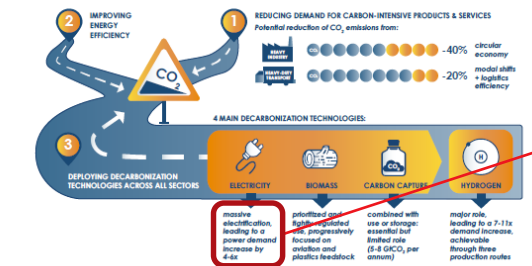


REACHING NET-ZERO CO<sub>2</sub> EMISSIONS FROM HARDER-TO-ABATE SECTORS BY MID-CENTURY IS POSSIBLE

**TECHNICALLY** Technologies are commercially ready or of research phase.

**ECONOMICALLY** It will cost less than 0.5% of global GDP.

THERE ARE THREE MAIN ROUTES TO DECARBONIZATION



Massive electrification, leading to an electrical power demand increase in Europe by a factor 4 to 6

## WINNING THE CLIMATE WAR

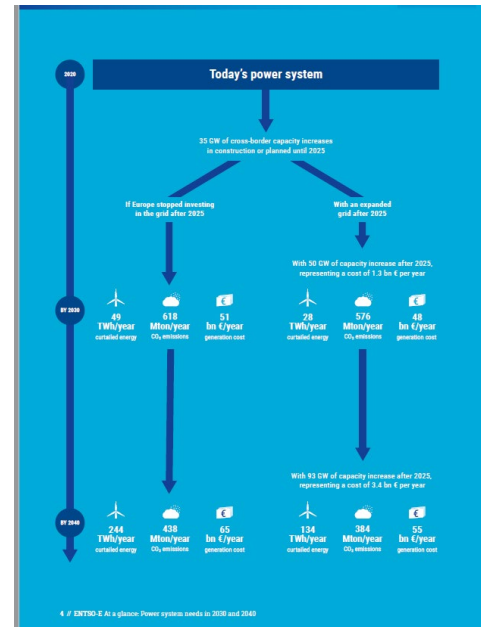
With immediate collective action, reaching net-zero CO<sub>2</sub> emissions from harder-to-abate sectors of the economy – in heavy industry and heavy-duty transport – is technically and economically feasible.



- | CHANGE DRIVER                                     | WHO                  | WHAT  |
|---|----------------------|---|
| 1 SET AMBITIOUS CARBON-INTENSITY TARGETS          | Industry             | Enforce light carbon-intensity mandates on industrial processes, heavy-duty transport and the carbon content of consumer products.  |
| 2 PUT A PRICE ON CARBON                           | Government           | Pursue international agreements while setting prices which are differentiated by sector, domestic, downstream & defined in advance. |
| 3 SHIFT FROM A LINEAR TO A CIRCULAR ECONOMY       | Industry, Government | Increase collaboration across the value chain to improve material efficiency and recycling, supported by tight regulation.          |
| 4 INVEST IN GREEN INDUSTRY                        | Government, Industry | Invest in and support R&D projects and commercial deployment of decarbonization technologies for harder-to-abate sectors.           |
| 5 CREATE DEMAND FOR GREENER PRODUCTS AND SERVICES | Government, Industry | Make voluntary commitments to "green purchasing" of e.g. trucks, flights, industrial components, building materials.                |
| 6 DRIVE DOWN THE COST OF RENEWABLE ENERGY         | Government, Industry | Drive down the cost and ramp up production of zero-carbon power, zero-carbon hydrogen and fully sustainable bioenergy.              |

# We are going to invest in grid, but we need more!

- Green Deal realisation 53 Mtons of CO2 avoided each year
- Investing will be the key to support the economy post COVID. It will support European industry.
- Addressing the identified needs by 2040 would represent 45 bn € of investment, translating directly into jobs and growth.



## Large radical changes



## Lead to large radical challenges

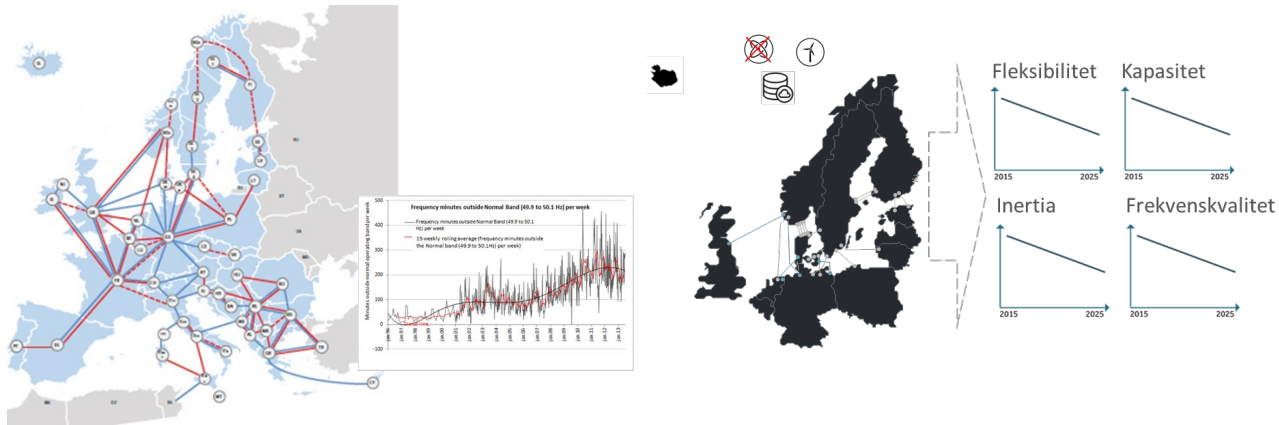


## Which need radical innovations



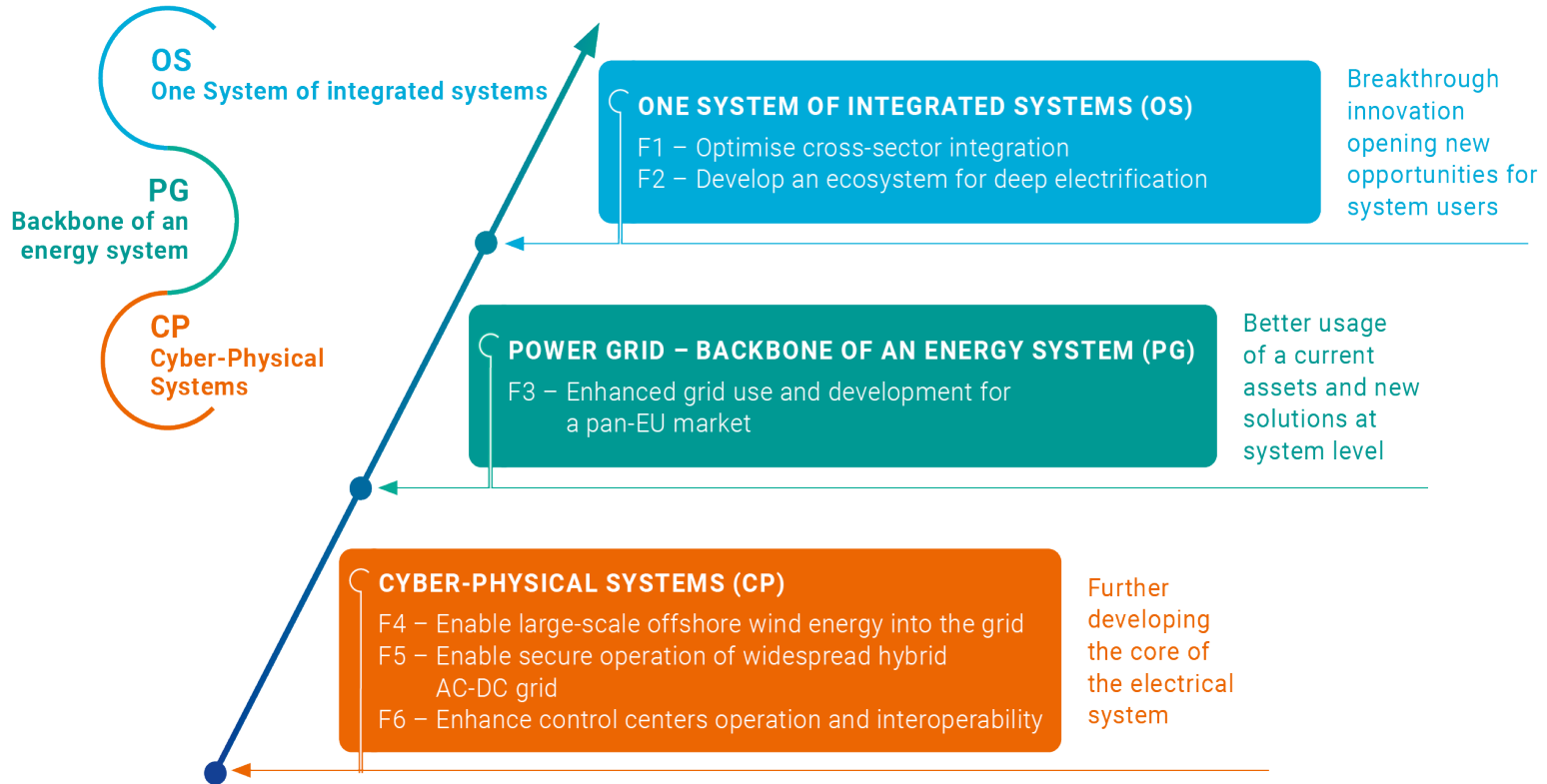


# Electricity grids are the enabler for de-carbonisation This gives both opportunities and challenges



it is all about keeping the lights on..  
and this is getting more difficult

# The ENISO-E R&I Roadmap 2020-2030: towards a pan-EU energy system with no net emissions of greenhouse gases in 2050



## Why R&D?

“ *The main objective with our commitment to research, development and demonstration in the energy field is to contribute to increased **value creation** and a **safe, cost-effective** and **sustainable** utilization of the Norwegian energy resources. ”*

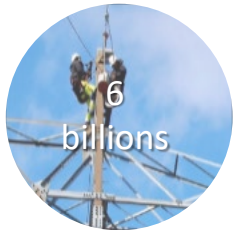
Ministry of Petroleum and Energy, Report No. 25 to the Storting (2015–2016)

“ *Statnett and other grid operators should **drive and envision development** and **qualification** of new technology. ”*

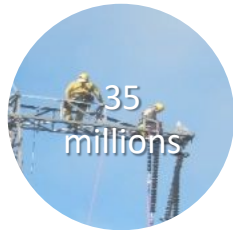
Ministry of Petroleum and Energy, Report No. 14 to the Storting (2011–2012)

# 10-15 BN

NOK saved since 1997



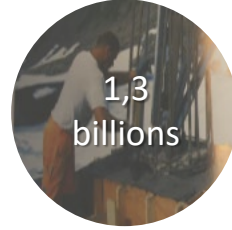
Voltage  
upgrading



Live line work



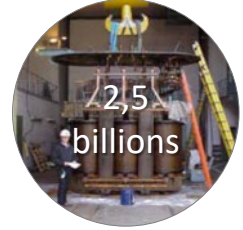
Minimum electrical  
clearances



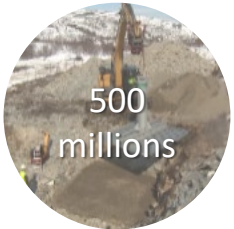
Concrete tower  
foundation



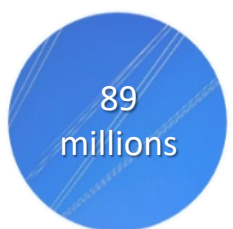
Installing aircraft warning  
markers using a robot



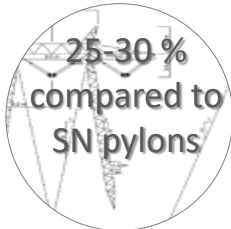
Transformers  
lifetime utilization



Pre-fabricated  
steel foundation



High  
temperature lines



M pylon –  
External guy-wires



AutoDig



Digital Station



Improving supply  
reliability

# Energy research saves Norway for billions of NOK

- Report ordered by Norwegian Research Council
- 3 projects where Statnett participated have an estimated saving potential of 60,4 billion NOK
- Research has contributed to
  - Data for better decisions
  - Strengthened education and knowhow
  - Strengthened national research environment
  - Advancing knowledge frontiers through international cooperation



# Vision for Center of Technology development and R&D 2020–2023

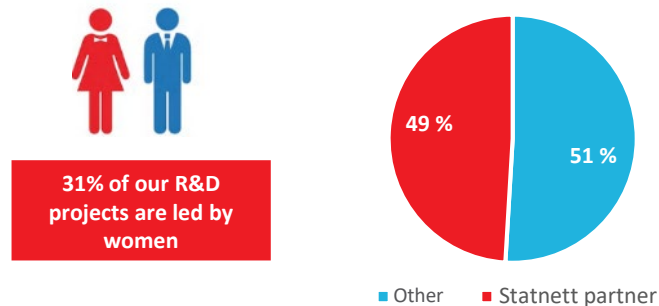
**Stimulate and encourage innovation** towards the realization of a **fully electrified Norway**

Statnett's efforts will lead to increased **know-how**, **innovation** and **added value** in a safe, secure and sustainable power system

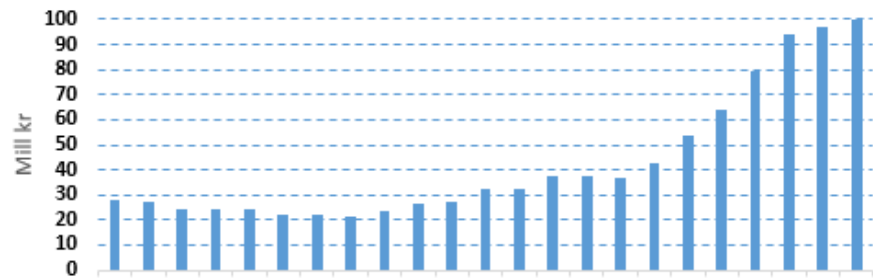
# Statnett's R&D in a nutshell (2019)

-  180 employees involved
-  8,6 MEuro invested
-  Total portfolio ~ 118 MEuro
-  67 ongoing projects
-  Patent
-  Safety price  
Smart Grid Center Innovation price

Active project in the NVE incentive scheme for R&D



R&D budget 1997-2019



# R&D Programs 2020 - 2023



## Co-operation in the energy system

Develop and drive interaction between network level, customers and industries and mature markets for flexible resources and capacity. Data driven grid planning.



## Digital, safe and cost-effective assets

Develop expertise, methods, solutions and technology that contribute to digital, secure and cost-effective assets and their management



## Real-time control and effective markets

Develop methods and system solutions that contributes to effective data-driven and automated decision support for future challenges in market and system operation.



## Continuous know-how development

Build strategic knowledge environments at universities, research institutions and the industry in general through strategic alliances with selected environments to develop competence for the future.

The projects deliver in the following areas



EHS



Cost



Digitalization



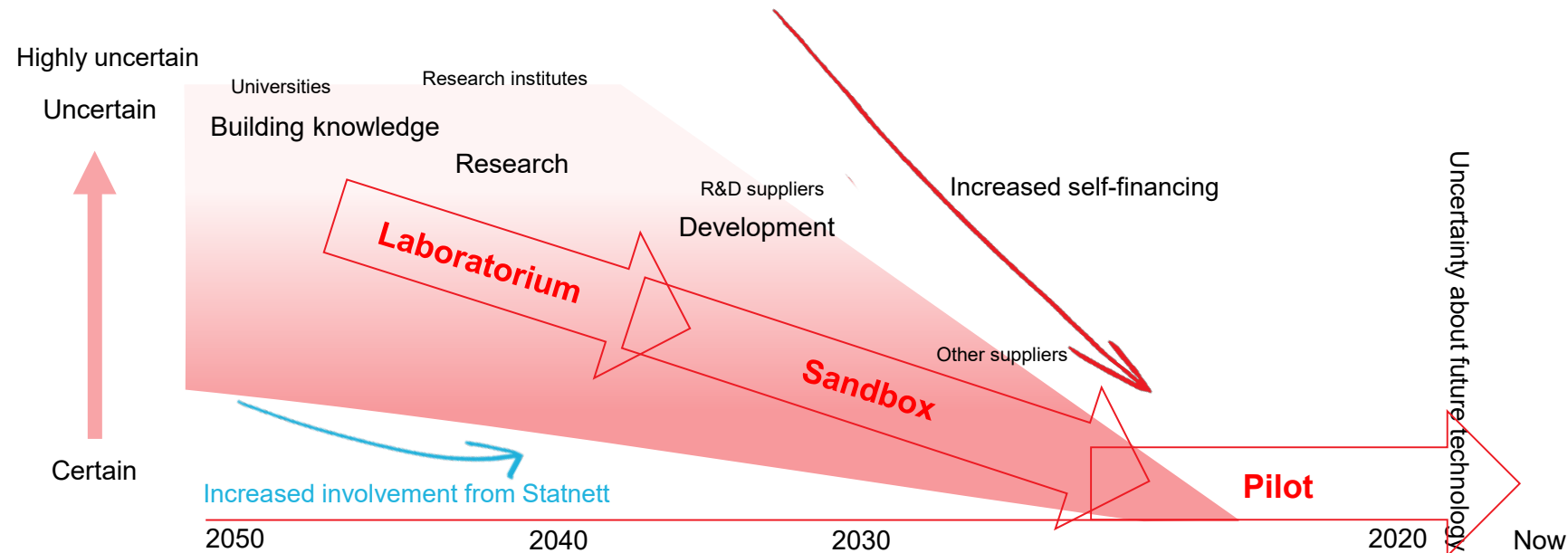
Know-how



Value creation



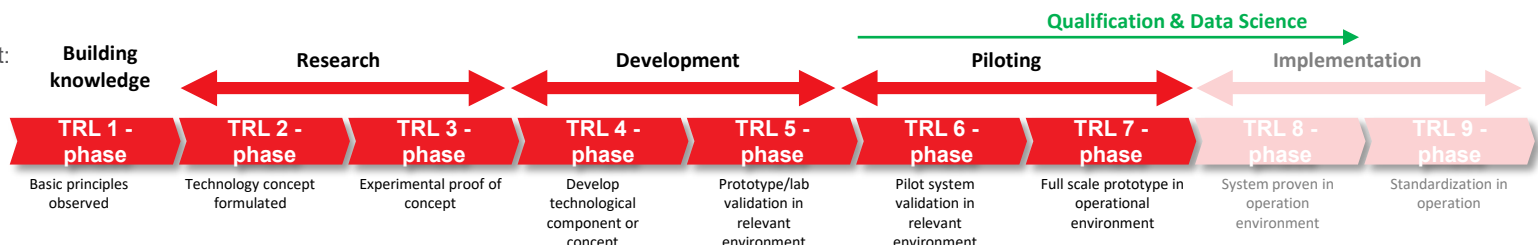
# How we innovate



Responsible unit:

● R&D

○ Line



# Our projects deliver on important areas for Statnett



EHS



Cost



Digitalization



Know-how



Value creation





# Co-operation in the energy system

## Samhandling i energisystemet

### Electrification and co-operation

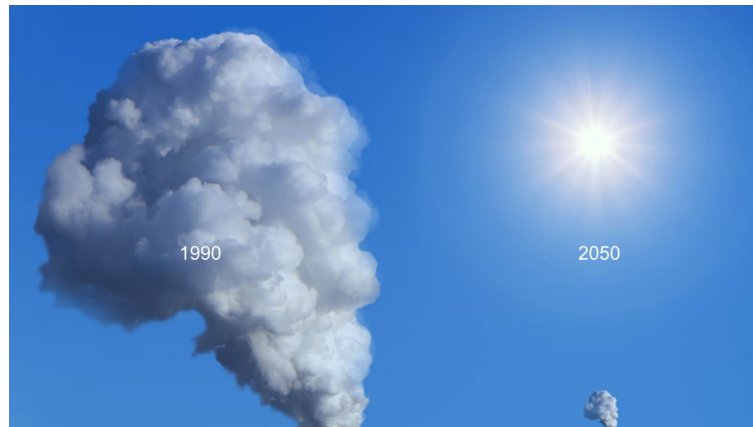
- Increase electrification against a low emissions society
- Co-operation between energy carriers
- Offshore grid

### Smart and flexible grid development

- Consumer flexibility and flexible resources

### Climate / environment

- Reduce greenhouse gas emissions



Goal: Increase electrical and renewable energy system for the future



# Digital, safe and cost-effective assets

Digitale, sikre og kosteffektive anlegg

## Primary Components, external impact and retrofit

- Increase the life of our assets through better knowledge about components and by developing retrofit methods

## Digital facilities

- Better assets management through the use of digital solutions

## Personnel safety

- Increase personal safety through new working methods and new technology



Goal: Lifespan extension, asset management and personal safety



# Real-time control and effective markets

Sanntidsstyring og effektive markeder

## Monitoring and control philosophy

- Automated monitoring and control
- Solutions for real-time communication and data exchange

## Operational challenges and market design

- Technology and methods for integrating renewable energy
- Increased information exchange and common balancing markets

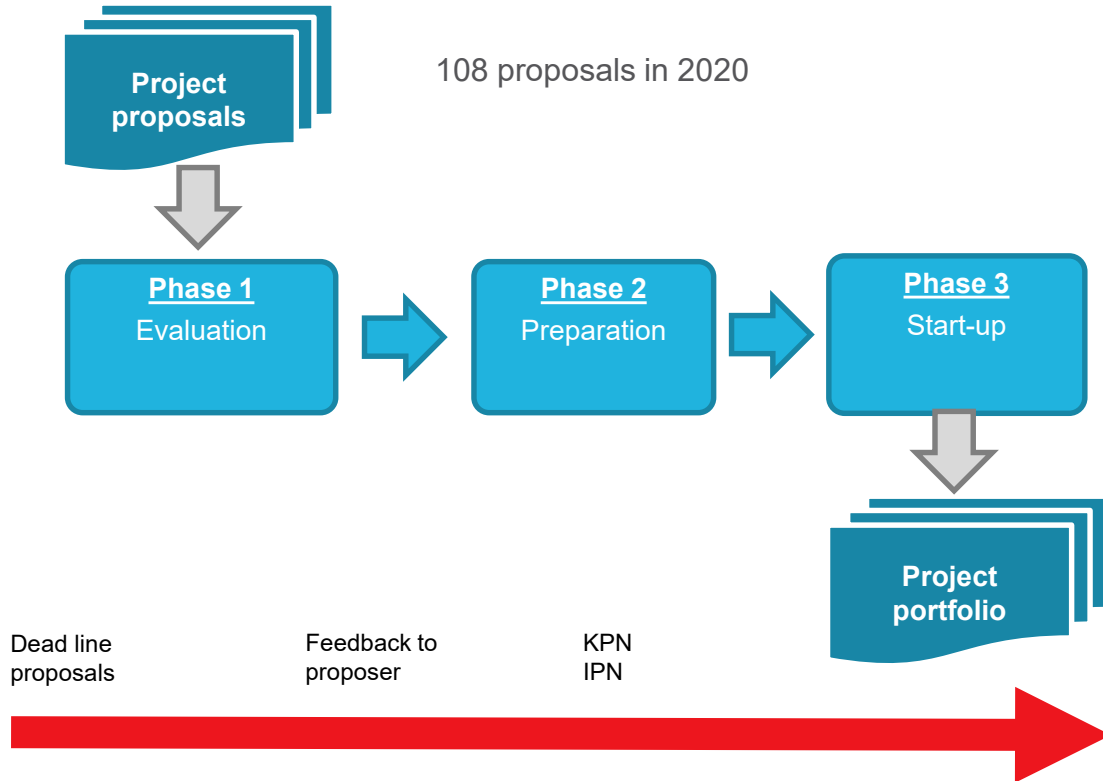
## Smart data and cyber security

- From "big data to smart data"
- Targeted and effective mechanisms to identify, protect, detect, respond and recover from cyber threats



Goal: Develop intelligent and automated system and market solutions of the future

# Processing of project proposals



## Submit R&D proposal

Required fields are marked with asterisk (\*)

### About proposer

First name \*  Surname \*

Organization \*

Phone number \*  E-mail \*

### Your proposal

Title \*

What kind of problem do you want to solve? \*

# Fantastic opportunities for all of us!



$$R1 = \left[ 1 - \frac{1}{(1+R)^n} \right] \cdot \frac{0.9 \cdot \sqrt{(x+y)}}{2}$$



**Statnett**

**Forskning** og Utvikling  
Research and Development

**Statnett**

The future is electric and digital!

<https://www.statnett.no/om-statnett/forskning-og-utvikling/>  
<https://www.statnett.no/en/about-statnett/research-and-development/>