Statnett

FoU og Teknologiutvikling

Center for RD&I

R&D

10.2020

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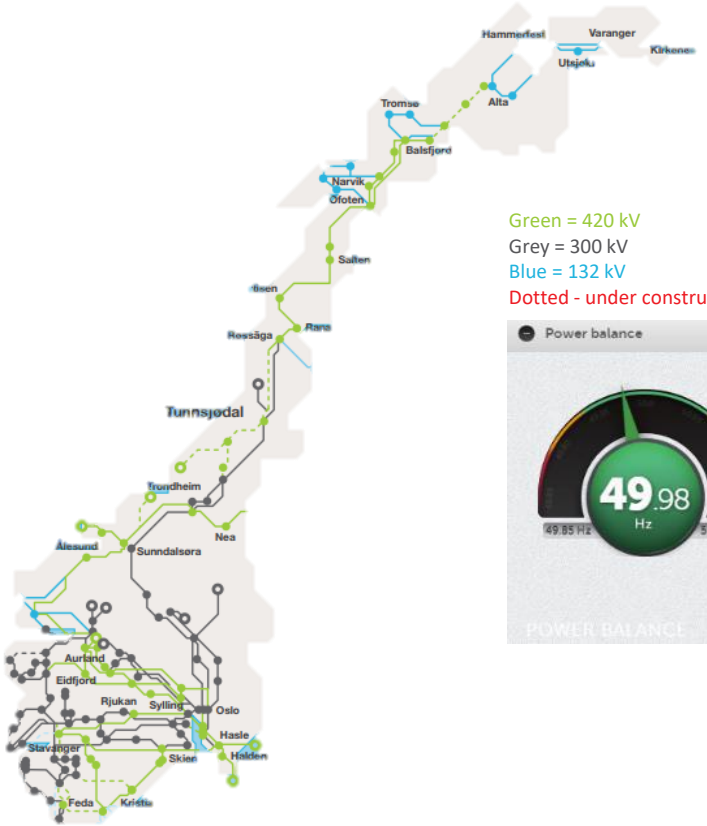
This is **Statnett**

- 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



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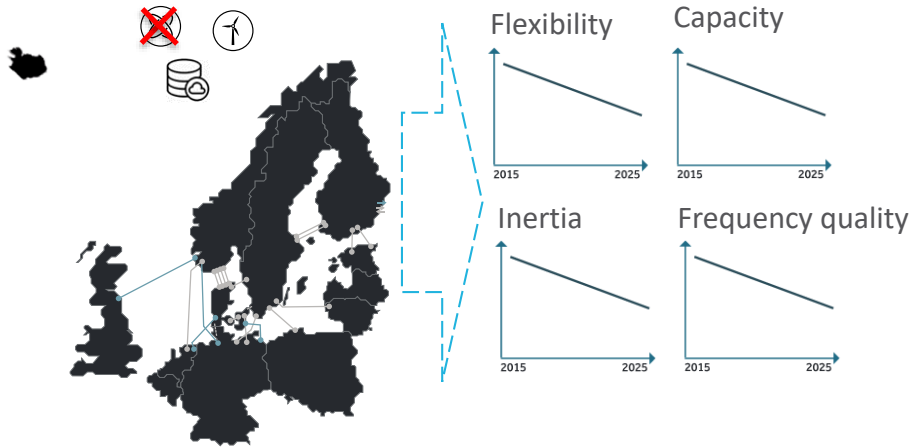
Climate targets in Europe, the Nordic countries and Norway presents us with new challenges



Social mandate

Corporate social responsibility

Norway is part of the Nordic synchronous area

import + production = export + consumption + losses

SUSTAINABLE DEVELOPMENT GOALS

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Co-operation is essential for R&D

prioritize, share scarce resources, inspire and harmonize

- National level

smartgrid The Norwegian Smartgrid Centre

energi 21

Forskningsrådet

Nordic level

Nordic R&D Group

ENERGINET FINGRID LANDSNET SVENSKA KRAFTNÄT Statnett

Nordic Energy Research

European level

ETIP SNET

entsoe

International level

ENERGY TRANSITIONS COMMISSION

ISGAN INTERNATIONAL SMART GRID ACTION NETWORK

iea International Energy Agency

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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.*

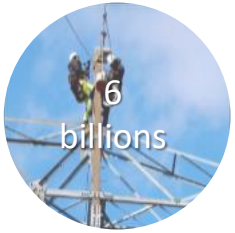
Ministry of Petroleum and Energy, Report No. 25 to the Storting (2015–2016)

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

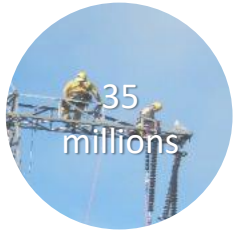
Ministry of Petroleum and Energy, Report No. 14 to the Storting (2011–2012)

10-15 BN

NOK saved since 1997

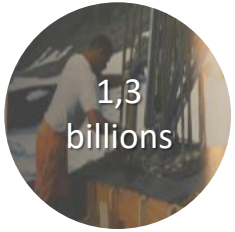


Voltage upgrading



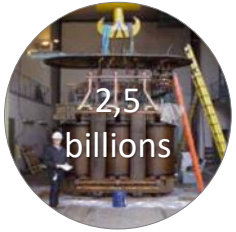
Live line work

Minimum electrical clearances



Concrete tower foundation

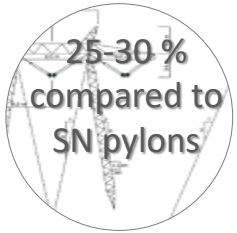
Installing aircraft warning markers using a robot



Transformers lifetime utilization

Pre-fabricated steel foundation

High temperature lines



M pylon – External guy-wires

AutoDig

Digital Station

Improving supply reliability

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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

Forskningsrådet

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

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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

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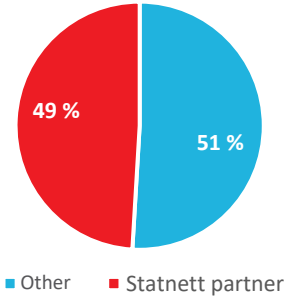
Statnett's R&D in a nutshell (2019)

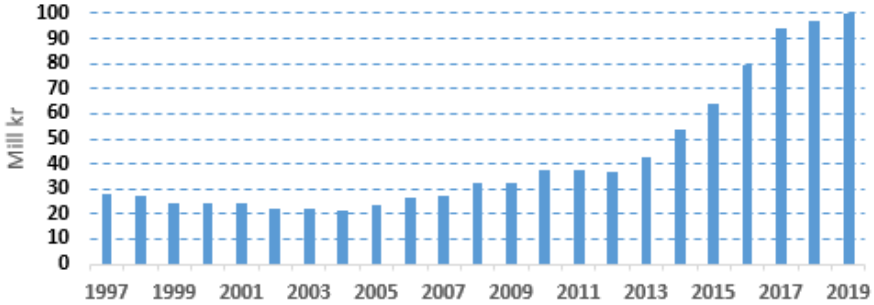
- 180 employees involved
- 8,6 MEuro invested
- Total portfolio ~ 118 MEuro
- 67 ongoing projects
- Patent
- Safety price
  Smart Grid Center Innovation price

31% of our R&D projects are led by women

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 future is **electric**

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The projects deliver in the following areas

EHS

Cost

Digitalization

Know-how

Value creation

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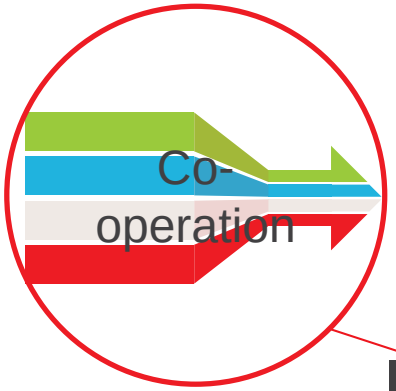
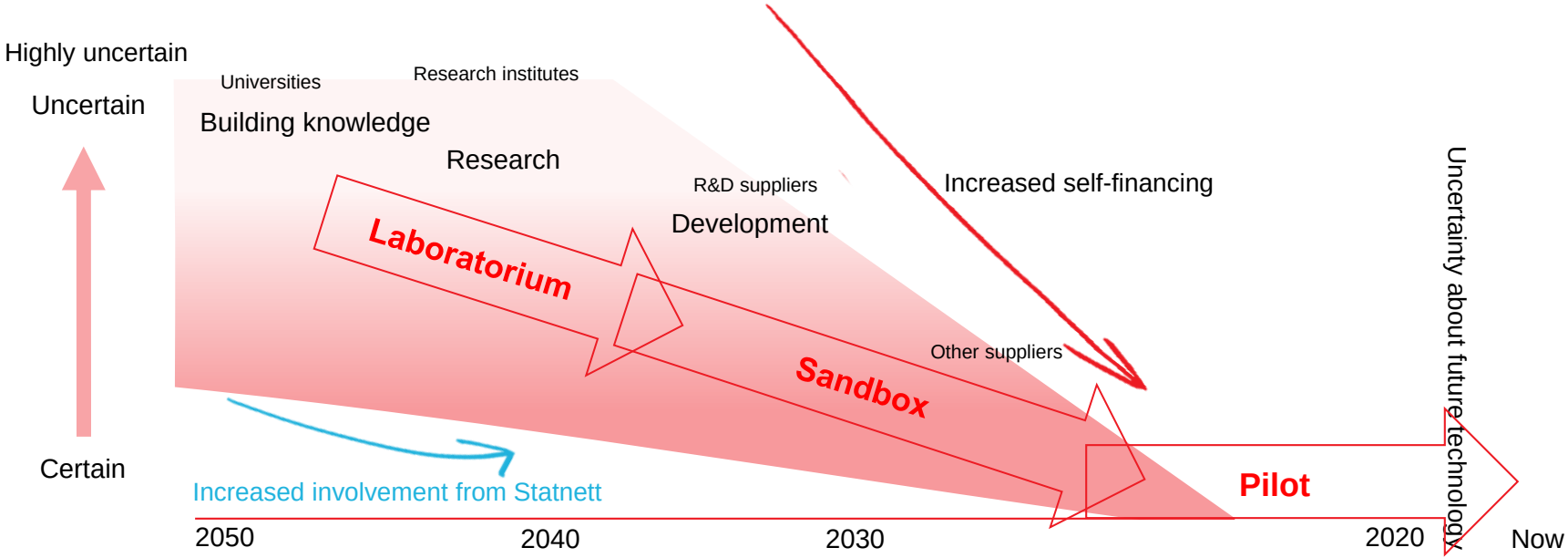
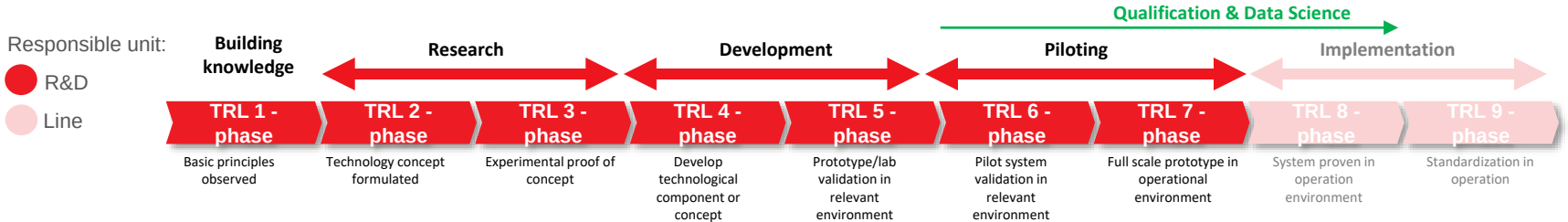
Interdisciplinary collaboration



How we innovate





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Our areas of digitalization

Robots

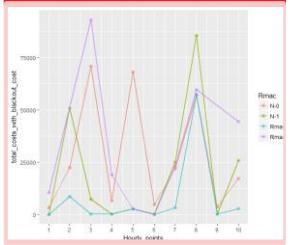
Self-diagnosis

Digital infrastructure

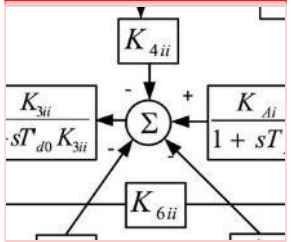
Cyber physical security

Faster response

Prediction



Model development



User interface

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Our projects deliver on important areas for Statnett

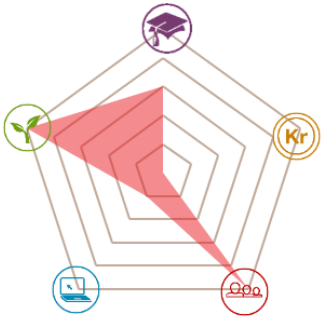
EHS

Cost

Digitalization

Know-how

Value creation



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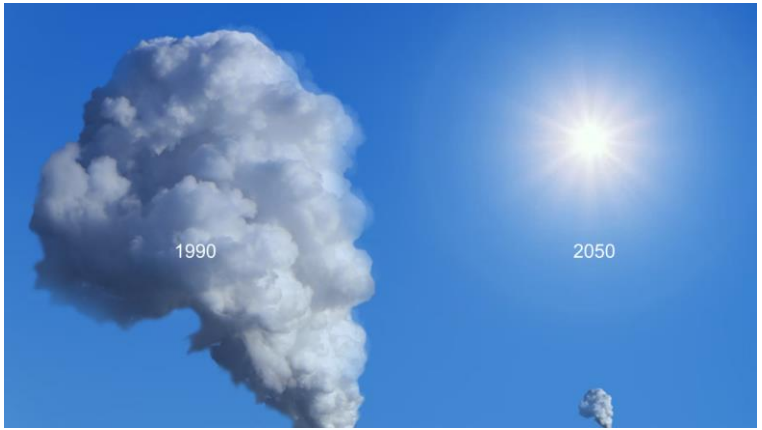
Co-operation in the energy system
Samhandling i energisystemet

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

GRAN

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Digital, safe and cost-effective assets
Digitale, sikre og kosteffektive anlegg

Goal

- Research Council project that will look at how we can restore terrain damage and reduce greenhouse gas emissions from bogs.

Method and results

- Improve and further develop planning and implementation of mitigation measures in construction projects.
- Contribute to reducing the total extent of encroachment on nature, greenhouse gas / CO2 emissions from bogs and wetlands and loss of natural values.
- The work will result in a "New framework for greener encroachment on nature and reduction of greenhouse gas emissions in construction work" (GRAN).

Expected gain (effect goal)

- HSE 50 MNOK

The Research Council of Norway

Project type	Project period	TRL	Partners
IPN	Q4/2017 – Q4/2021	-	Xxxxxxxx, xxxxxxxx, xxxxxx

Rakett

Goal

- To understand the large and rapid changes in the energy system, it is important to find out how each part of the system behaves. Flexibility in renewable resources is difficult to model, the project will develop a model that must be able to "understand" hydropower.

Method and results

- Reduce the calculation time and make the model applicable in the industry.
- A better model will enable Statnett to make better decisions about the transmission network, producers/others can make better decisions about power plants, consumption and other matters related to the power system.
- Better decisions provide more efficient use of the energy system, benefits the whole of society.

Expected gain (effect goal)

- Cost efficiency – 15 MNOK

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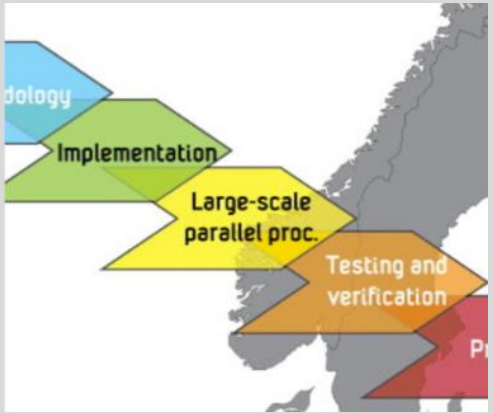
Co-operation in the energysystem
Samhandling i energisystemet



The Research Council of Norway

Project type	Project period	TRL	Partners
IPN	Q2/2020 – Q4/2021	7	NVE, Statkraft, Sintef

iFleks

Statnett

Co-operation in the energysystem
Samhandling i energisystemet

Background

- Quantify future price sensitivity for households and commercial buildings in urban areas. The project will give us knowledge about how end users react to different hourly prices for electricity.

Method and results

- Carry out a price experiment in the winter of 2019/20 with a selection of households and office buildings in the big cities where we measure their actual response to different price signals.
- The experiment will provide data on how different consumers react with their electricity consumption at different prices. The results must be generalizable and transferable to all metropolitan areas in Norway.
- Carrying out a similar experiment in winter 2020/21 to get the best possible data base.

Expected gain (effect goal)

- Cost efficiency – 600 MNOK

The Research Council of Norway

Project type	Project period	TRL	Partners
Co-operation	Q4/2019 – Q2/2021	2	Future Home, Smartly/Lyse, Entelios, Energi Salg

Statnett

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

420 kV Composite tower

Statnett

Digital, safe and cost-effective assets
Digitale, sikre og kosteffektive anlegg

Background

- Statnett has a need for tower concepts that are less expensive and at the same time are safer and faster to construct

Method and results

- Transmission towers made of composite materials will result in a lighter tower with a reduced visual impact.
- Less helicopter lifts, shorter construction time and increased safety
- The expected result is an HSE benefit by reducing the number of helicopter lifts, this will also have an economical effect. We will also gain knowledge and experience about composite materials in tower constructions.

Expected gain (effect goal)

- HSE – 30 MNOK
- Cost efficiency – 10 MNOK

Project type	Project period	TRL	Partners
Collaborative	06/2015 – 06/2020	5	Csub, Amiblu, DNV-GL, EFLA, Sintef, OPS, Mitas

ICEBOX

Background

- As power lines are not designed to withstand the highest ice loads, during a 150-year return period, the ICEBOX project aims to develop methods for real time ice load monitoring, efficient ice removal and a national ice load map with future ice forecast for better planning of new OHL corridors.

Method and results

- Development of real time ice load measurement devices with "Internet of Things" communication solutions
- Map and gather information on efficient methods for ice removal from OHL's
- Develop a national ice-map with future (geo-specific) ice forecast for better planning of new OHL corridors

Expected gain (effect goal)

- HSE: 15 MNOK
- Cost efficiency – 350 MNOK

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Digital, safe and cost-effective assets
Digitale, sikre og kosteffektive anlegg

The Research Council of Norway

Project type	Project period	TRL	Partners
IPN	01/2018 – 09/2021	3	KVT, EFLA, I2G, CICERO, NCAR, UiT, UiO, Landsnet

ECoDiS

Background

- The main goal is to exploit the full potential inherent in digital substations, in order to increase security-of-supply, safety, observability and reduce costs in a changing energy system.

Method and results

- Recommend sensor technologies for condition monitoring in digital substations
- Test functionality of digital sensor technologies in the three pilots
- Investigate interoperability in substations with digital and conventional components
- Test and evaluate how existing methods for condition assessment can be used in DS for maintenance and reinvestment management in a digital twin, with demonstration at the pilot substations.
- Establish a laboratory platform for investigation of issues related to the IEC 61850 standards (interoperability, cybersecurity, etc.
- Quantify added value of technologies and components used in the pilots
- Provide recommendations and strategies for implementation of DS

Expected gain (effect goal)

- Cost efficiency - 600MNOK
- Value creation - 1600MNOK

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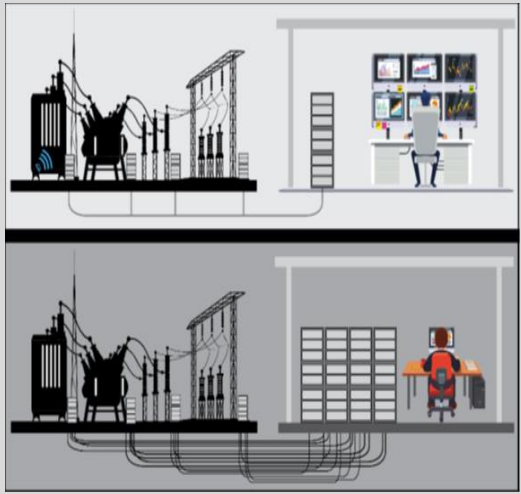
Digital, safe and cost-effective assets
Digitale, sikre og kosteffektive anlegg



The Research Council of Norway

Project type	Project period	TRL	Partners
IPN	Q1/2019 – Q3/2023	3	Sintef, NTNU, NVE, Eidsiva, BKK, Elvia, Skagerak, Tensio

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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

CybWin - testbed digital station

Statnett

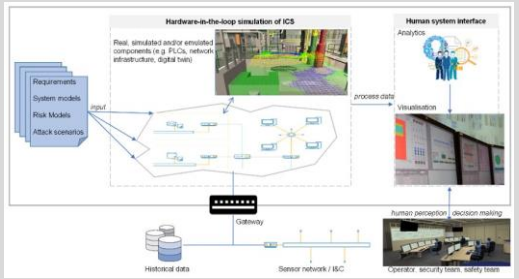
Real time control and effective markets
Sanntidsstyring og effektive markeder

Background

- There is a need for understanding the threats towards critical infrastructure, including attack surfaces, vulnerabilities and associated risks. In addition, there is a need for processes, methods and tool for efficient assessment of cyber security of critical infrastructure

Method and results

- The main delivery is a cyber security platform with physical, replicated and simulated components of critical infrastructure, in addition to vulnerability assessment, simulation of attacks incident prediction and response.
- A digital twin of the Digital Station and a number of attack scenarios will be developed to assess the security robustness.



Expected gain (effect goal)

- Digitalisation – 500 MNOK
- Cost effectiveness – 500 MNOK

The Research Council of Norway

Project type	Project period	TRL	Partners
KPN	01/2020 – 03/2022	3-6	IFE, NTNU, Secure-NOK, VTT, KAIST, Avinor, Eurocontrol, KraftCert

NEWEPS (Nordic Early-Warning Early-Prevention System)

Statnett

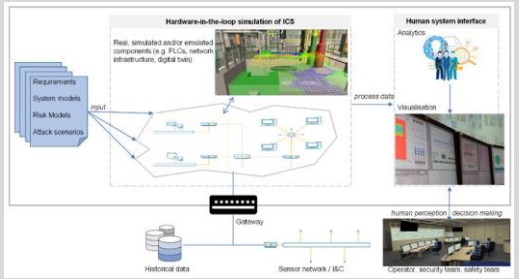
Real time control and effective markets
Sanntidsstyring og effektive markeder

Background

- The purpose of the project is to develop and demonstrate PMU-based system for monitoring and control of power system operation in cooperation with the Nordic TSOs.

Method and results

- Develop applications which enable the operators to detect and understand critical situations which may impact the stability of the Nordic power system
- Create a common Nordic platform as a basis for implementing and demonstrating prototypes for applications, control systems, GUIs and coordination functions.
- Improved observability and new applications will contribute to maintain stability and security of supply when introducing more renewable power (solar and wind)



Expected benefit

- Cost efficiency and economic growth – 500 MNOK

The Research Council of Norway

Project type	Project period	TRL	Partners
Collaborative	06/2017 – 06/2023	3-7	Nordic TSOs, universities and research institutions

Sandie - Nordic Sandbox Research Infrastructure Environment

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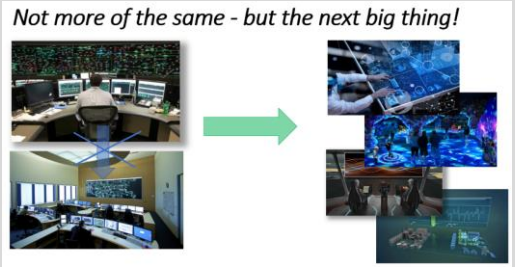
Real time control and effective markets
Sanntidsstyring og effektive markeder

Background

- There can be a big gap between R&D and implementation. The solutions are not mature enough to be tested in an operational environment, but we are not able to go forward without.
- We need a collaborative arena for trial and error, a place to be able to 'mature' ideas, where we can show the possibilities and adjust ideas without affecting the operational operation of the power grid - a sandbox



Method and results

- Develop alternative concepts / solutions for a sandbox
- Establish a sandbox based on the recommended solution

Expected gain (effect goal)

- Semi-operational and realistic lab facilities and make data available for R&D projects
- Common infrastructure that can be reused
- Facilitate easier testing and training

Project type	Project period	TRL	Partners
TBD	08/2020– 12/2022	3-9	TBD

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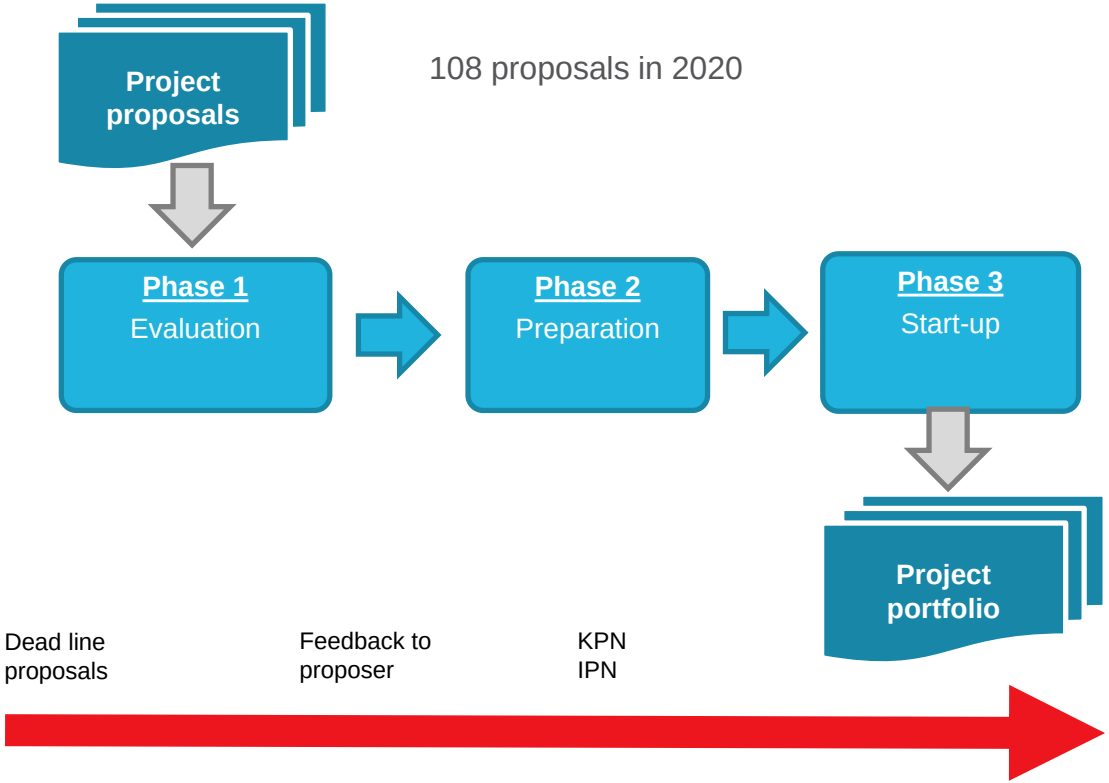
Processing of project proposals



Submit R&D proposal

Required fields are marked with asterisk (*)

About proposer

First name *
John

Surname *
Doe

Organization *
Organization name LTD. or 'Private person'

Phone number*
+4712345678901234567

E-mail *
john.doe@example.com

Your proposal

Title *

What kind of problem do you want to solve? *
Describe the problem you want to solve and why

http://www.statnett.no/en/Sustainability/Research-and-Development-/Project-proposals/ProjectProposal/

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To sum up

- R&D is essential for Statnett to succeed
- Systematic innovation approach implemented
- Employee engagement important for an innovative Statnett
- R&D is a collaborative effort of suppliers, DSOs, universities and research institutes

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Forskning og Utvikling
Research and Development

Statnett

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