
SOLUTIONS
REPORT 2020
WEBINAR – June 2, 2020
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Webinar groundrules

THE WEBINAR IS RECORDED AND WILL BE MADE AVAILABLE

PLEASE USE THE Q/A FUNCTION DURING THE WEBINAR

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STATE YOUR NAME AND COMPANY WHEN YOU WRITE A QUESTION

EACH PRESENTER HAS 5-10 MINUTES FOR QUESTIONS

PARTICIPANTS ARE NOT ABLE TO USE THE MICROPHONE OR CAMERA

Agenda

Time	Topic
09:00	INTRODUCTION (KRISTIAN PLADSEN, FACILITATOR)
09:05	CURRENT TRENDS IN POWER SYSTEM DEVELOPMENT – TSO PERSPECTIVE (HANNE STORM EDLEFSEN, DIRECTOR, ENERGINET)
09:25	KEY FOCUS IN OFFSHORE DEVELOPMENT (RICARDA PETERS, HEAD OF OFFSHORE WIND AND TRANSMISSION, COPENHAGEN INFRASTRUCTURE PARTNERS)
09:55	BIDDING ZONE REVIEW PROCESS (MÅRTEN BERGMAN, HEAD OF TRANSMISSION AND WHOLESALE MARKETS UNIT, SVENSKA KRAFTNÄT)
10:15	KEY FOCUS IN DIGITALIZATION IN THE POWER SYSTEM (JON ANDREAS PRETORIUS, CIO, HAFSLUND NETT)
10:45	10 MINUTES BREAK
10:55	KEY FOCUS IN MARKET DEVELOPMENTS (PETTERI HAVERI, ADVISOR, FINNISH ENERGY ASSOCIATION)
11:25	OPPORTUNITIES IN INDUSTRY CARBON REDUCTION – LARGE SCALE HYDROGEN CASE STUDY (EVA VITELL, GENERAL MANAGER, HYBRIT DEVELOPMENT AB)
11:55	CLOSE AND WRAP-UP (HANNE STORM EDLEFSEN, DIRECTOR, ENERGINET)

CURRENT TRENDS IN POWER SYSTEM DEVELOPMENT – TSO PERSPECTIVE

Hanne Storm Edlefsen

Director, Energinet

Ensuring high market capacity and reliable operations

Solving congestion

Bidding zones

Balancing production and consumption

CEP 70% rule

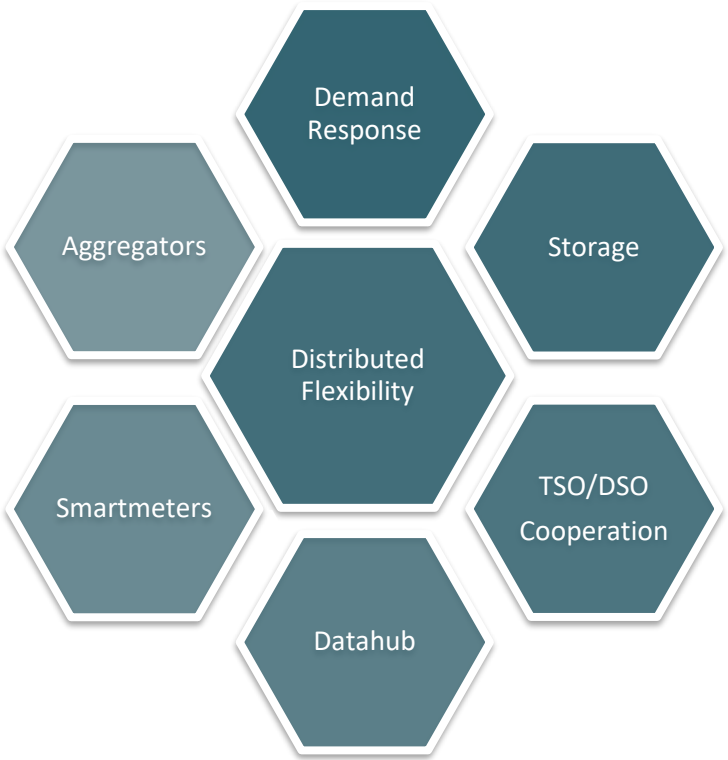
Cost-effective operations

RSC

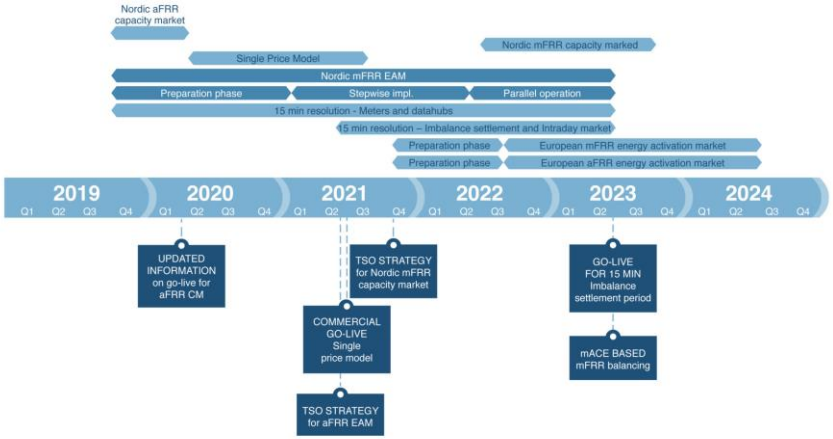
Evolving market design

NEMOs

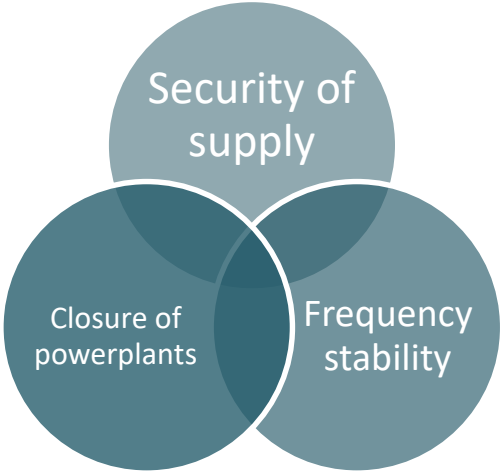
Creating distributed flexibility through close cooperations with market participants



Balancing towards new, more efficient systems operations



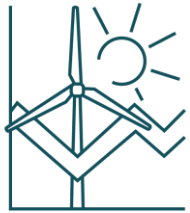
Nordic Balancing Model



Frequency Services

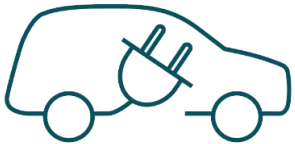
Creating the foundation for the future energy system

Joint Nordic Analysis

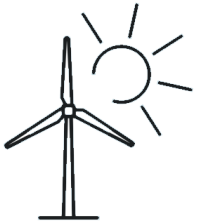


Resource Adequacy

Sector Coupling



Electrification

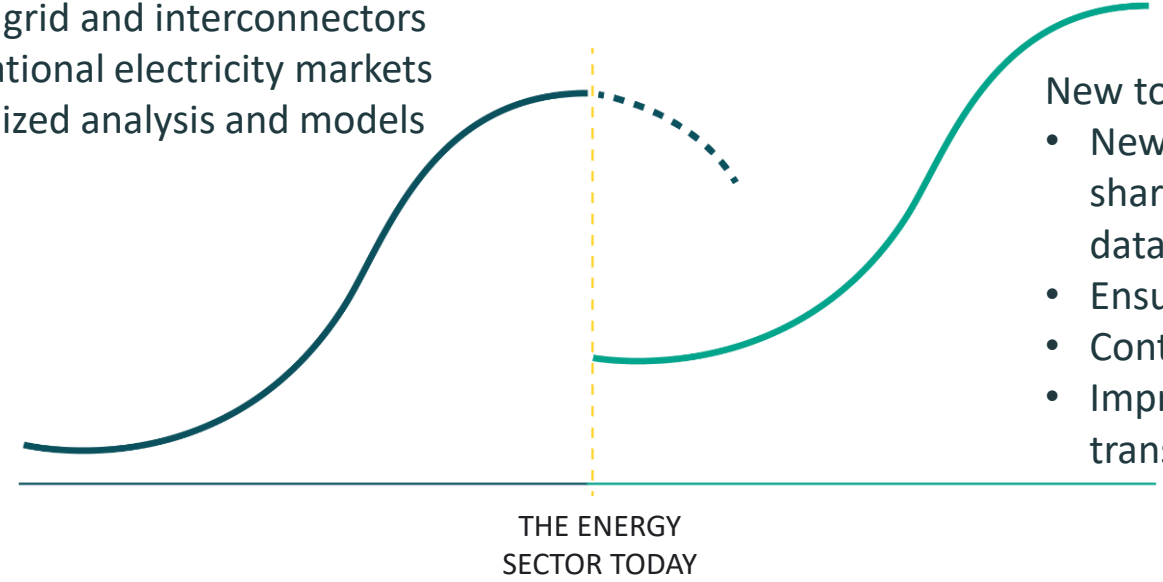


Renewable Resources

Collaboration with Society

Developing secure, digital and innovative tools

Existing tools
- Strong grid and interconnectors
- International electricity markets
- Specialized analysis and models



New tools
- New and efficient ways of sharing and using energy and data
- Ensure digital security
- Continue the strong R&D efforts
- Improve data quality and transparency

WORKING TOGETHER

For the green transition

Questions:

Current Trends in Power System Development

KEY FOCUS IN OFFSHORE DEVELOPMENT

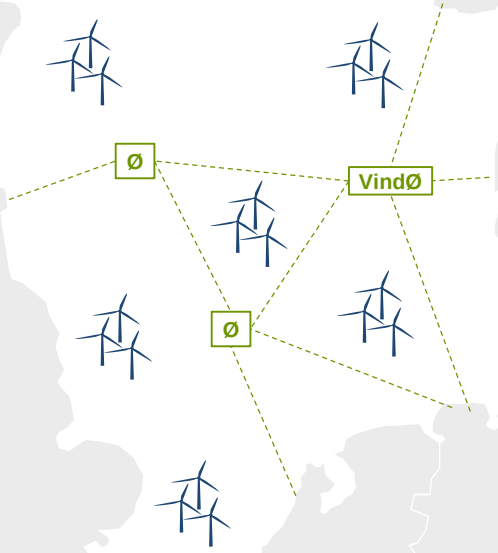
Ricarda Peters

Head of Offshore Wind and Transmission, Copenhagen Infrastructure Partners

Offshore Development

VindØ – An Offshore Wind Concept

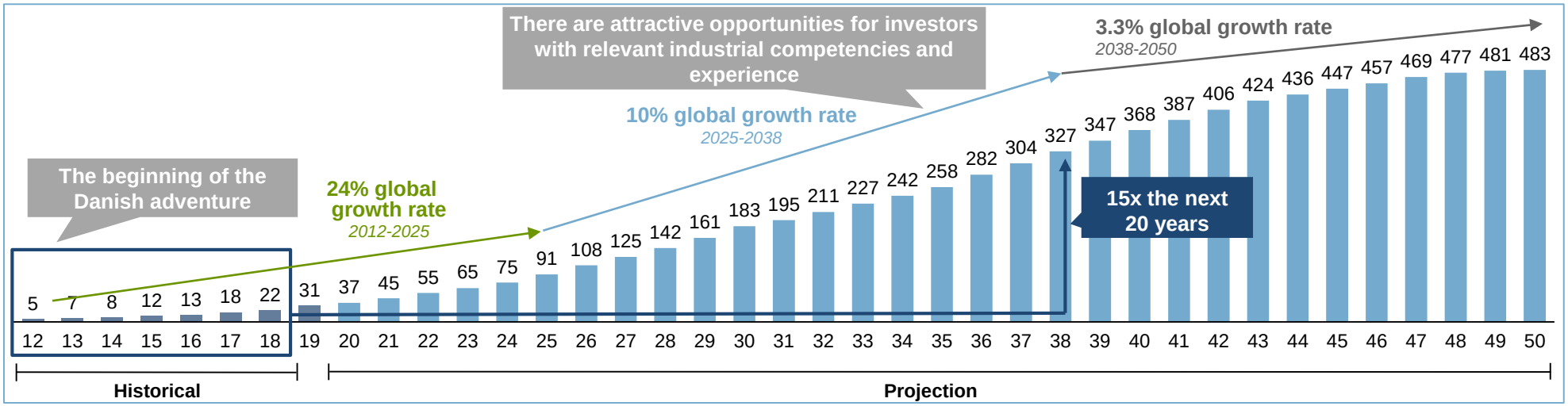
Energinet webinar, 2 June 2020



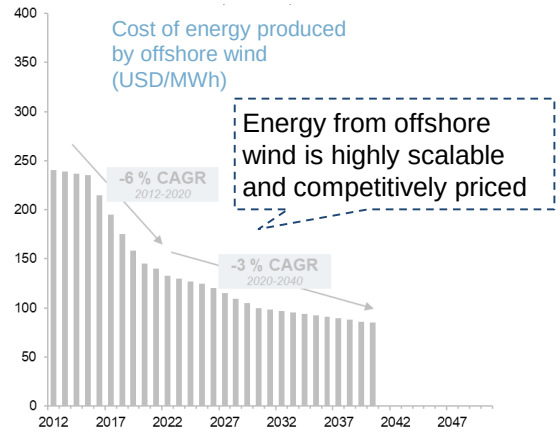
Offshore wind will be crucial in achieving national and EU climate targets

- Offshore wind technology offers the large capacities and public acceptance needed for significant decarbonization

Expected development in installed offshore wind capacity until 2050 (GW)



Capacity build-out led by a fall in "levelized cost of electricity" (LCOE) …



- Offshore wind costs have fallen from over € 200 / MWh to less than € 60 / MWh and there is a prospect of further declines of 40% lower LCOE in 2030 to € 30-40 / MWh
- Auction prices have fallen, illustrating that sea winds are competitive (e.g. 2019 UK CfD Round 3 awarded at record low prices £ 39.65 / MWh (2012 real))

… and climate targets drive overall decarbonisation

COP21 agreement in Paris

- 196 countries signed the agreement
- Aim to strengthen climate action every five years
- Keep global warming below 2 degrees
- Strive to keep global warming below 1.5 degrees

- The Paris Agreement enters into force if 55 countries (covering 55% of global emissions) sign by 2020
- USD 100 billion has been allocated to developing countries for climate change initiatives by 2020
- European Commission decarbonisation scenarios expect between 230 GW and 450 GW of offshore wind by 2050[1] in Europe

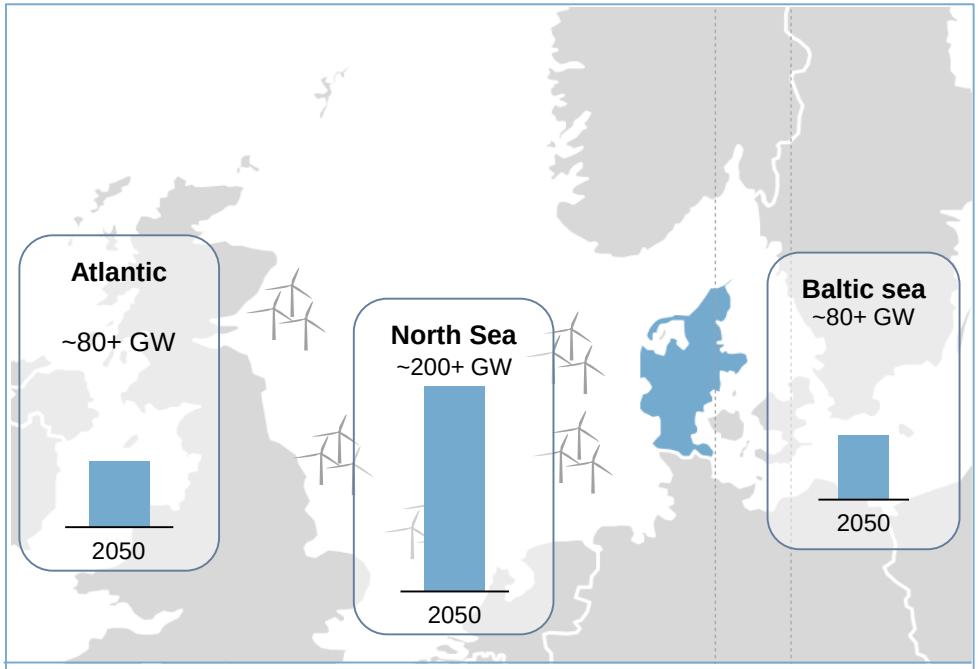
1) Offshore Wind Outlook 2019, International Energy Agency, 2019

ILLUSTRATIVE EXAMPLE

What opportunities arise from a large scale build-out of offshore wind?

- Nordic countries have historically been front-runners in the development of wind energy

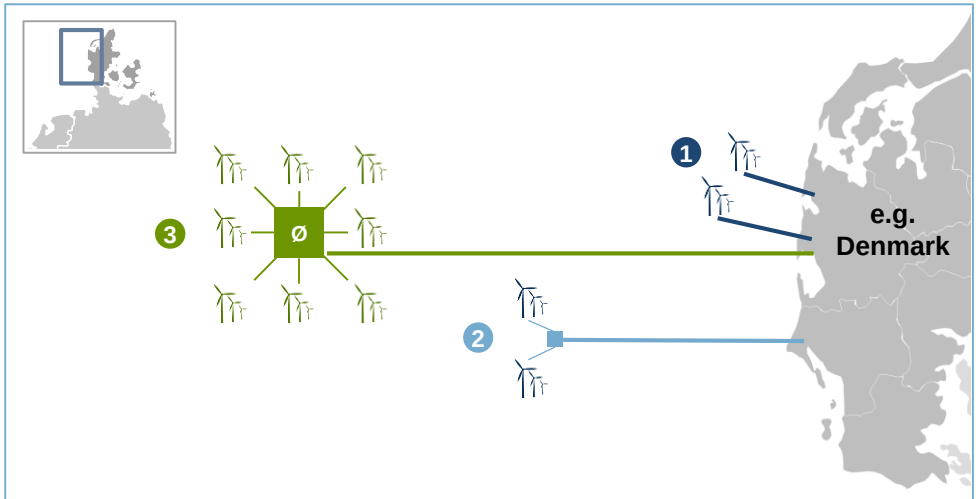
The North Sea will become a European power center for clean energy generation...



- To reach the 2050 EU climate targets, between 230 -450 GW offshore wind capacity[1] are expected to be installed in Europe
- The northern part of Europe will play an important role in the development with ca. 85% of expected capacity
- The North Sea stands out as a focal point with strong wind resources, relatively low water depths and plenty of space.

✓ **Nordics have an excellent position to participate to a large extent in the development of the North Sea as a clean energy supply center**

… but fully integrated electricity systems must be established in order to utilize offshore wind power as baseload in the system



1 **Continuing the traditional HVAC approach,** where separate offshore wind farms are connected directly to land, will create an challenges to the onshore grid

2 **An offshore HVDC platform (conventional technology) with more than one windfarm connected** enables energy to be transported to load centers over large distances or exported but will only utilize approx. 50% of the transmission cable capacity

3 **An island can bundle energy from several wind farms and thus enables better utilization of the transmission cable in the long term** incl. potential of thermal storage, which allows the utilization of offshore wind power as baseload capacity

✓ **VindØ is a prerequisite for realizing the full offshore wind potential in the North Sea by leveling consumption and production**

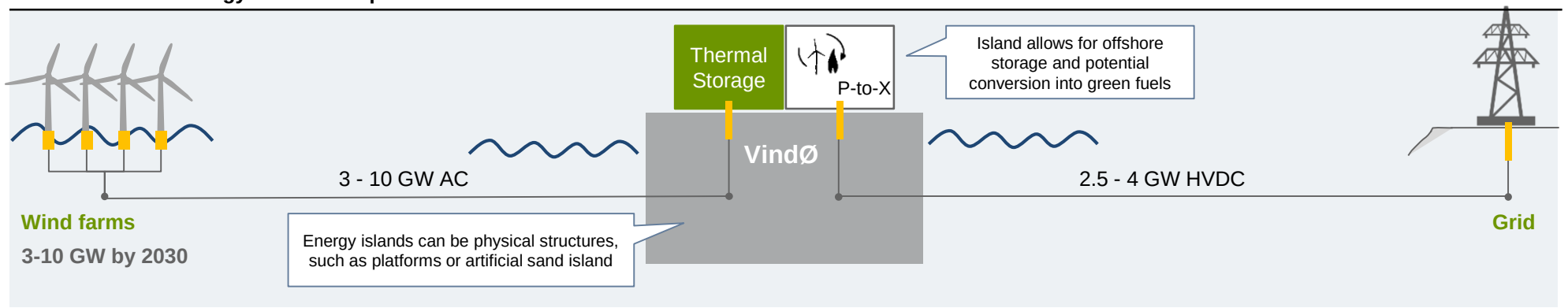
1) A Clean Planet for all, European Commission, 2018

ILLUSTRATIVE EXAMPLE

How does an energy island work and how can it be realized?

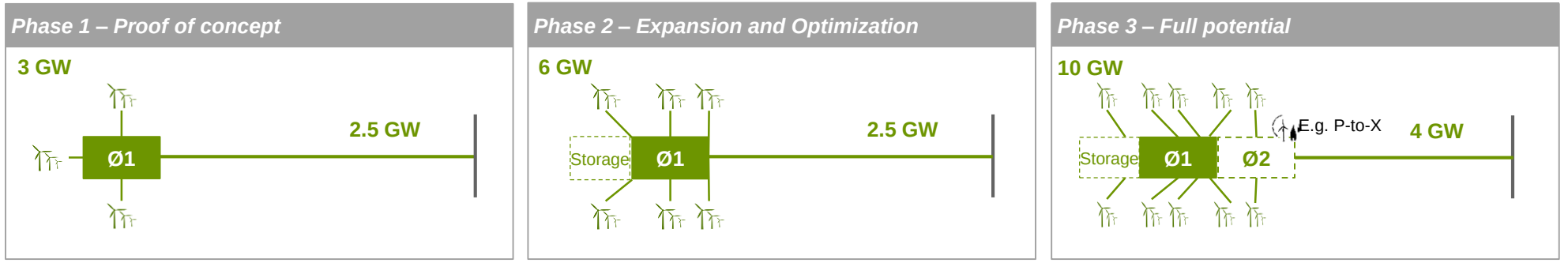
- VindØ not only collects and transports power but it offers additional benefits like the potential for offshore storage and sector coupling

Illustration of an energy island set-up – all numbers illustrative



✓ **VindØ offers potential to bundle energy, host storage and power-to-x facilities to optimize the clean energy produced offshore**

Illustration of potential build-out of VindØ – all numbers illustrative



✓ **In the long term, the green electricity from the energy islands must be converted and used in sectors that cannot use green electricity directly yet, for example aviation, heavy transport, some processes in business, etc.**

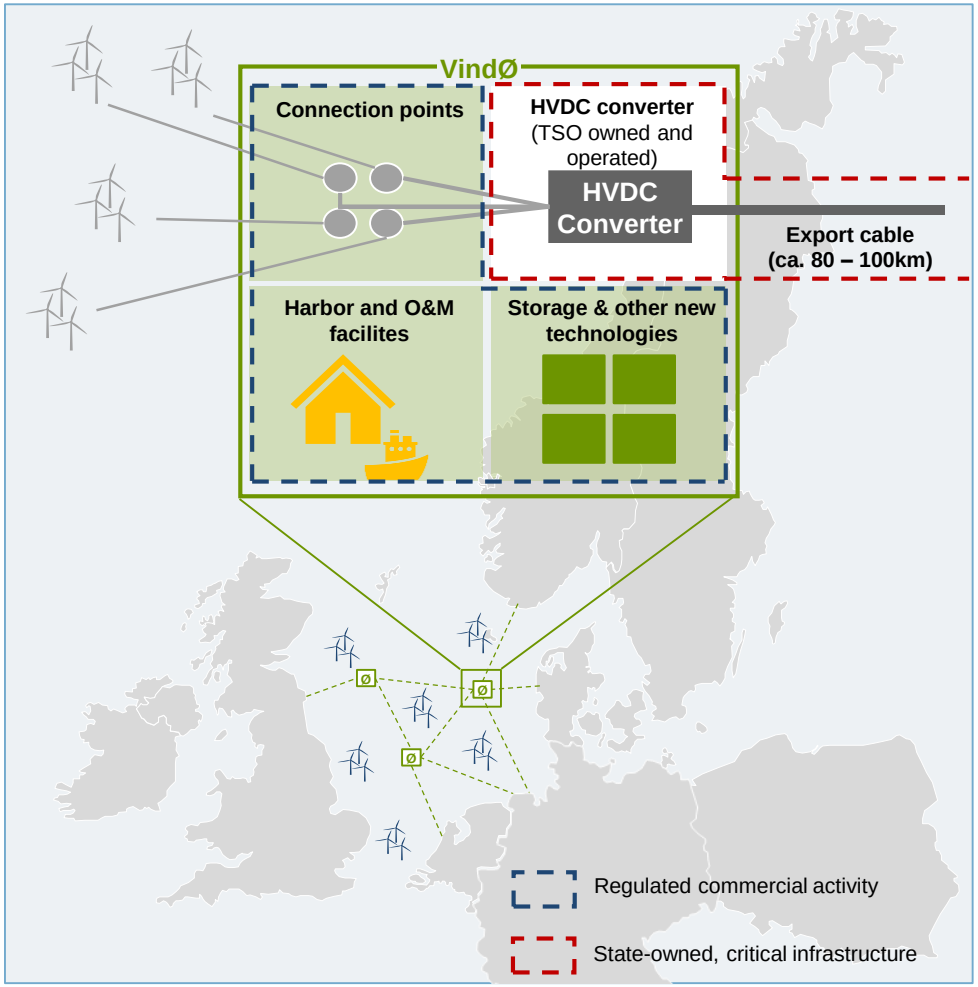
Source: Klimahandlingsplanen (2020) https://fm.dk/media/18017/faktaark-til-foerste-del-af-klimahandlingsplanen.pdf

ILLUSTRATIVE EXAMPLE

Illustration of the concept and stakeholders involved in the operations

- Realization of VindØ depends on an existing governmental framework

Illustration of VindØ - all numbers illustrative



Description of individual components of the VindØ concept

- Rights to build **wind farms** will be tendered competitively
- Location far from shore will increase public acceptance
- New offshore wind areas with attractive wind resources

VindØ

- The **island** will be financed and owned by investors (Danish pension funds and customer-owned energy company) who have already confirmed interest in the concept
- No government funding will be required

- Wind farm developers will **connect to the island** (instead of radial connection)
- Connection point is guaranteed against lease payments

HVDC Converter and export cable

- **Transmission system** with “onshore” construction approach and risk profile for TSO
- O&M expenses are comparable to onshore activities

- **O&M facilities** for wind farms and transmission system can be hosted offshore but close to site
- Synergies will benefit island stakeholders

- **Storage** increases the value of offshore wind as it smoothens the production curve and thus allows for longer periods with very high green energy content
- In the long term, the island can play a regional optimization role (e.g. with regard to negative prices)

ILLUSTRATIVE EXAMPLE

Is it possible to build an artifical island in the North Sea?

- VindØ construction process inspired by Anse du Portier (Monaco) - more detailed planning required

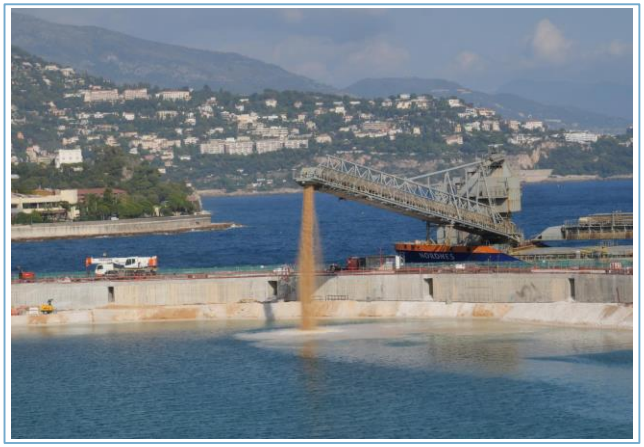
Production of caissons

- Production lines must be placed close to shore, in deep but calm waters with sufficient area for production and storage

Transport and installation of caissons

- One barge is needed to transport each caisson from the production site to the installation site
- After the first caisson has been installed, two caissons can be installed simultaneously

Sand infill and compacting



- Sand is needed to infill the area encompassed by caissons
- While sand infill is ongoing, compacting must be carried out

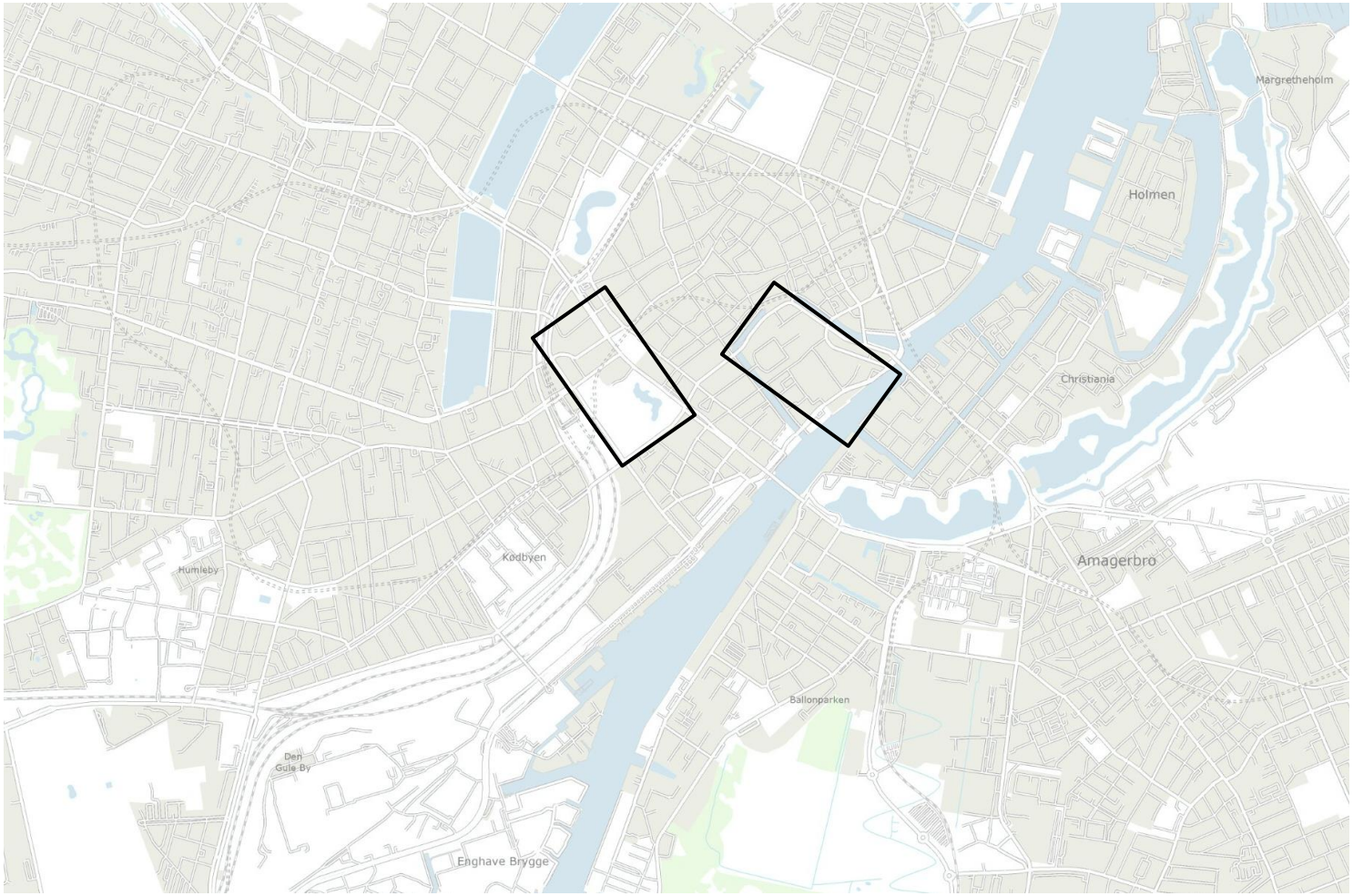
✓ **VindØ can be built with existing and proven technology**

✓ **Denmark is the first country in the world to establish energy islands. Energy islands represent a paradigm shift**

Source: https://www.theconstructionindex.co.uk/news/view/new-phase-begins-on-monacos-land-extension; COWI reports from 2 May 2019 and 24 June 2019 and telco on 12 May 2020

ILLUSTRATIVE EXAMPLE

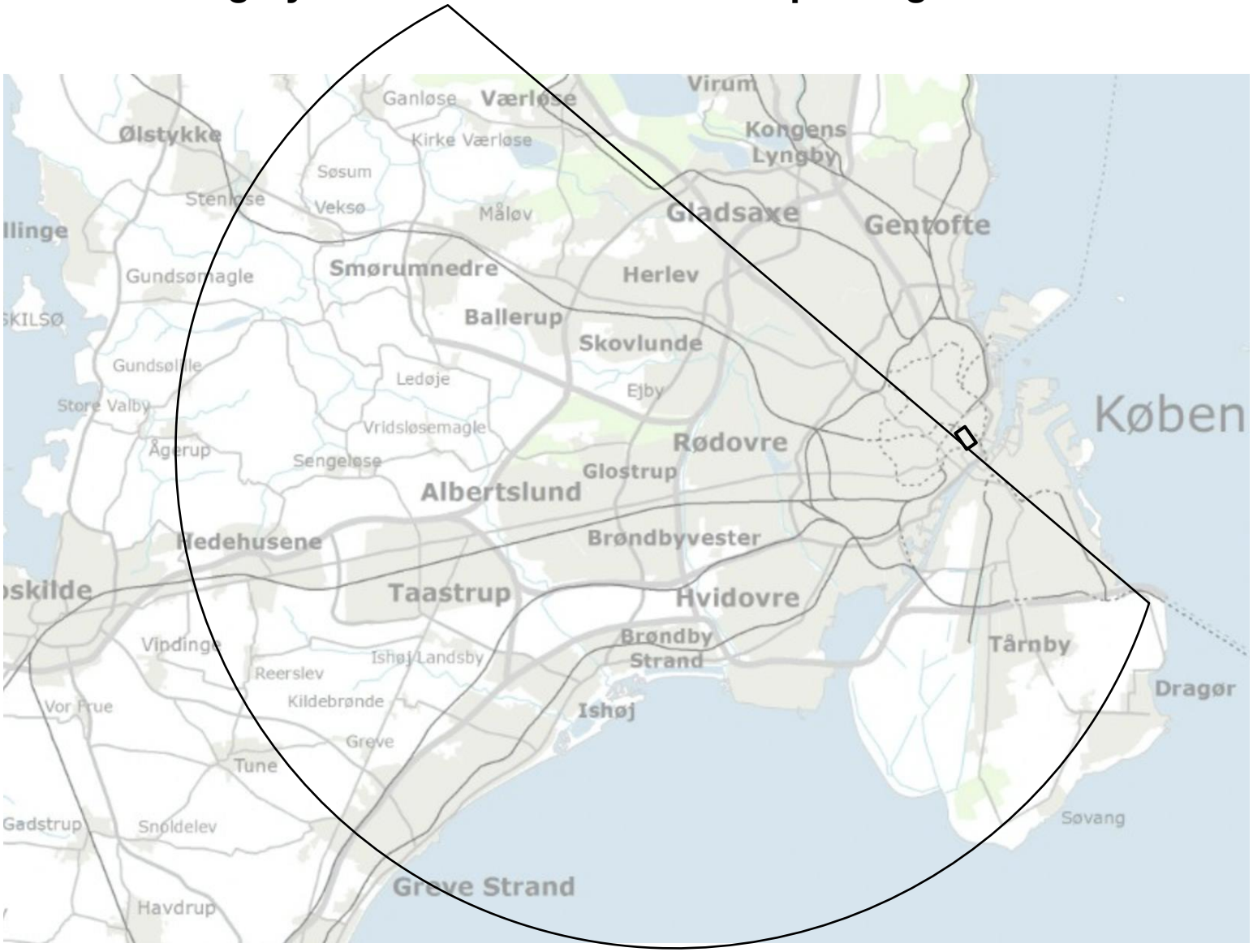
The energy island will cover an area three times larger than Tivoli Gardens and slightly larger than Slotsholmen



Sources: sdfekort.dk; tivoli.dk; da.wikipedia.org/wiki/Slotsholmen

ILLUSTRATIVE EXAMPLE

The 3 x 1 GW offshore wind farms connected to the energy island will cover an area roughly the size of the Greater Copenhagen area



Sources: sdfekort.dk
Note: Offshore wind farms assumed positioned relative to prevailing winds, i.e. predominately west of the island

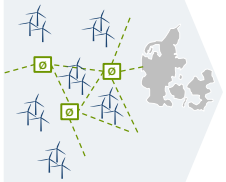
Key take-aways: VindØ will make it possible to achieve climate goals - without state funding but with state ownership of critical infrastructure facilities

1. VindØ is a prerequisite for realizing the full offshore wind potential[1] of the North Sea

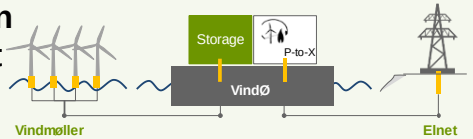
2. The development of VindØ must commence now in order to reach climate targets in 2030 (see Danish climate plan)

3. VindØ is supported by a consortium of investors (Danish pension funds and customer-owned energy company)

4. Following its construction, part of the island could be divested to the TSO to install their infrastructure and operations

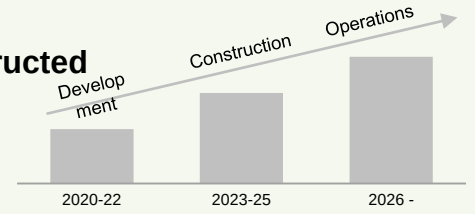


VindØ can increase share of green power in Europe, and the concept has great export potential



VindØ will contribute significantly to realising Denmark's 2030 climate ambitions

VindØ can be planned and constructed without the need of government funding and risk-taking



Critical infrastructure is owned by government and costs are similar to alternative solutions

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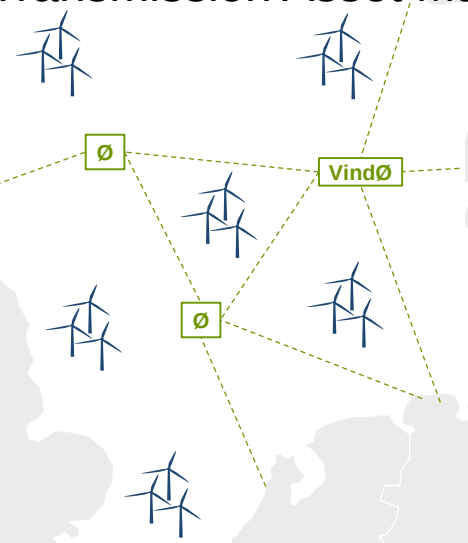
Source: Klimahandlingsplanen (2020) https://fm.dk/media/18017/faktaark-til-foerste-del-af-klimahandlingsplanen.pdf

Many thanks for your attention!

Ricarda Peters
Head of Offshore & Transmission Asset Management, CIP



Questions:

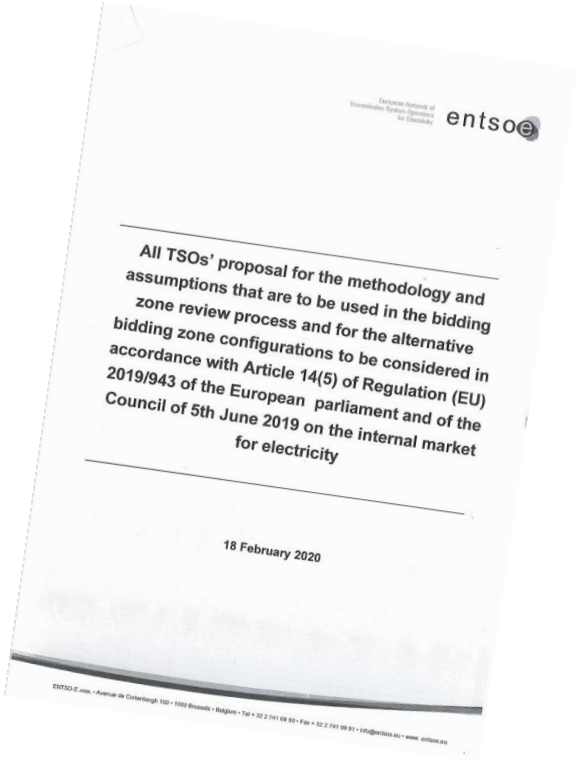
Key Focus in Offshore Development

BIDDING ZONE REVIEW PROCESS

Mårten Bergman
Head of Transmission and Wholesale Markets Unit, Svenska kraftnät

Bidding zone review process – Background and Introduction

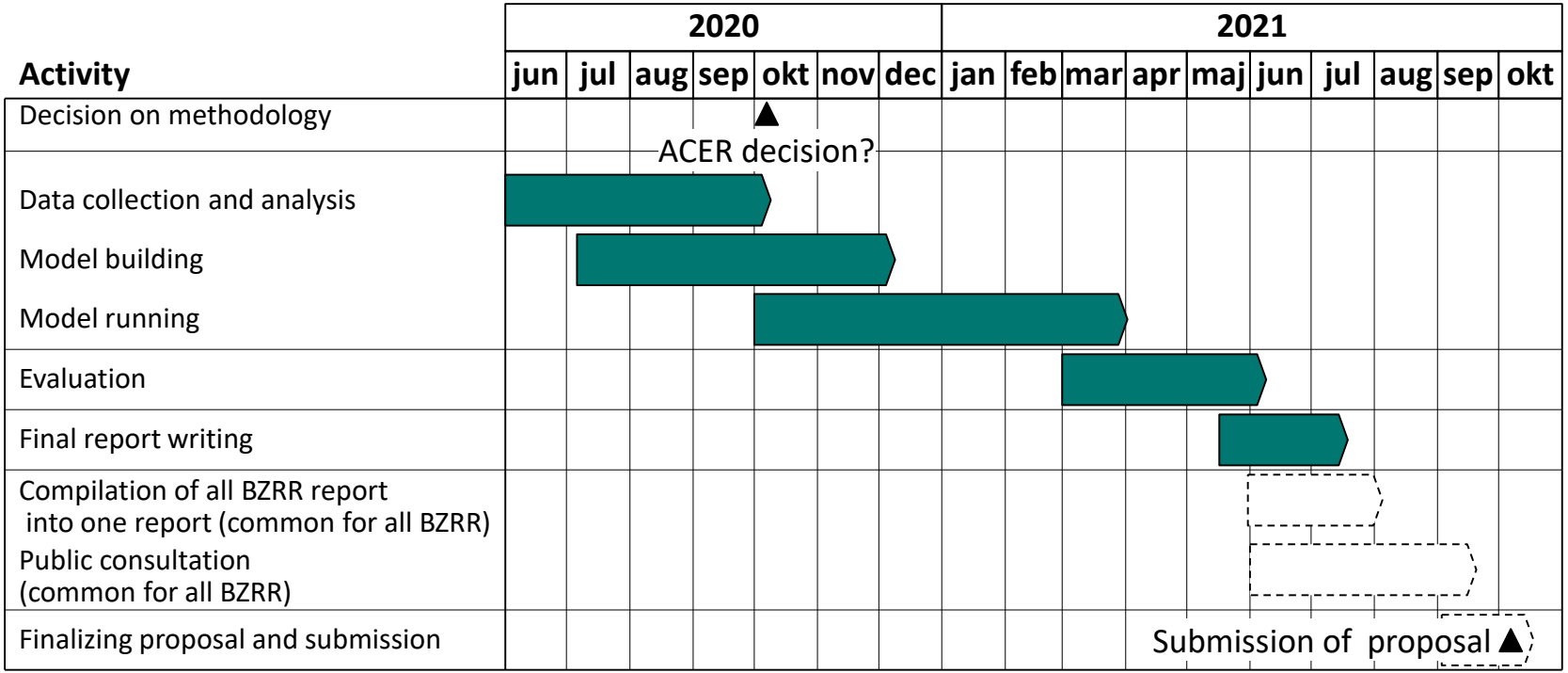
- The Nordics have a long tradition of bidding zones
  - Bidding zone reviews have been done before on national level
- Background - the revised electricity regulation (943/2019)
  - All relevant transmission system operators shall submit a proposal for the methodology and assumptions that are to be used in the bidding zone review process and for the alternative bidding zone configurations to be considered
  - The review will be performed on a regional level
  - Bidding zone borders shall be based on long-term, structural congestions in the transmission network
- The Nordic TSOs have taken part in the development of the bidding zone review methodology



Nordic Bidding zone review – proposal for further investigation

- Norway
  - Splitting the NO4
- Sweden
  - Merging or amending current SE3 and SE4
  - Merging or amending current SE1 and SE2
  - The Stockholm Metropolitan Area constitutes a new BZ
- Denmark
  - No changes →Energinet do not see any significant challenges with meeting the 70% requirement
- Finland
  - No changes on BZ → sufficient availability of HVAC capacity for cross-zonal trading with internal investments and use of remedial actions as shown in ACER reports and ENTSO-E Technical report
  - Evaluation of including NO4-FI border in market coupling

Bidding zone review process – Preliminary time plan and next steps



Questions:

Bidding Zone Review Proces

KEY FOCUS IN DIGITALIZATION IN THE POWER SYSTEM

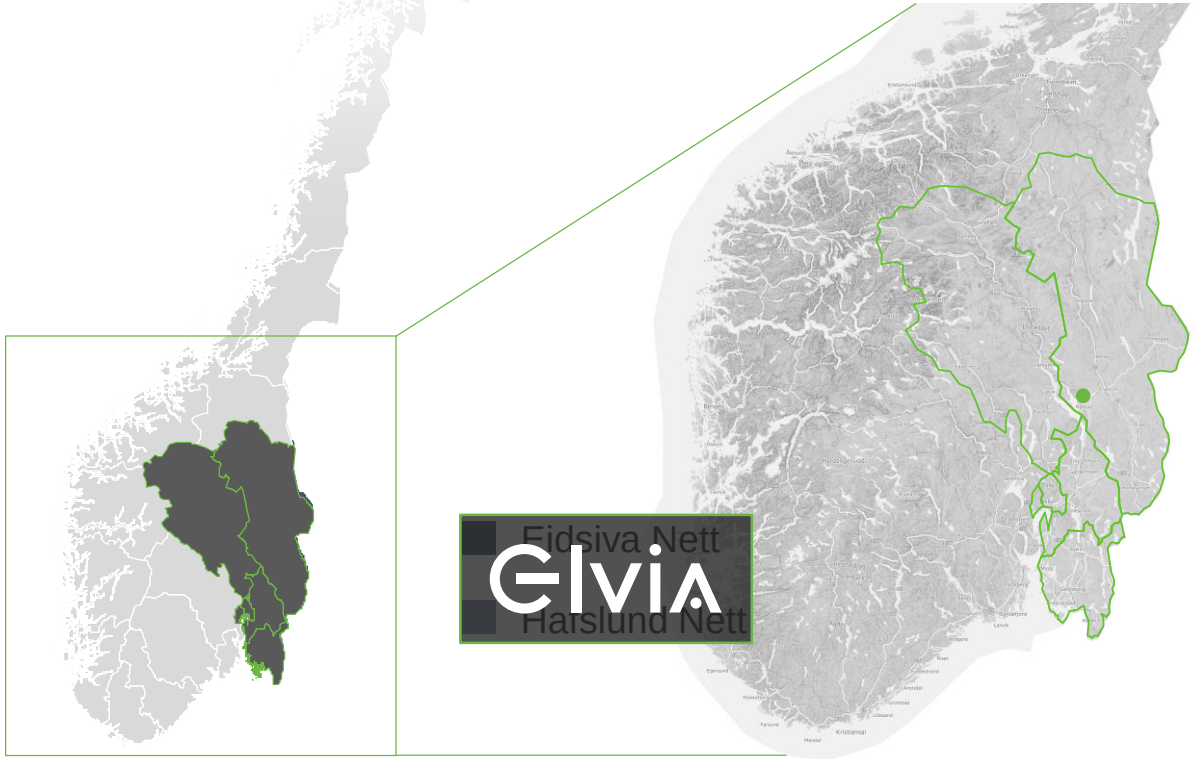
Jon Andreas Pretorius

CIO, Hafslund NETT

Key focus in digitalization in the power system

Jon Andreas Pretorius, CIO

Elvia is the result of an ongoing merger

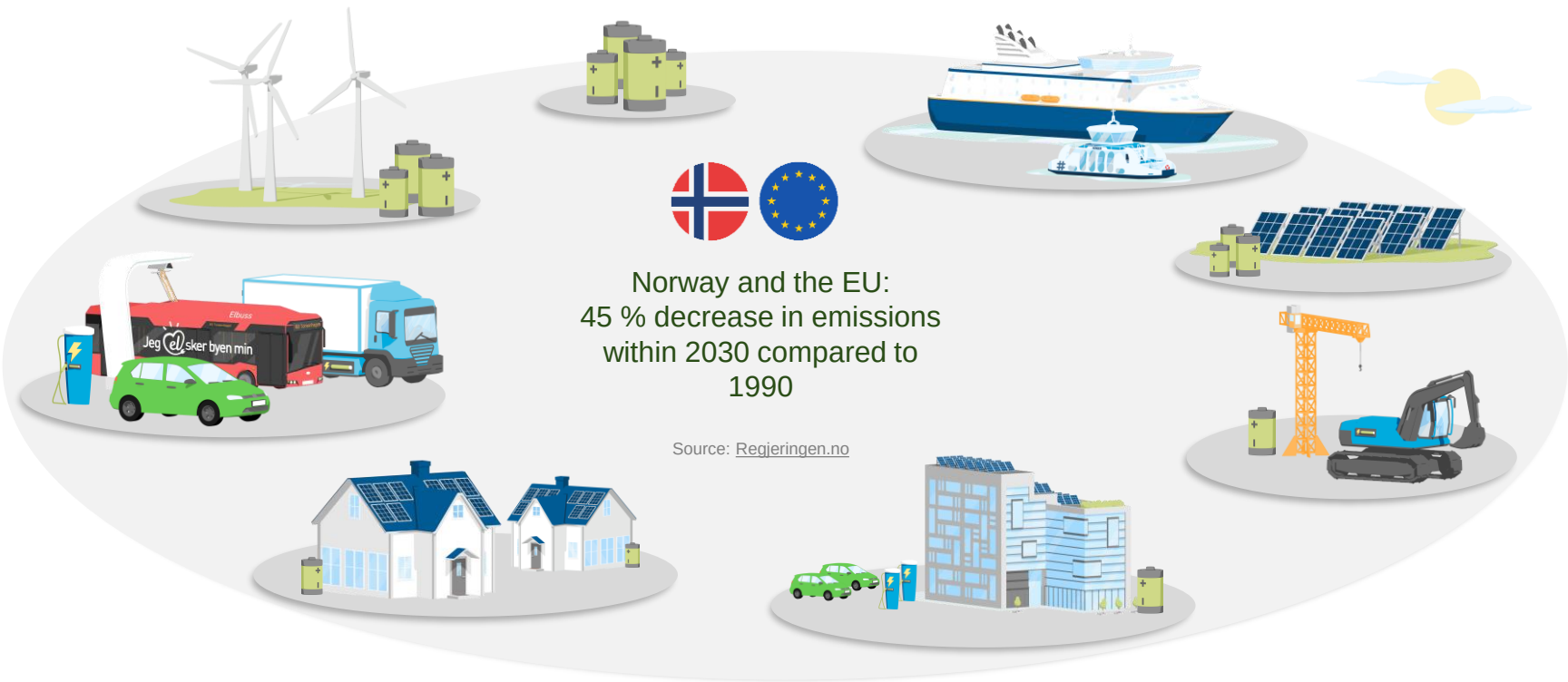


The most efficient DSO in Norway

Employees	822
Customers	915 000
Annual customer growh	10 000
Annual investments	2 Bn NOK
Revenue	7,5 Bn NOK
Energy delivered	30 TWh
Length HV grid	65 600 km

Elvia

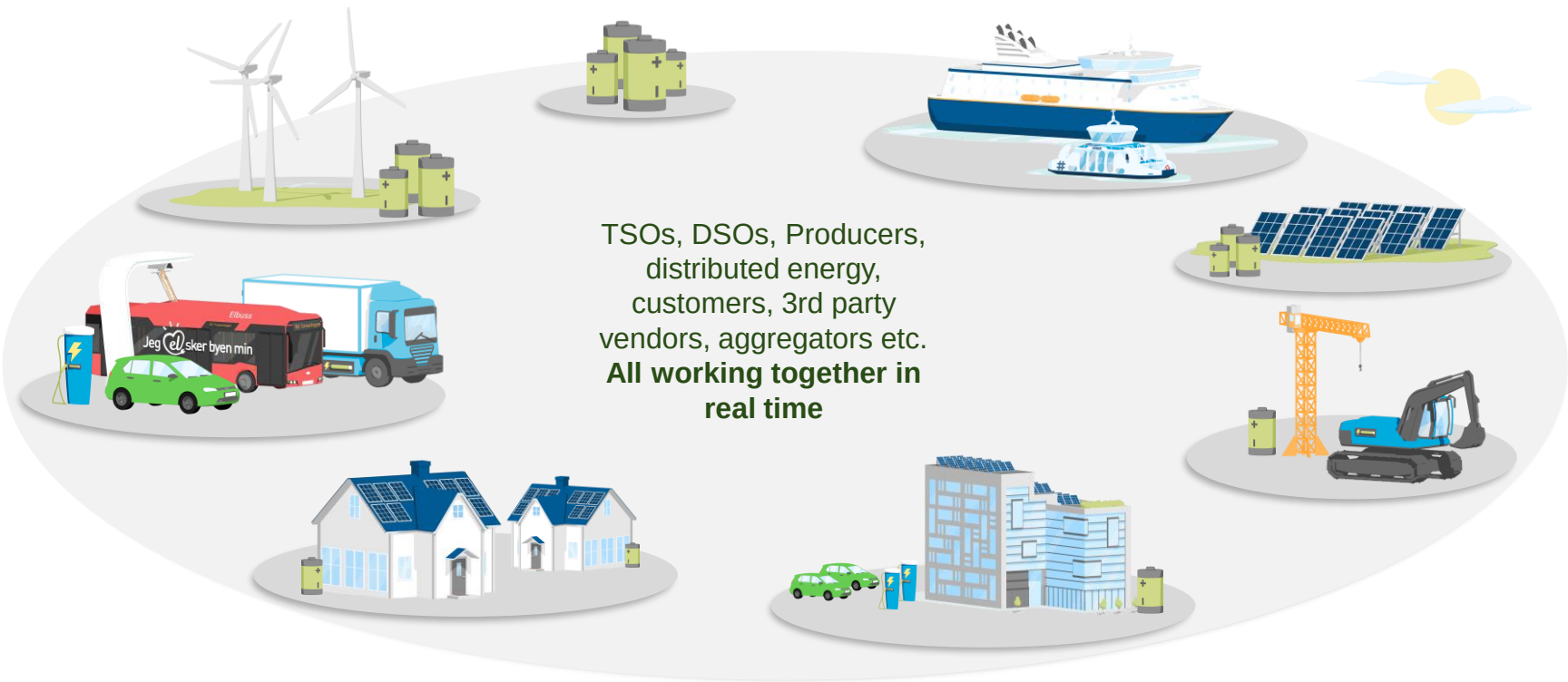
Climate commitments sets new requirements to the distribution systems



Norway and the EU:
45 % decrease in emissions within 2030 compared to 1990

Source: Regjeringen.no

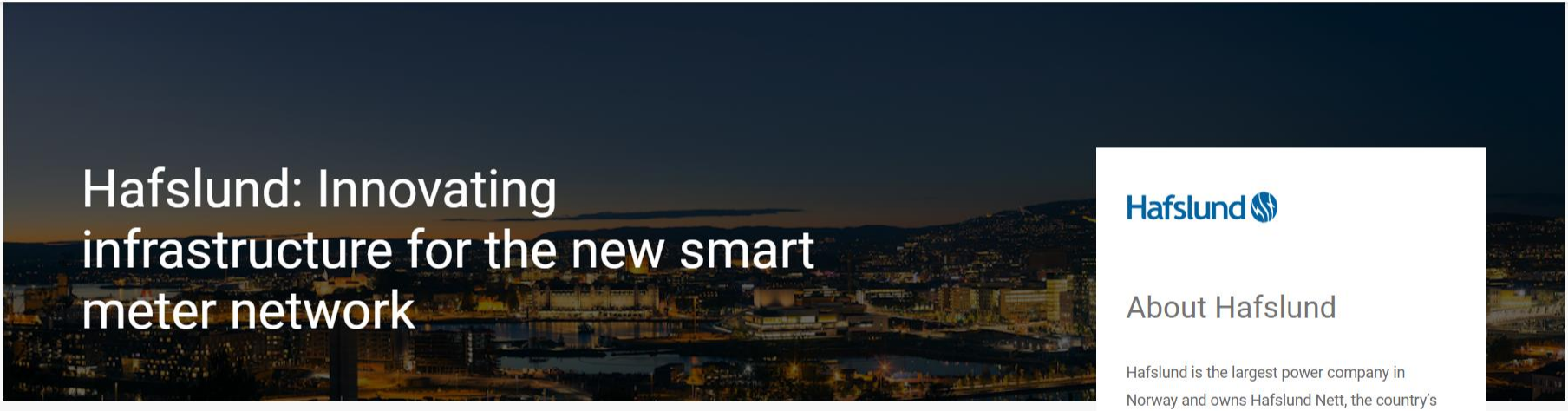
The future solutions demands eco systems, partnerships and continuous sharing of high quality data and information



TSOs, DSOs, Producers, distributed energy, customers, 3rd party vendors, aggregators etc. **All working together in real time**

The future demands digitalization

The distribution industry is not ready



Hafslund: Innovating infrastructure for the new smart meter network

When Norway introduced compulsory smart meters, Hafslund, the country's largest power company, met the new, complex data challenge with a solution built on Google BigQuery, Google Cloud Bigtable, and Google Cloud Platform.

Hafslund

About Hafslund

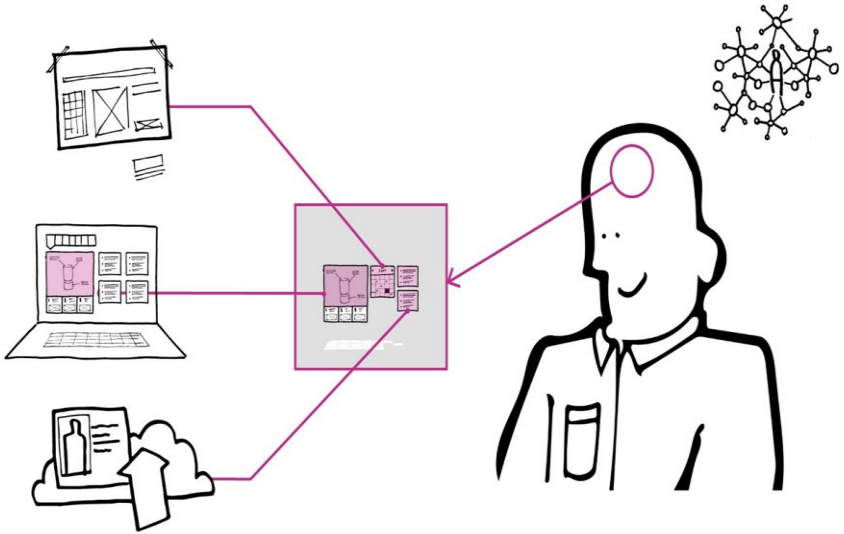
Hafslund is the largest power company in Norway and owns Hafslund Nett, the country's largest grid company, supplying more than 700,000 customers.

Industries: Utilities

Location: Norway


IT is no silver bullet
«but modern IT is a necessity»

Step 1 ; *reshape the organization, end to end processes, controlling structures, and competence*



Our organizations are the greatest and hardest obstacle on our way to become a digital business and things like

- existing processes (based on yesterday)
- existing organizational structures (silos)
- existing controlling structures (anti agile)
- existing mindset (this is how we always has done it)
- existing data quality (good enough for today)
- existing IT organization (tomorrow: less infrastructure, more business development supporting business organizations)

are working against a digital success every day

Step 2 ; *Commoditized IT infrastructure where possible, and gain technology flexibility by using Cloud Computing (mainly PaaS and SaaS)*

Automation

All cloud vendors **supports full life cycle automation of services running on the platform**, something less available on on-prem solutions. To be specific this means "infrastructure as code", **state based text files describing wanted state on the platform.**

Scaling

Most **services in the cloud supports scaling**, and it is possible to scale without re-installing or down time. A lot of services supports automated dynamic scaling

Security

Cloud platforms is because of size itself depended on heavy standardization and industrialization. The vendors invests lot of money yearly to secure the services and the platform itself . Because of this **services running on standardized cloud platform will be more secure compared to local on-prem solutions**

Innovation

For example, if you have an idea using data from the smart meters to automate fault handling, it is **fast, easy and cheap to test the hypothesis in cloud where infrastructure can be available in minutes** and removed right away after use.

SCADA soultions and other regulated areas must be isolated to secure compliance, and to not slow down other areas who can run on cloud technology. The industry and the regulators should work togheter on future regulations, in our opinion cloud computing is more secure than on-prem soulutions if it is done the right way

Elvia

Step 3 ; Long term strategy: *replace old specialized legacy applications with new standardized and modular applications, and tear apart the old rickety integration platform(s)*

Focus on non functional requirements when procuring

As long as you have flexibility you will always be ready for tomorrow

Simplify

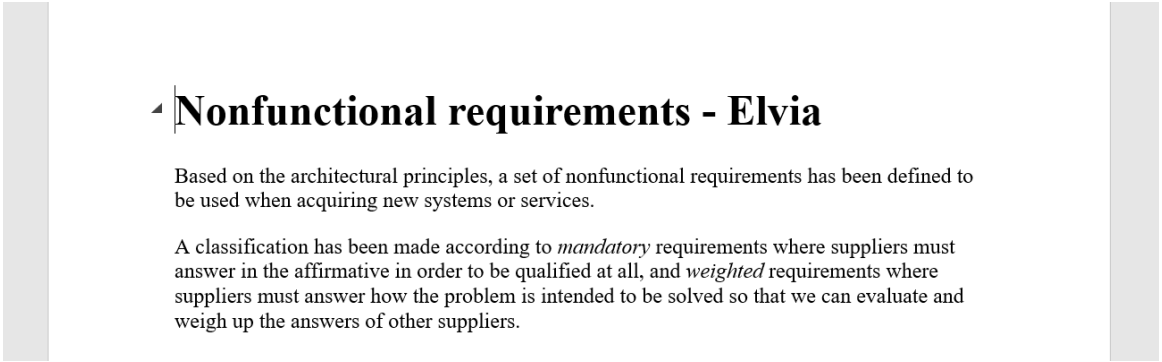
Being special is expensive, no point being special if you do not need to. Special solutions needs to be isolated, and for that you need another architecture

Think modular

Break big complex software into smaller pieces. It is very comfortable to go from 3 expensive potential vendors to 20 best of breed vendors.

Take ownership

Data driven architecture, data modelling and modern integration is not something you buy, it is something you do and own with clear internal ownership



Nonfunctional requirements - Elvia

Based on the architectural principles, a set of nonfunctional requirements has been defined to be used when acquiring new systems or services.

A classification has been made according to *mandatory* requirements where suppliers must answer in the affirmative in order to be qualified at all, and *weighted* requirements where suppliers must answer how the problem is intended to be solved so that we can evaluate and weigh up the answers of other suppliers.

Elvia

Step 4; *Use data and information to automate, visualize, streamline, innovate, share, predict and become a true actor in the future energy eco system*

Pushed to the extreme: we will not succeed with this step without doing the former steps first.

A bit more moderate, there will always be areas this can be done isolated in for learning, but if this is the only thing we focus on it will be «smoke and mirrors»

Overview

STEP	COMPLEXITY	VALUE BY ITSELF
Step 1: Reshape existing organization	HIGH	HIGH
Step 2: Commoditized IT infrastructure	MEDIUM	LOW
Step 3: Standardized and modern applications	MEDIUM	MEDIUM
Step 4: Innovate	MEDIUM	NA

The value of doing this three steps in parallel is the great leap we are looking for, and initiates the last step or the new state

We tend to start with step 4, by our self or by having vendors talk us into it. We need to roll up our sleeves and start working on step 1 at the same time as working on step 2 and 3


Elvia
Thank you!

Questions:

Key Focus in Digitalization in the Power System

Break – 10 min

KEY FOCUS IN MARKET DEVELOPMENT

Petteri Haveri

Advisor, Finnish Energy Association

Key focus in market developments

Petteri Haveri, Finnish Energy

Finnish Energy

Finnish Energy

Future’s (today’s) electricity system - complex

And there’s not much we can or should do about it

- The share and amount of renewable generation is increasing, and the customers are learning to react on electricity prices
  - Intermittency
  - Predictability

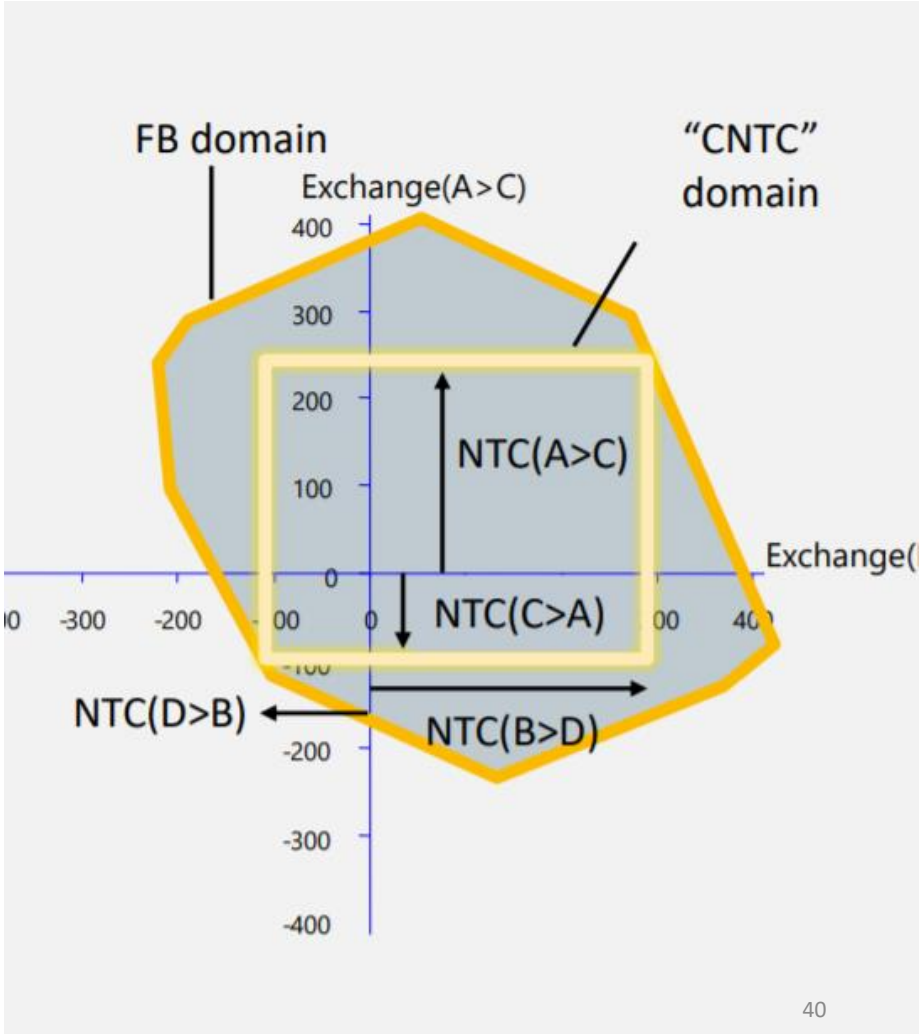
However, we can avoid additional complexities and provide tools for the markets to better cope up with the inbuilt complexities

The TSOs have responsibility for maintaining the system secure, but overly control causes complexities for the TSOs and for the markets

Flow based - complex

Should be a methodology for improving capacity calculation and enabling more transmission capacities for the markets

- However, big worries that it is evolving towards a black box which moves internal congestions on borders, detoriates intraday-trading and which eventually nobody understands
- There's, however, still time to improve the methodology to fit for purpose and test it properly



Markets are getting more complex

Many products, all with different requirements, different pre-qualification processes among products and among connecting TSOs, differing bidding rules

Where and how should offer my resources and flexibilities?

In short

- Ensure that capacity calculation delivers, and that it's understandable. Additional complexcities, such as considering BZ's internal congestions, add complexities
- Instead of creating new products and markets, consider what could be achieved with existing and how to get more participants
  - Bidding rules
  - Understanding
  - Reasonable and harmonized pre-qualification processes
- Give market participants tools to manage their balances and to support the system when needed
  - Tranparency on price formation
  - Trading until the start of delivery perios
- From national to Nordic and European

Finnish Energy

Questions:

Key Focus in Market Development

OPPORTUNITIES IN INDUSTRY CARBON REDUCTION

LARGE SCALE HYDROGEN CASE STUDY

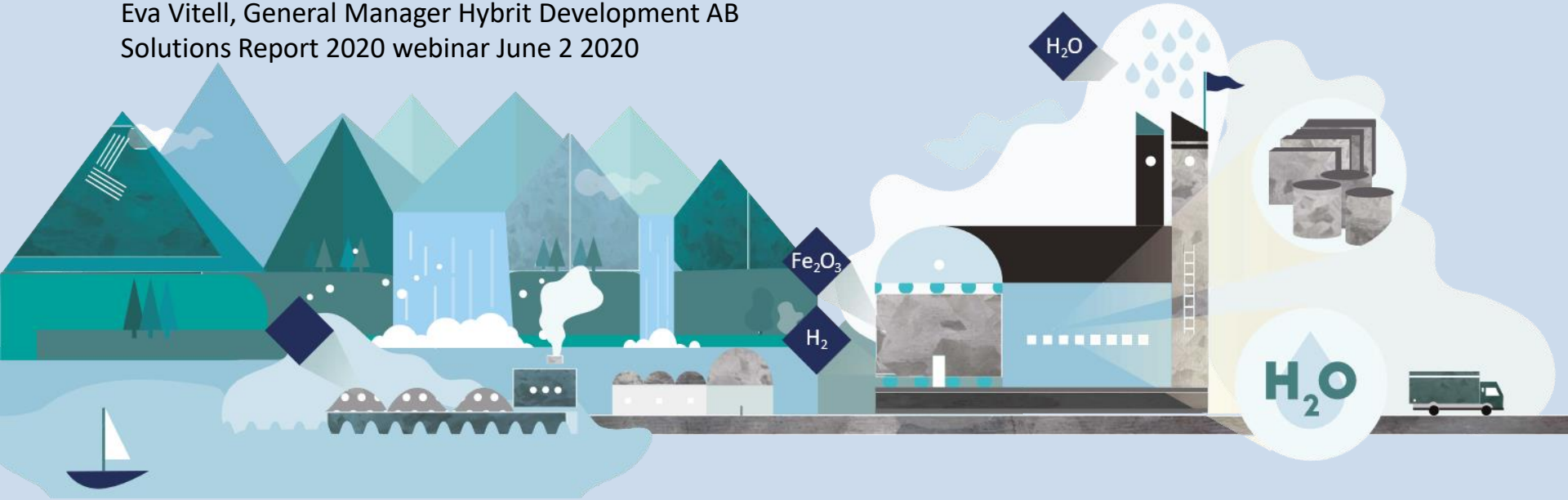
Eva Vitell

General Manager, Hybritt Development AB

The HYBRIT-initiative - towards fossil free steel

HYBRIT
FOSSIL-FREE STEEL

Opportunities in industry carbon reduction – large scale hydrogen case study
Eva Vitell, General Manager Hybrit Development AB
Solutions Report 2020 webinar June 2 2020



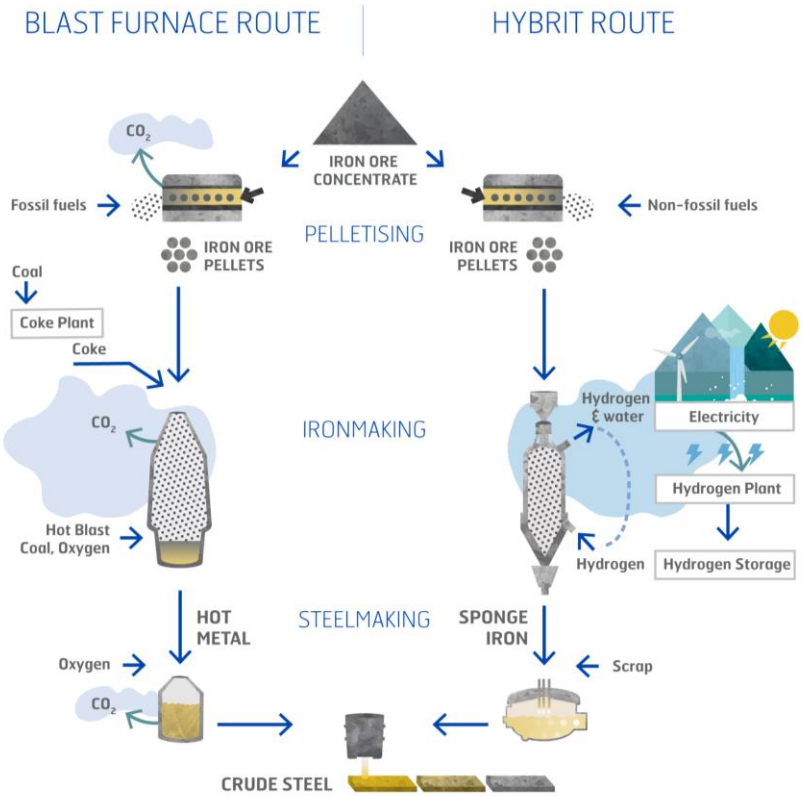
The worlds first fossil free steel making technology, with virtually no carbon footprint!

A value chain transition

Per tonne of crude steel

1,600 kg CO_2

235 kWh electricity



25 kg CO_2

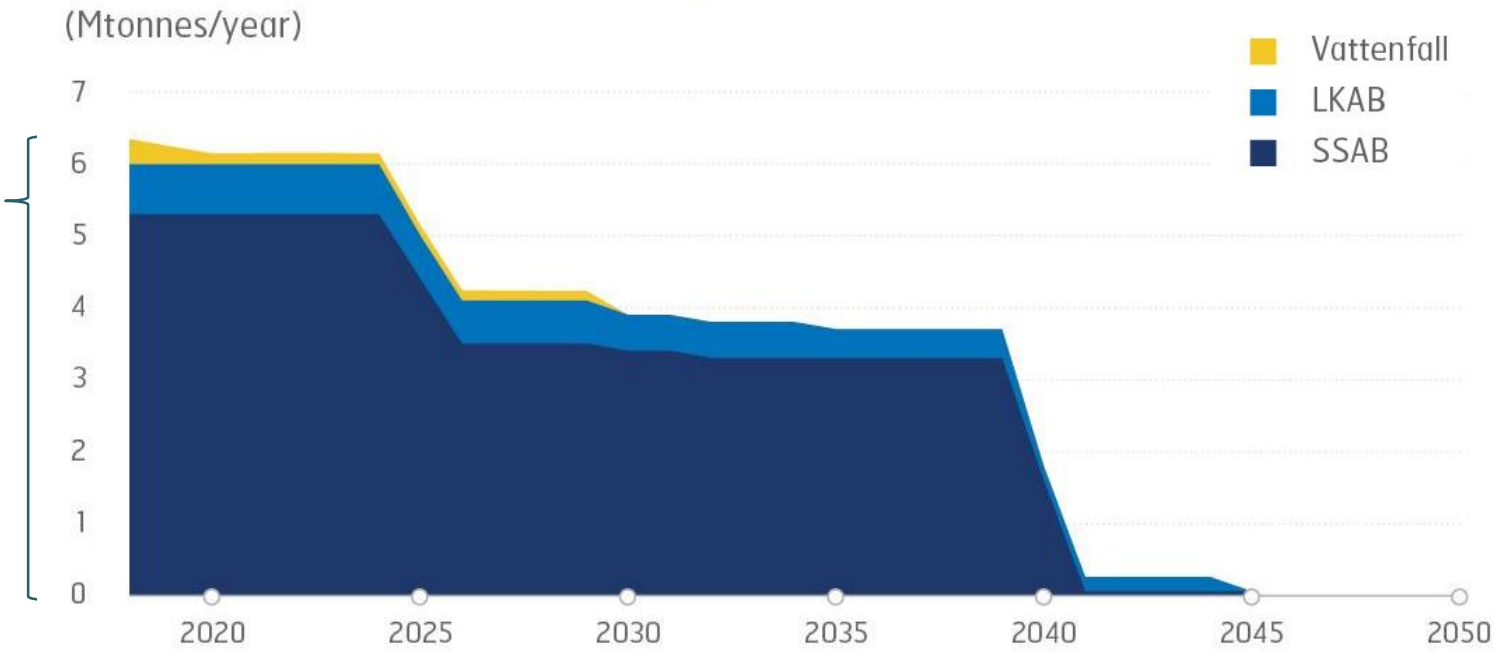
3,488 kWh electricity

2020-06-01

48

Aiming to reduce 10 % of Sweden's CO_2

10% of Sweden's total CO_2 emissions



Pre-feasibility study

2016 – 2017

2016
Prefeasibility study and four year Research & Development project with support from the Swedish Energy Agency

Feasibility Study Pilot plant trials

2018 – 2024

2018–2021
Fossil free pellets trials in Malmberget

2020–2024
Hydrogen based reduction and melting trials at Pilot plant in Luleå

2021/22–2024
Hydrogen storage trials in Luleå

2022
Construction to start for HYBRIT Demonstration plant

Demonstration and Transformation

2025 – 2040

2025
HYBRIT Demonstration plant operational - first fossil free steel on market by 2026

2025-
Transformation of LKAB's pellet plants

2025
Transformation from blast furnace to electric arc furnace at SSAB Oxelösund

2030-2040
HYBRIT Industrial plants (No. 2, 3, …)

2030 - 2040
Transformation to electric arc furnace at SSAB Raahe and Luleå

2045

SSAB, LKAB, Vattenfall
Fossil-free value chain

HYBRIT Demonstration plant

- First industrial scale production facility
- High-paced timeline
  - Localization decision 2020
  - Construction start 2022
  - Plant operational 2025
- Next step – localization and permits


HYBRIT
FOSSIL-FREE STEEL

Questions:

Opportunities in Industry Carbon Reduction

CLOSE AND WRAP-UP

Hanne Storm Edlefsen
Director, Energinet

Close and Wrap-up

- The webinar will be posted on the events page for 180 days.
- An evaluation form has been emailed to you. Please fill it out and email it to us, so we can continue to improve the proces.
- We maintain an information list for future events and reports. If you would like to join the mailinglist, please send an email to **AFA@energinet.dk**

THANK YOU