



Offshore Wind in
Denmark
Columbian
Delegation
12 October 2021

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Chief adviser at the Danish Energy Agency

Agenda

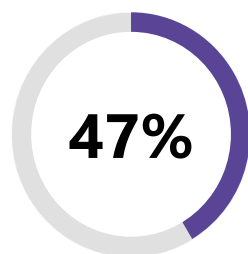
Introduction to offshore wind in Denmark

1. Targets and drivers for the green transition in Denmark
2. Current status
3. Auction model
4. One stop shop
5. Questions and AoB

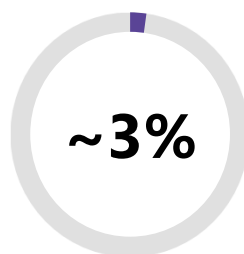
Denmark is a role model for green transition

RESULTS

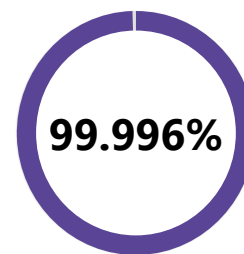
WIND POWER IN
POWER
CONSUMPTION*



WIND POWER
CURTAILMENT



SECURITY OF
SUPPLY



TARGETS

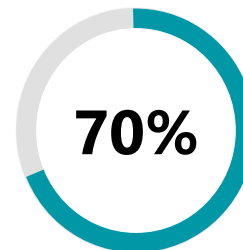
GREEN POWER
IN 2030



CLIMATE
NEUTRALITY IN
2050



GHG
REDUCTION IN
2030

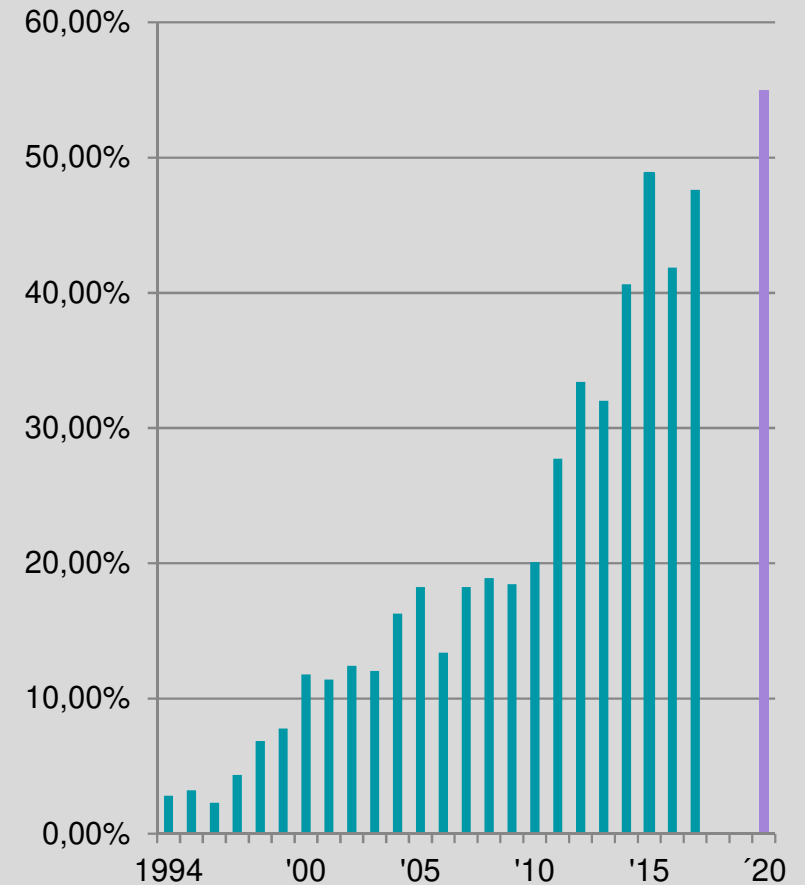


Offshore Wind Development in Denmark

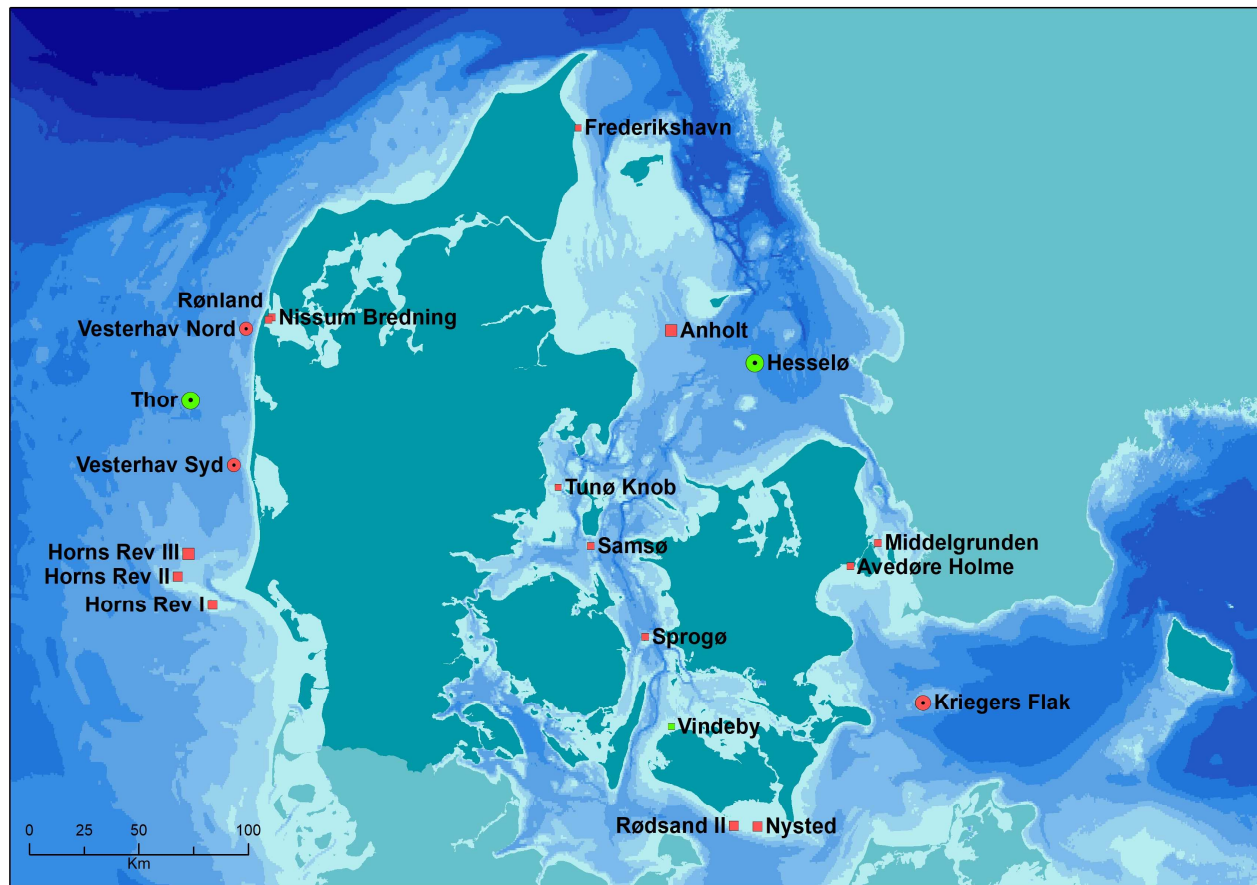
25 years of experience

- **1991:** First Danish offshore wind farm Vindeby (5 MW)
- **2011:** 868 MW offshore capacity
- **2019:** ~ 1,700 MW offshore capacity including 28 MW R&D
- **2021:** ~ 2,3 MW offshore capacity
- **2027:** 2 new large-scale offshore wind farms for an additional capacity of up to 2,000 MW
- **~2032:** 2 energy islands connected to 5,000 MW of offshore wind farms

Wind Power Generation % of Danish Power Production

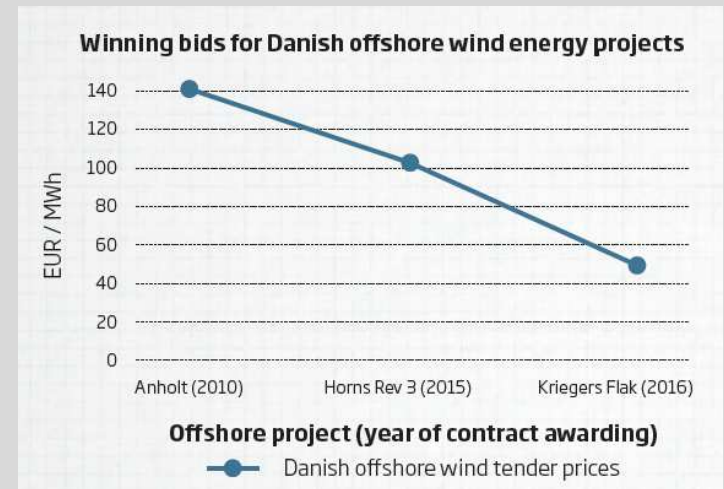


Offshore wind farms in Denmark



DE-RISKING is the key word

Denmark has been able to reduce the Levelized Cost of Energy (LCOE) of offshore wind by **de-risking** as much as possible the development of offshore wind projects

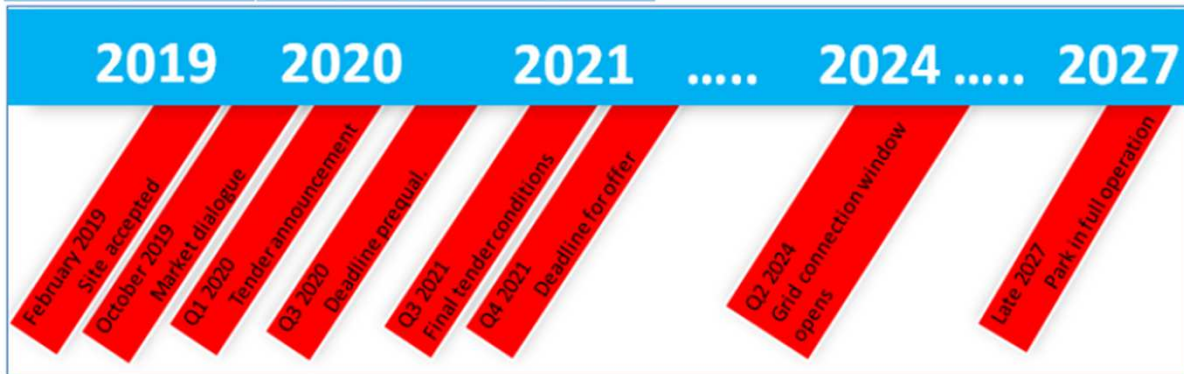


Anholt: 400 MW (2010)
EUR 141/MWh
Horns Rev 3: 400 MW (2015)
EUR 103.1/MWh
Kriegers Flak: 600 MW (2016)
EUR 49.9/MWh

The ongoing tender for Thor offshore wind

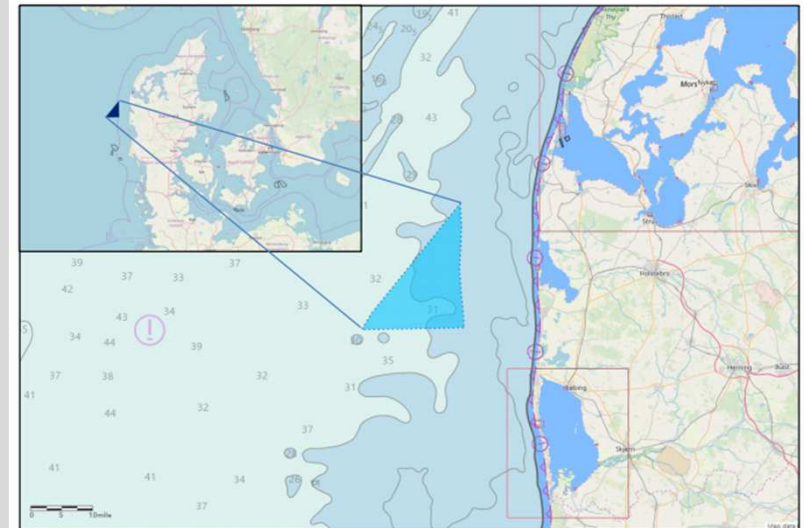
1,000 MW in the North Sea

Preliminary time table for the first offshore wind farm, Thor



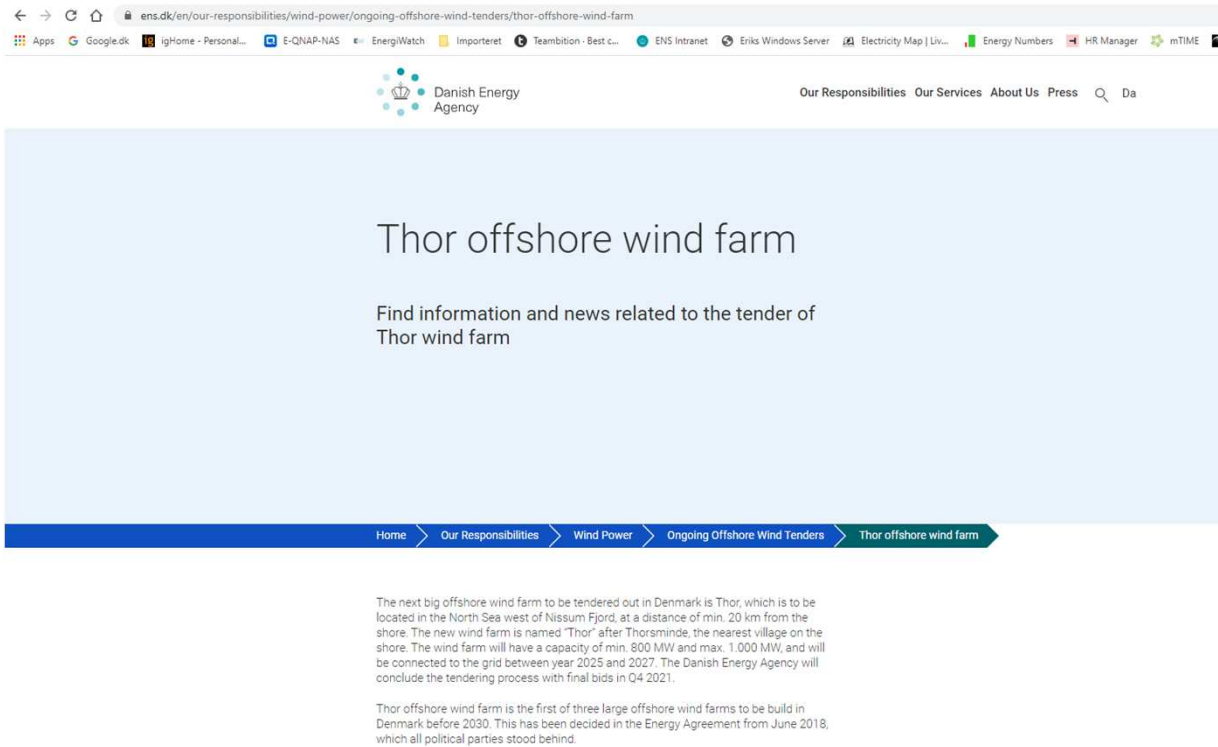
Location of the site

Based on preliminary screening and site-investigations, it has been decided that Thor should be built in the North Sea west of Nissum Fjord, min. 20 km from the shore of Jutland.



440 km² is undergoing site investigation;
286 km² is the tendered site size

Ongoing tender for 1,000 MW Thor



The screenshot shows a web browser window with the URL ens.dk/en/our-responsibilities/wind-power/ongoing-offshore-wind-tenders/thor-offshore-wind-farm. The page header includes the Danish Energy Agency logo and navigation links: "Our Responsibilities", "Our Services", "About Us", and "Press". The main content area features the title "Thor offshore wind farm" and the subtitle "Find information and news related to the tender of Thor wind farm". A breadcrumb trail at the bottom of the content area reads: "Home > Our Responsibilities > Wind Power > Ongoing Offshore Wind Tenders > Thor offshore wind farm".

The next big offshore wind farm to be tendered out in Denmark is Thor, which is to be located in the North Sea west of Nissum Fjord, at a distance of min. 20 km from the shore. The new wind farm is named "Thor" after Thorsminde, the nearest village on the shore. The wind farm will have a capacity of min. 800 MW and max. 1.000 MW, and will be connected to the grid between year 2025 and 2027. The Danish Energy Agency will conclude the tendering process with final bids in Q4 2021.

Thor offshore wind farm is the first of three large offshore wind farms to be build in Denmark before 2030. This has been decided in the Energy Agreement from June 2018, which all political parties stood behind.

www.ens.dk/thor

www.ens.dk/hesselo

The Danish tender process

1. Site selection

Maritime Spatial Planning from rough mapping to fine screening

2. Preliminary studies

- Strategic Environmental Assessment
- Metocean surveys (wind, wave, current)
- Geo investigations

3. Technical dialogue

Transparent dialogue and negotiation with potential bidders

4. Pre-qualification

- Financial and technical pre-qualification requirements to participate in the final bid
- No local content requirement

5. Tender award

Lowest price per kWh is the **only** final award criterion



The One Stop Shop

What is the Danish One-Stop-Shop?

”

The One Stop Shop is an administrative procedure in which the Danish Energy Agency is the single authority responsible for the development of offshore wind projects: the DEA coordinates with all relevant authorities to grant the necessary permits.

Why a One-Stop-Shop?



Clear, transparent, smooth consenting process

→ Developers: Creating confidence by reducing risks & uncertainties

→ Other authorities: Better understanding of the projects

Main involved authorities (1)

ENERGINET
Transmission System
Operator (TSO)

- Grid connection
- SEA
- Metocean surveys
- Geo investigations

Danish Nature
Agency

- SEA
- Approval of local plans for grid connection on land

Danish Working
Environment
Authority

- HSE requirements

Danish Transport,
Construction and
Housing Authority

- Air Traffic

Danish Business
Authority

- Potential conflicts of interest

Main involved authorities (2)

Maritime Authority

- Shipping activities
- Wind farm marking

Danish Coastal Authority

- Coastal protection
- Sand dune conservation zones

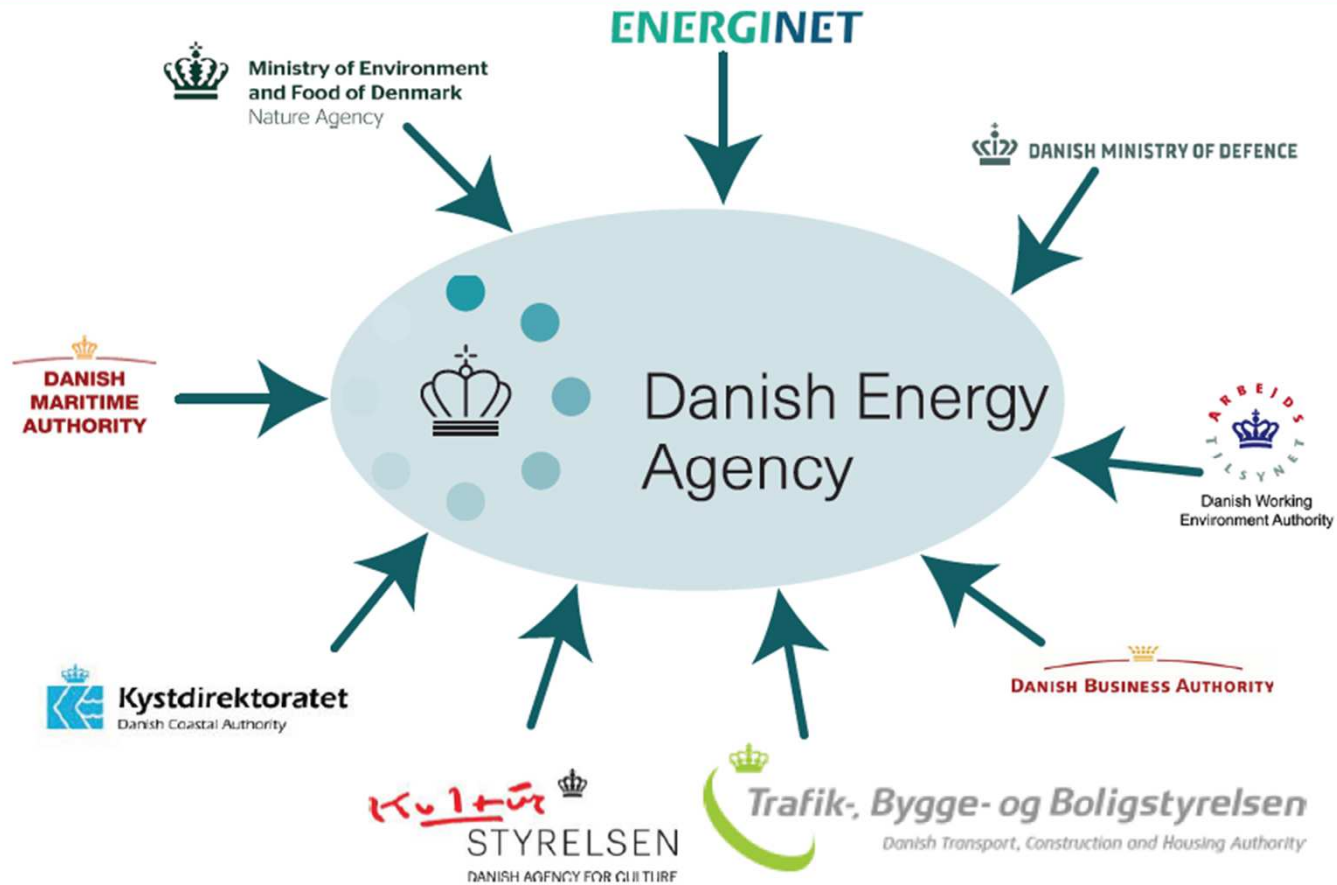
Danish Culture Agency

- Heritage areas
- Shipwreks

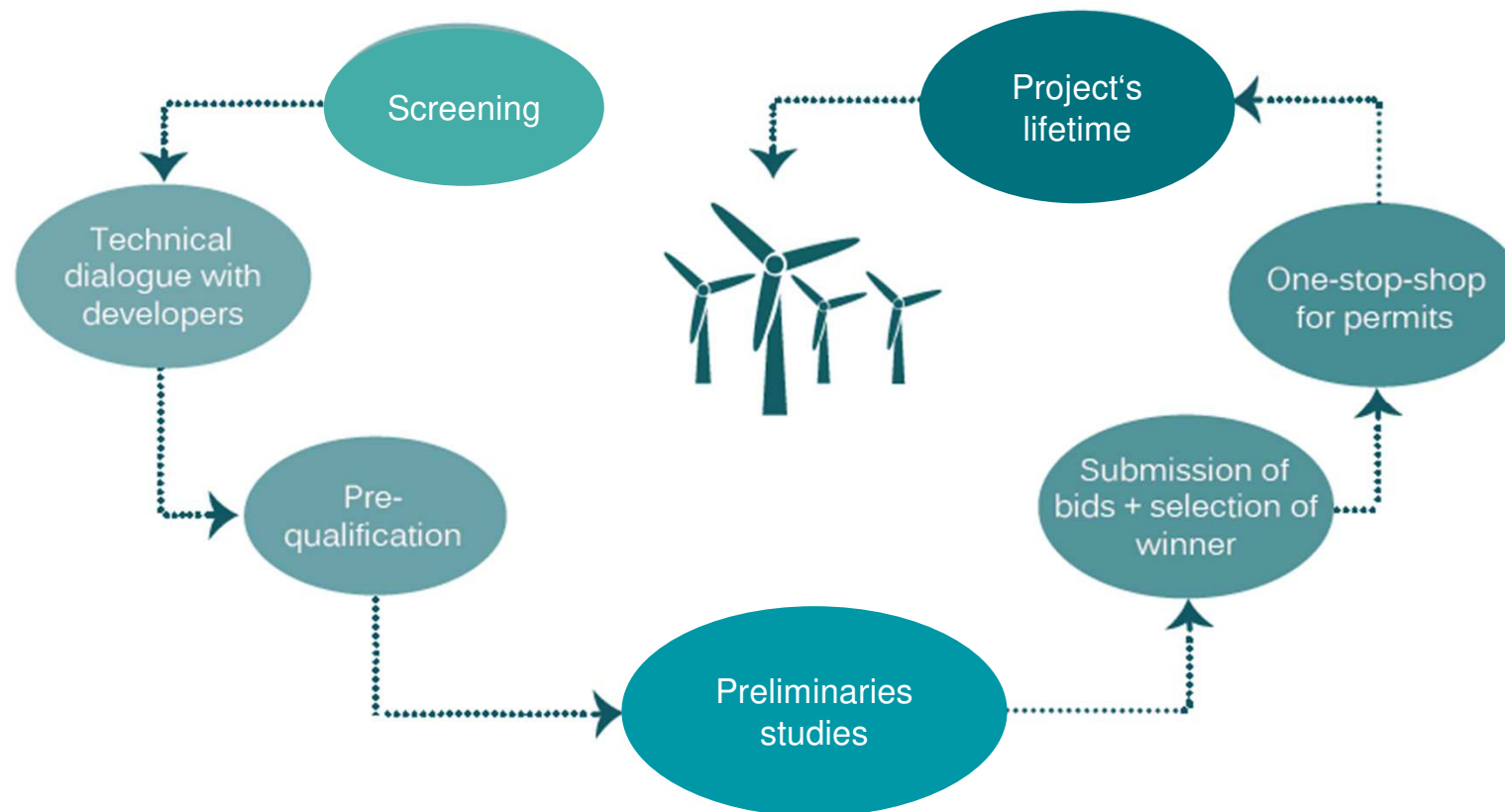
Danish Ministry of Defence

- UXO
- Military Air Traffic

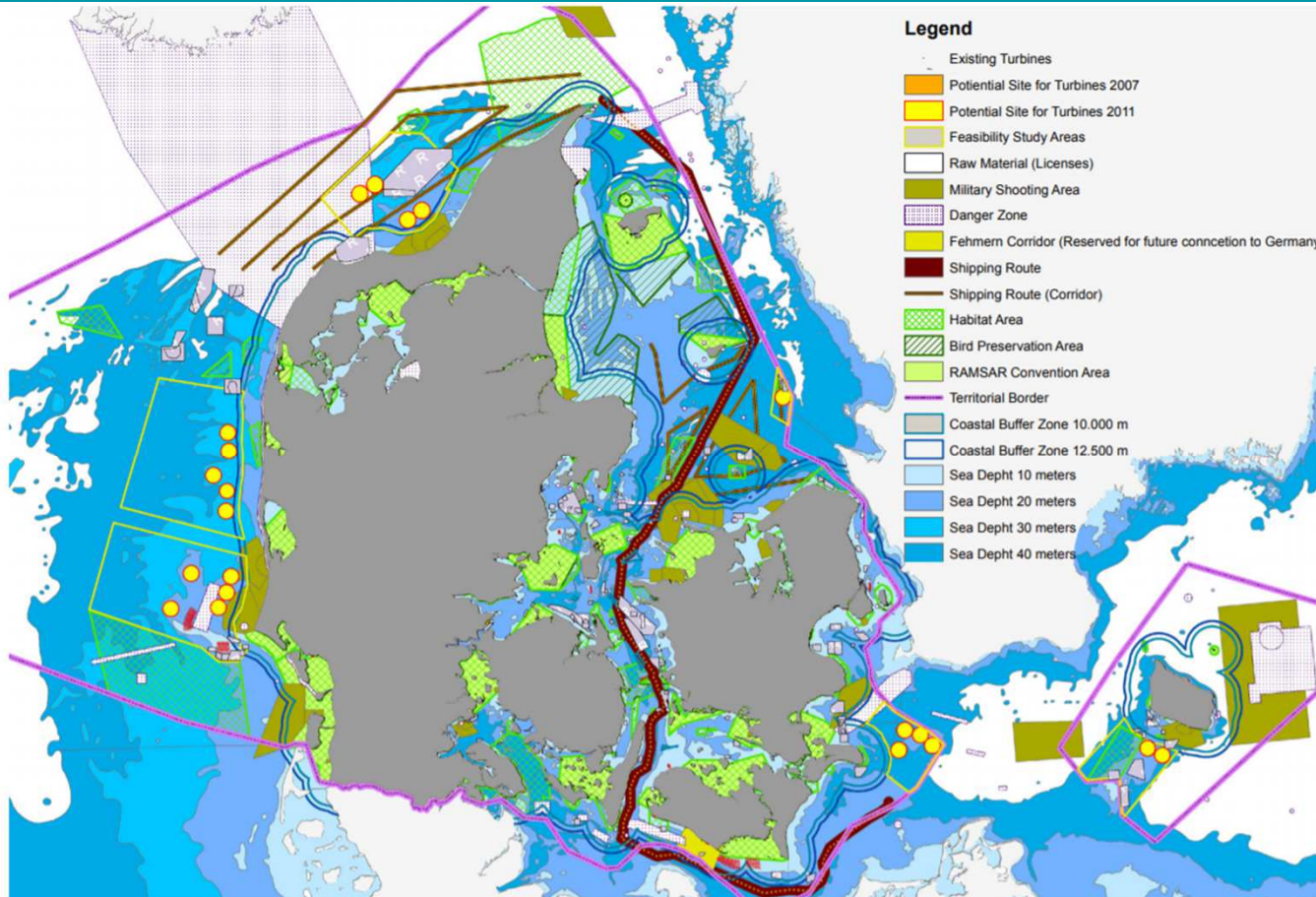
The key is communication!



One-Stop-Shop Consent Procedure



1 - Screening



2 - Market dialogue

- Timetable for the tendering process
- Conditions for pre-qualification
- Award criteria and financial terms
- Compliance penalties
- Environmental assessment
- Issues related to the grid connection
- ...

3 - Prequalification

Technical capacity



- References that demonstrate experience
- Planning, design, construction methods, procurement, quality control, etc.

Financial capacity



- Turnover requirements
- Financial statements
- Equity/debt structure

Prequalification

Minimum requirements (for 600MW)

Example:
Kriegers Flak



Financial Capacity

- Annual turnover of minimum 2.3 billion USD as an average for the last 3 years, and
- Equity-ratio of 20% **or** long debt rating BBB (Standard & Poors and Fitch) or Baa3 (Moody's)



Technical Capacity

- Documented experience in development and management of construction of at least one offshore wind farm of 150 MW (project completed)

4 - Preliminary surveys (coordinated by the Transmission System Operator)

Environmental surveys

- Complete SEA before bidding
- Greatest conceivable environmental impact

Metocean surveys

- Wind, wave and current conditions
- Understanding of the local conditions (design)
- Viable financial business case

Preliminary geo investigations

- Geophysical & geotechnical surveys
- Understanding of the local seabed conditions (design)

Unexploded Ordnances (UXOs)

- Unexploded mines and bombs from the World Wars
- Safety

6 - Permitting

1. License to carry out preliminary investigations (with Concession Agreement)
2. License to establish offshore wind turbines (with Concession Agreement)
3. License to exploit wind power for 25 years
4. Approval for electricity production in compliance with the electricity supply legislation

7 – Project's lifetime

The DEA must be consulted in case of major decisions:

- Sale of the project
- Change of components
- Incident
- Decommissioning
- Etc...





Public acceptance
towards wind power
in Denmark

Wide support for wind development...

Over 90% of the Danes are in favour of the expansion of wind power in Denmark

- Broad political support
- Long tradition for local ownership
- Involvement of stakeholders at very early stages
- Public participation in the decision making process

The visual disamenities are the most studied impacts



- *Preference for offshore wind farm located further than 18km from shore*
- *Evaluation of potential visual disamenities in EIA*

The former community engagement instruments (Renewable law of 2009)

Loss-of-value scheme



Compensation for value loss on properties in the vicinity of the wind turbines.

Option-to purchase scheme



The developer must offer at least 20% of the share of the project to local residents.

Guarantee scheme



A dedicated Guarantee fund provides a guarantee to local cooperatives for preliminary investigations.

Green scheme



Financing to municipalities for enhancing the landscape and the recreational values of wind projects.

Starting from 2020, 5 instruments to promote community engagement

Loss-of-value scheme



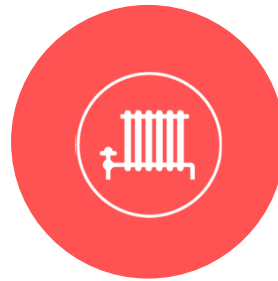
Compensation for value loss on properties in the vicinity of the wind turbines.

Sale-option scheme



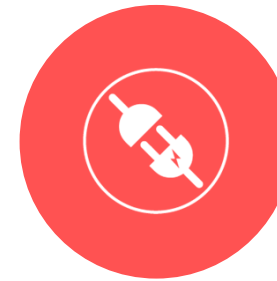
Local residents (within 4D-6D) can sell their house to the project developer, if the loss of value is higher than 1%.

Renewable -bonus scheme



Local residents (within 4D-8D) receive an annual tax-free compensation.

Guarantee scheme



A dedicated Guarantee fund provides a guarantee to local cooperatives for preliminary investigations.

Green scheme



Financing to municipalities for enhancing the landscape and the recreational values of wind projects.

Offshore and fisheries

„The Fisheries Act entitles the fishermen to a compensation for the loss of income due to the establishment of the wind farm, both during the construction and the operation phases.

- *The developer has to negotiate the compensation for documented losses with the Danish Fishermen's Association, and with individual fishermen if necessary.*
- *An impact assessment on fisheries is part of the EIA.*

Requirements are also imposed on underwater noise management during construction. The DEA assesses and approves the mitigation measures during the licensing process.

ENERGY ISLANDS



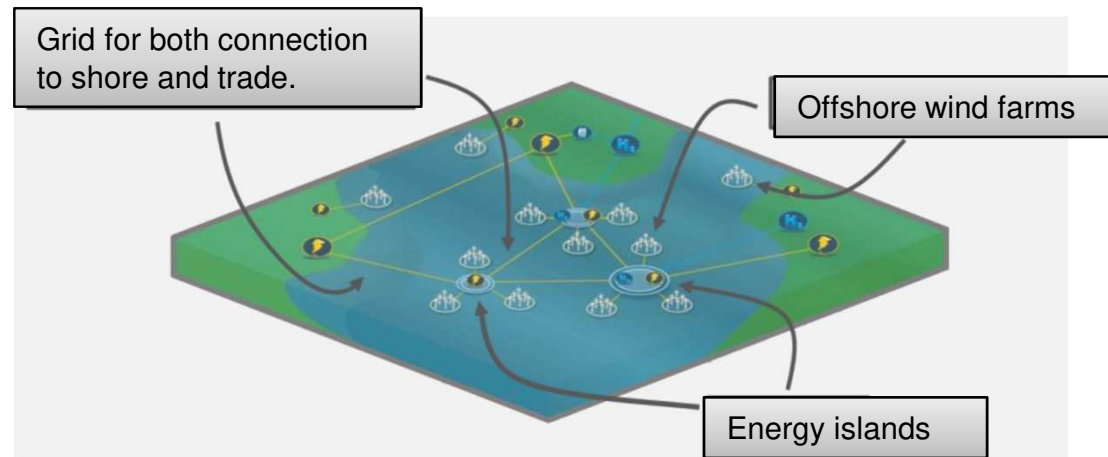
Energy Islands as
accelerator for
tomorrow's offshore
wind power
– increasing the
European
interconnection

Danish Climate Plan June 2020: The worlds first energy islands

- Danish Climate Plan June 2020: key component to build two energy islands with a minimum capacity of 5 GW. Can be expanded to host 10 GW
- The energy islands will be placed in the North Sea and by the Danish Island of Bornholm in the Baltic Sea
- Traditionally, offshore wind farms have been built as individual non-connected entities
- An energy island serves as a hub for electricity generation for the surrounding wind farms, by collecting and distributing the electricity between countries connected by an electricity grid

What is an energy island?

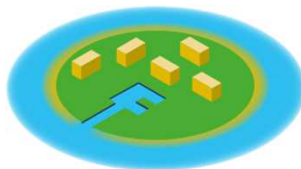
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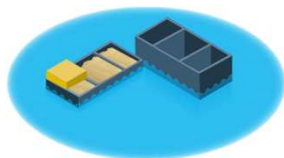
Island construction

North Sea hub

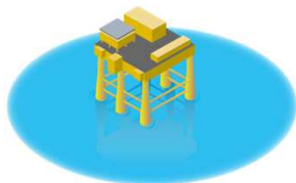
– Three options under consideration:



Sand island



Caisson island



Platforms

Baltic Sea hub

– Bornholm island as hub:

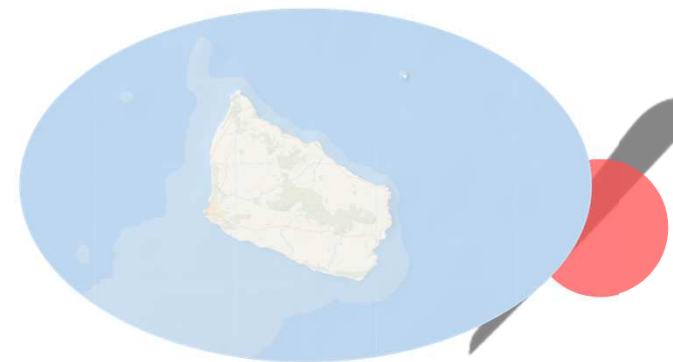


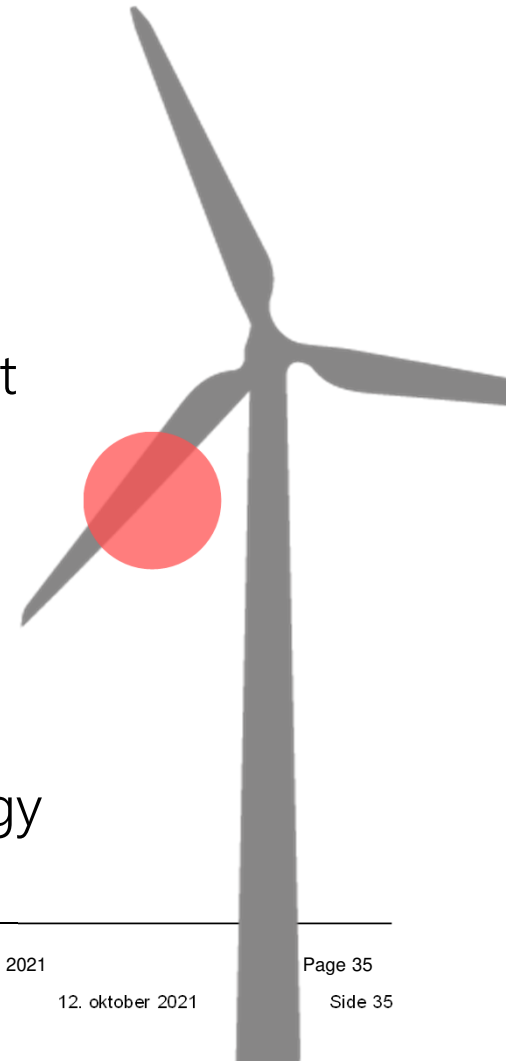
Illustration credits: North Sea Wind Power Hub

The vision of energy islands

- Offshore wind energy is at the core of how Europe can go carbon-neutral – playing a crucial role for the EU to reach climate neutrality by 2050
- Preparing to enter a new era of green energy production – a paradigm shift in the way we approach offshore wind power
- Intention to connect energy hubs with interconnectors to bordering countries and sector coupling through power-to-hydrogen conversion
- Step-by-step roll out of the energy hubs concept coordinates the international development of wind farm connections and interconnections to minimize the need for onshore grid reinforcements
- Cost-effective way to transport offshore wind energy and securing energy of supply

EU ambitions on offshore wind

- Deployment of offshore wind will play a key role in the green transition and decarbonizing of the European economy by 2050
- With European Green Deal the Commission has set the ambition to increase the EU's reduction target for 2030 to at least 50 % and towards 55 %
- Commission estimates the need for between 240 and 450 GW of offshore wind capacity to reach climate neutrality by 2050
- Great focus on offshore wind – EU Offshore strategy to be launched by October 2020

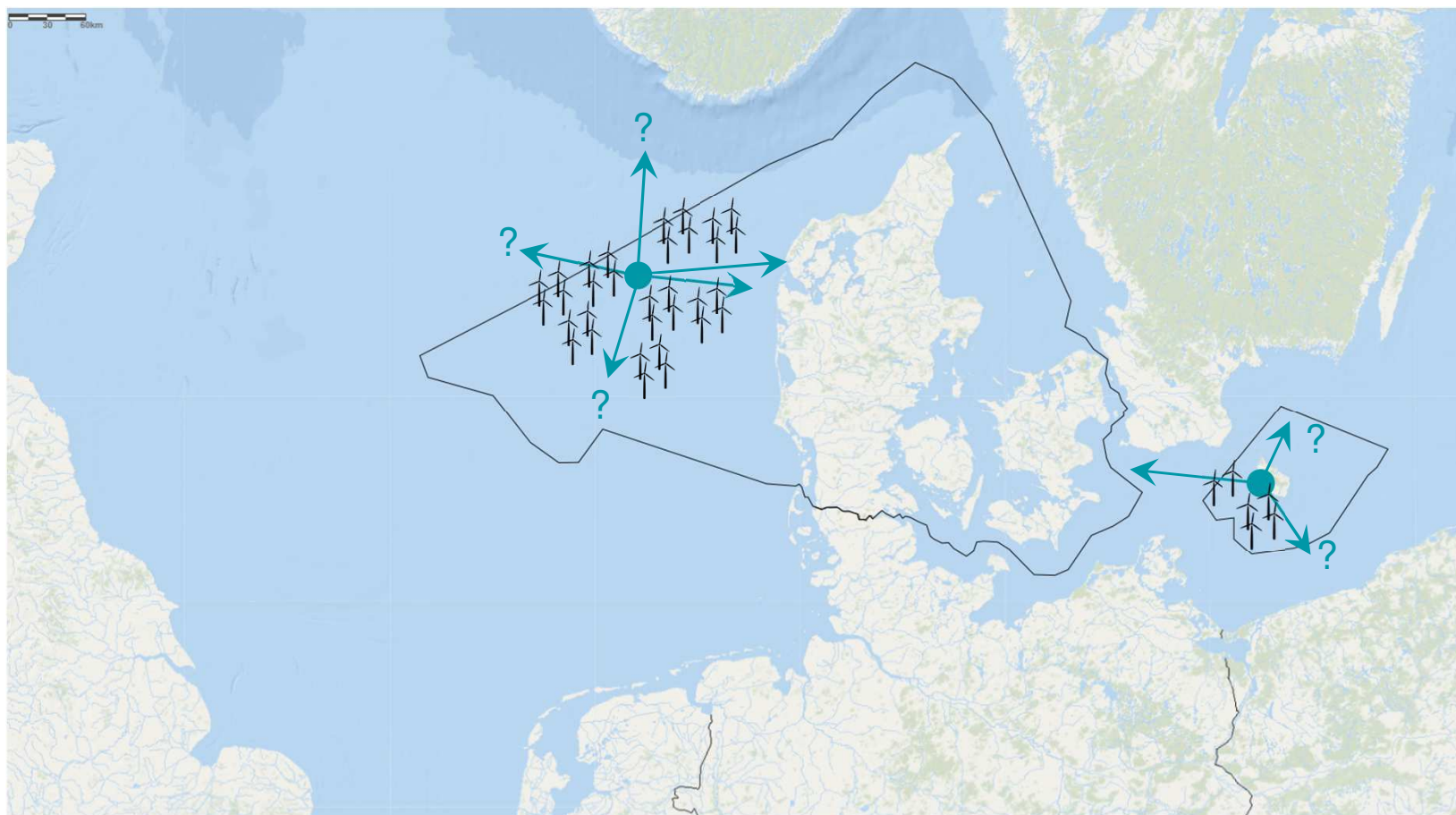


Danish Energy Islands (2030)

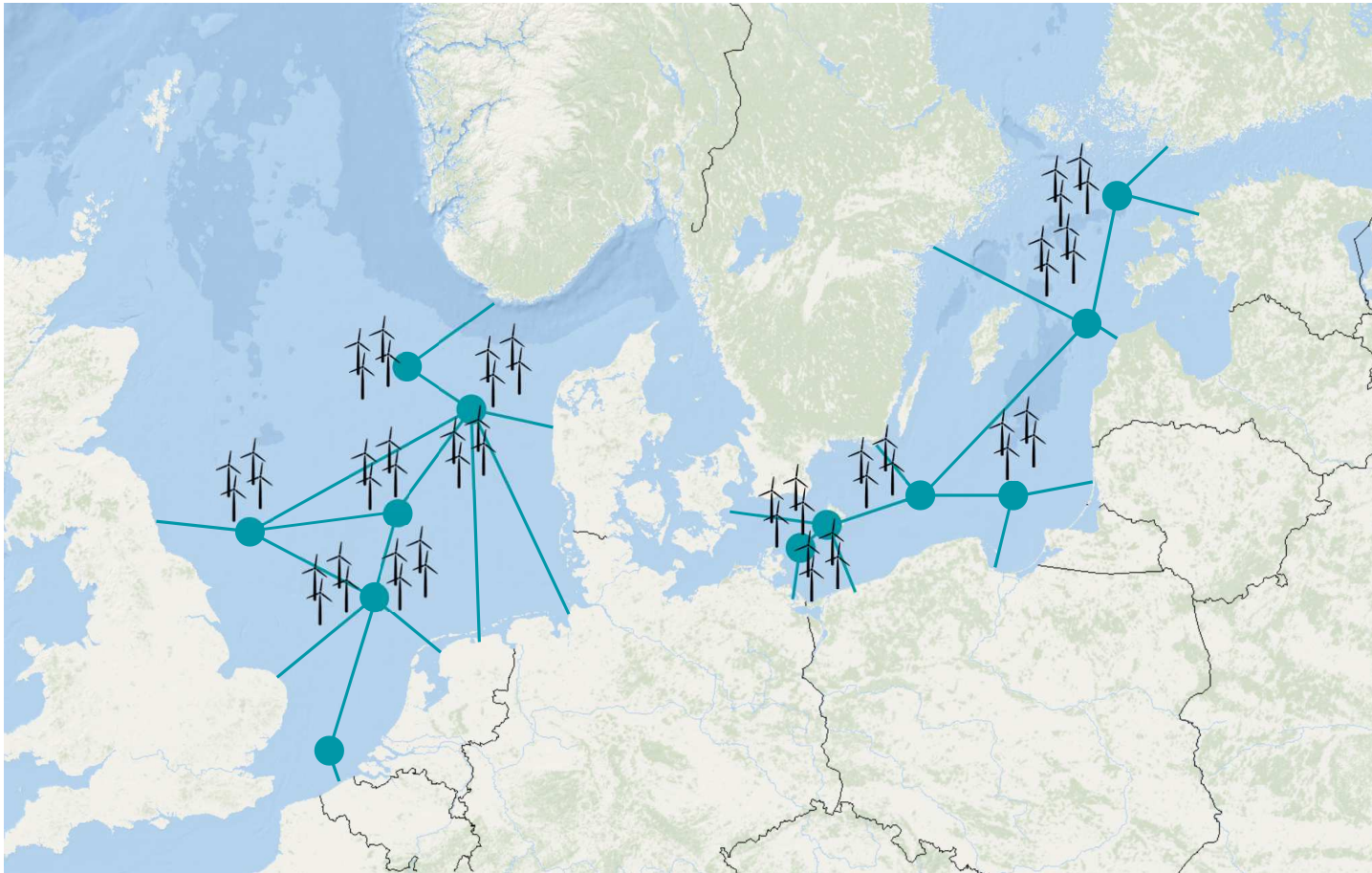
Planning initiated



Danish Energy Islands – *next phases?*

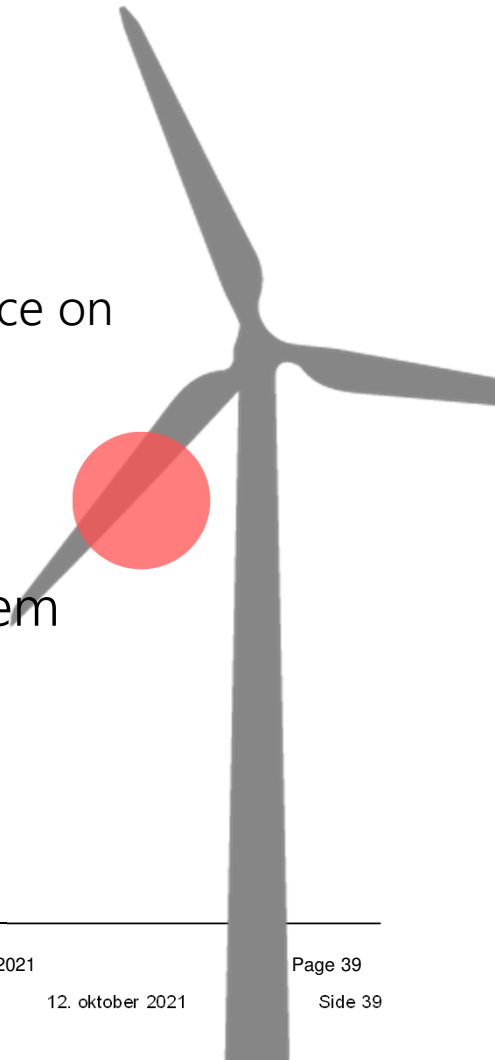


Energy Hubs – long term vision (NSWPH+BASREC)

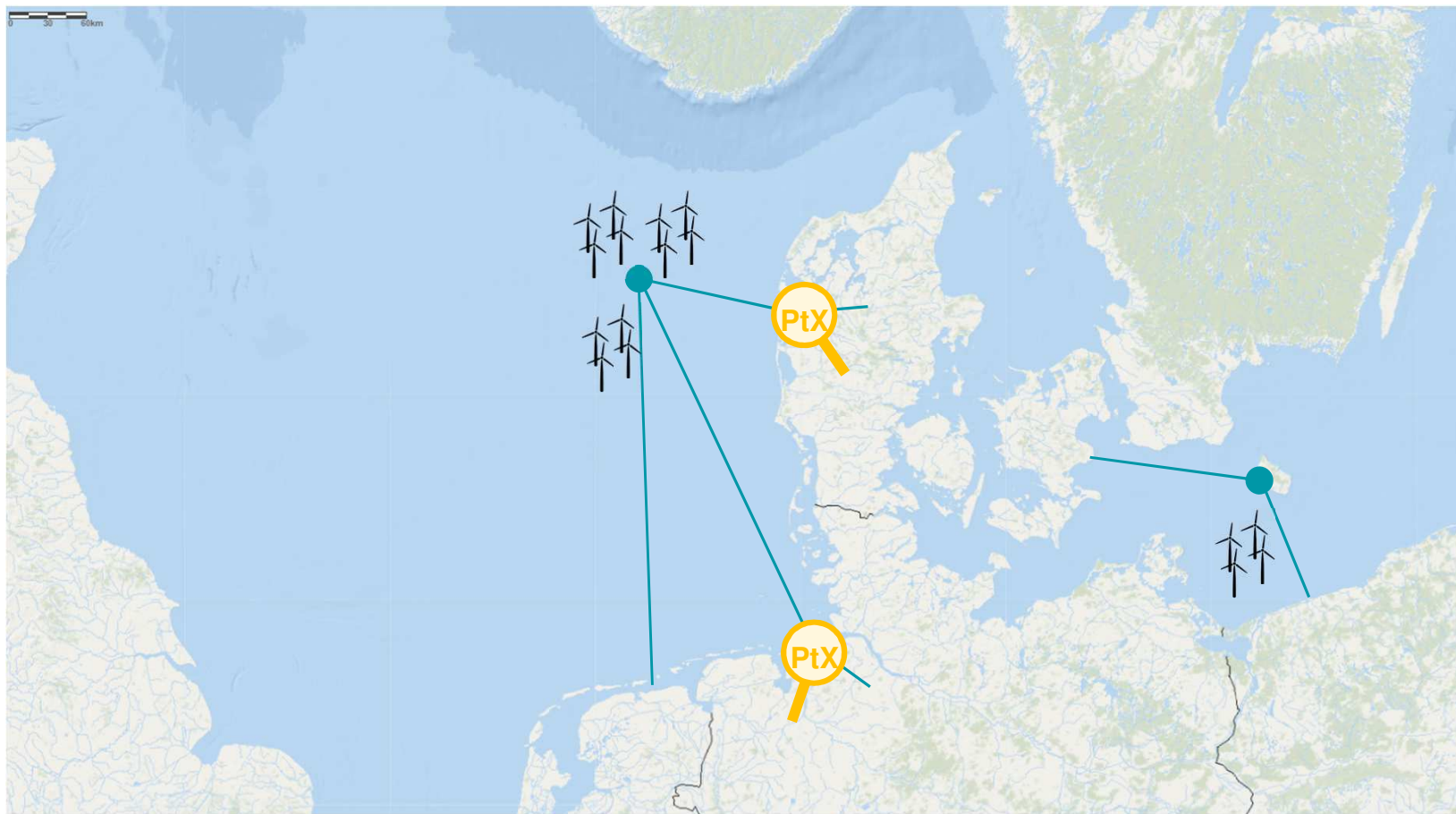


Benefits for X country from an interconnection to Danish energy island?

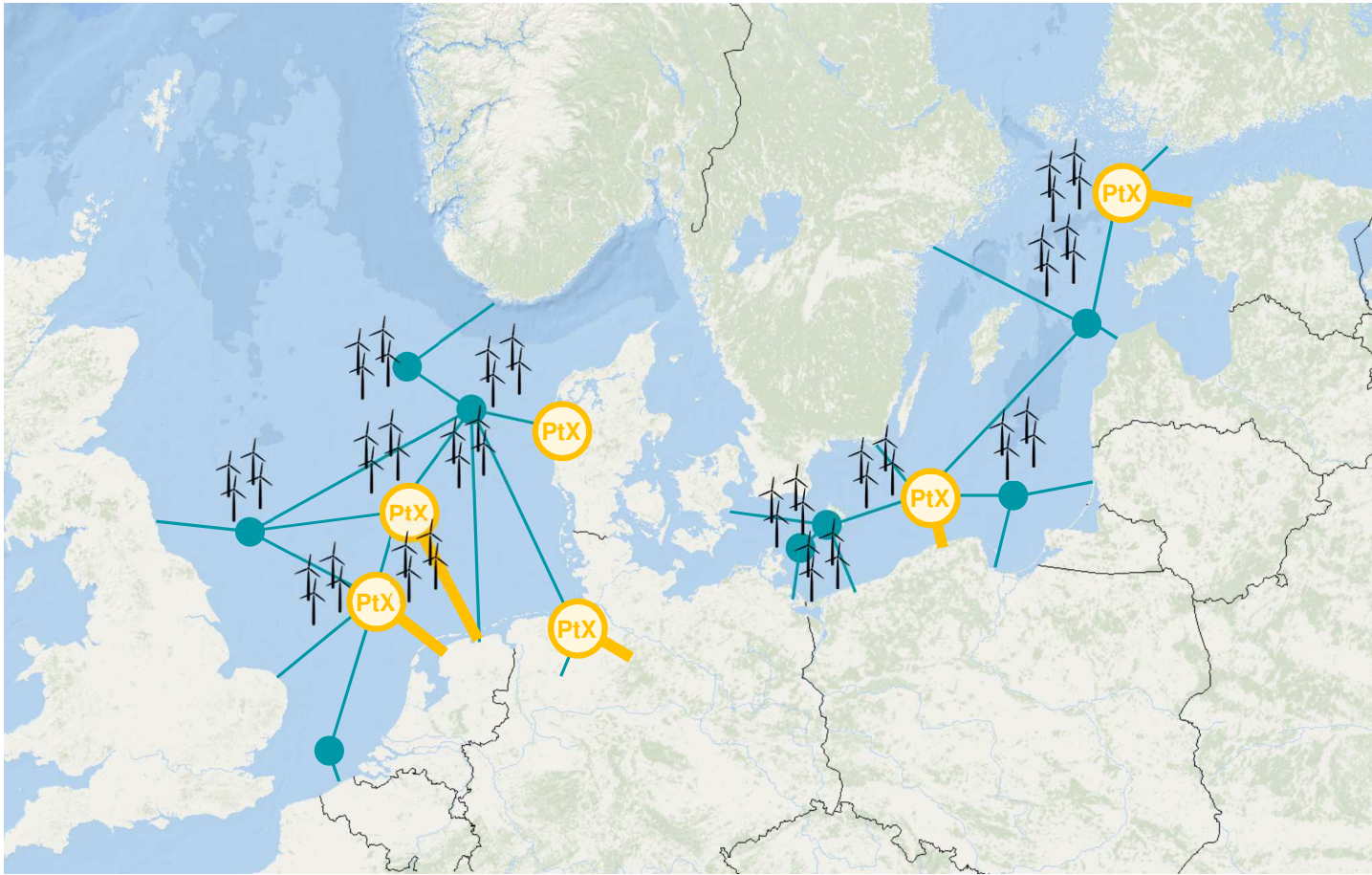
- Increased security of supply
 - Access to larger production capacity
 - Bigger connection to Nordic electricity area
 - Conversion from fossil fuels to electricity decreases reliance on natural gas
- Lower electricity prices for consumers
- More renewable energy in the energy mix
- Increased share of green electricity in the power system
- Positive business case for energy island and interconnections
- Bottleneck revenue from interconnections



Possibility for Power-to-X – in 2030?



Possibility for Power-to-X – after 2030



The latest on Danish Energy Islands

Press Release dated 04 February 2021



Illustration: Danish Energy Agency.

Feb 04, 2021 12:27 CET

Denmark decides to construct the world's first windenergy hub as an artificial island in the North Sea



12 October 2021

12. oktober 2021

Page 42

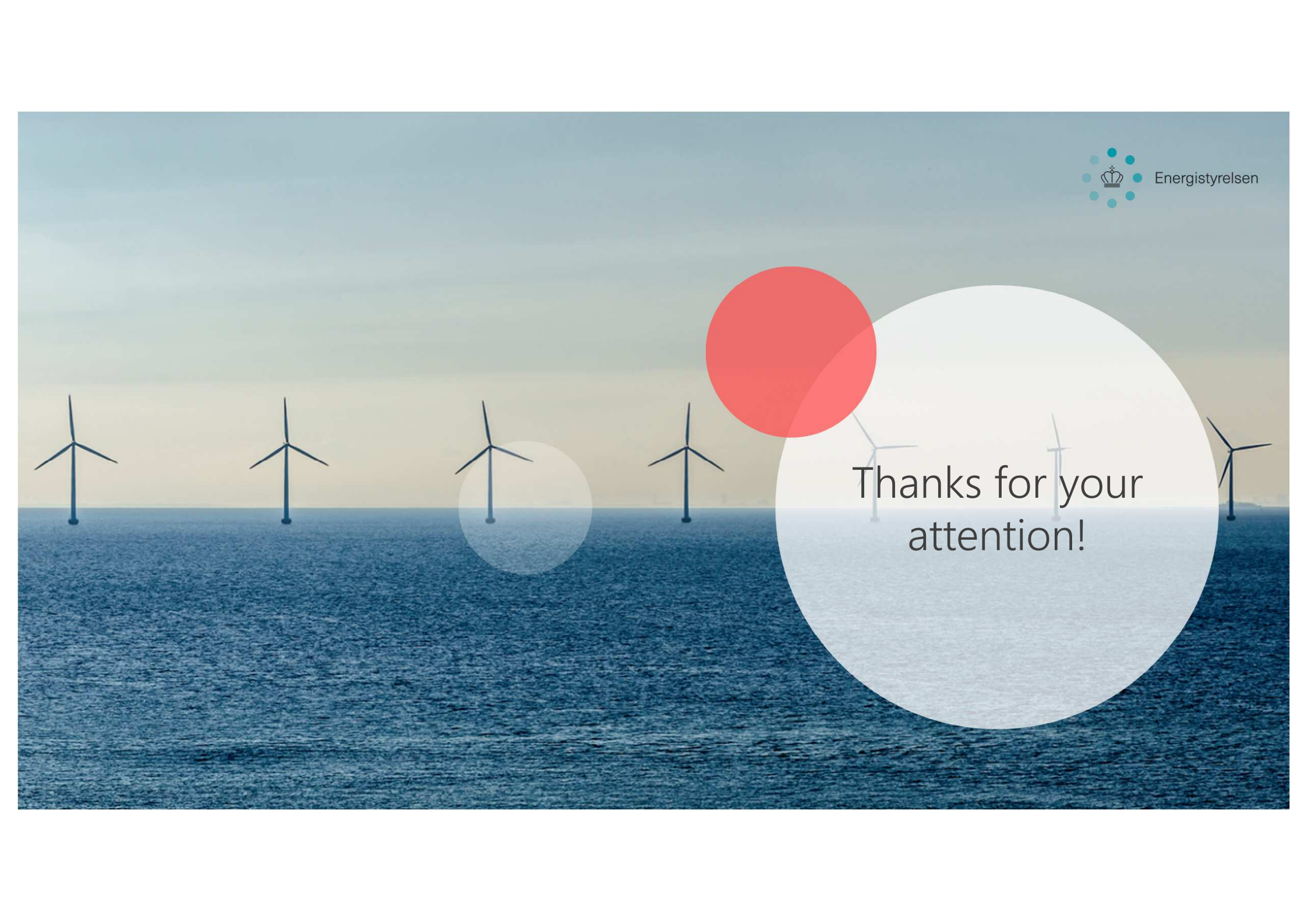
Side 42

Denmark and Europe's thinking in relation to interconnectors

Example: Viking Link, 760 km HVDC cable from UK to Denmark

<https://vimeo.com/191807895>

7 mins.



Thanks for your
attention!