Danish Energy Agency

The Danish Maritime Spatial Plan and Offshore Wind Sites Screening

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Offshore wind planning at the Danish Energy Agency

- **Planning for new offshore wind farms**
  - Inputs to the political energy agreements
  - Screening of the sea for potential best site areas
  - Select sites for offshore wind tenders

  } Maritime spatial planning & site screening

- **Granting permits for establishing and operating an offshore wind projects**
  - License to carry out preliminary investigations
  - License to establish offshore wind turbines
  - License to exploit wind power for 25 years
  - Approval for electricity production in compliance with the electricity supply act

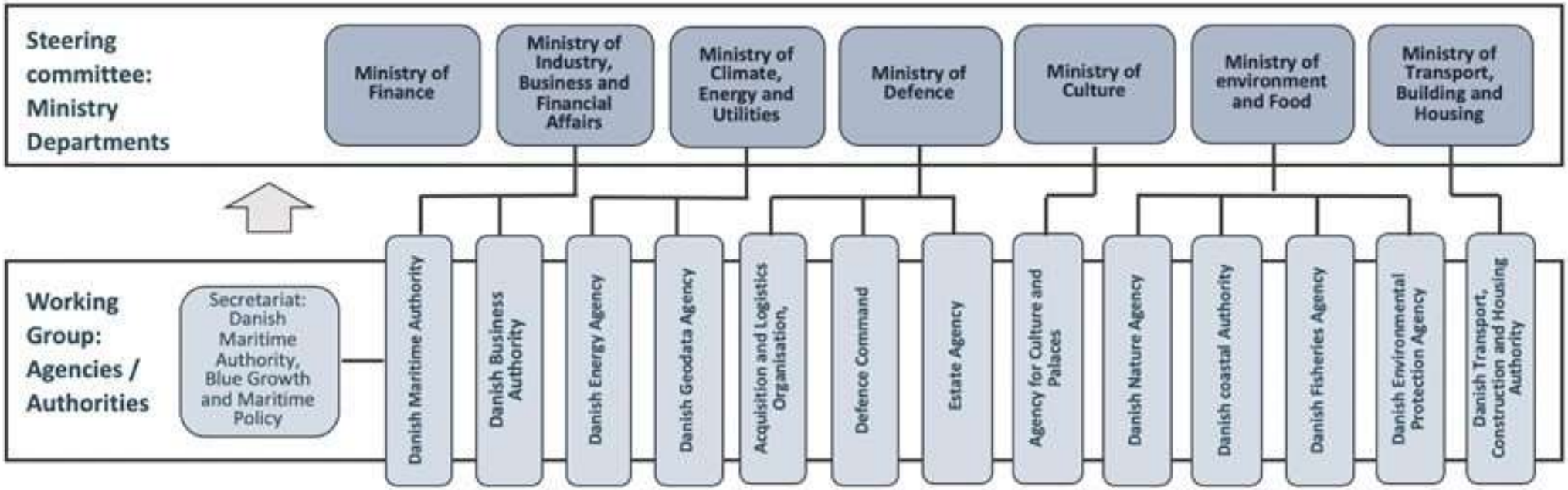
- **Preparing and implementing offshore wind tenders**
  - Develop and improve tender framework conditions for offshore wind
  - Prepare offshore wind tender package
  - Responsible for dialogue with industry and potential bidders
  - Prepare offshore wind tender documents
  - Evaluation and award bids for offshore wind tenders
  - Concession agreement
  - Review and approval of project plan
  - Project monitoring

Maritime Spatial Planning (MSP)

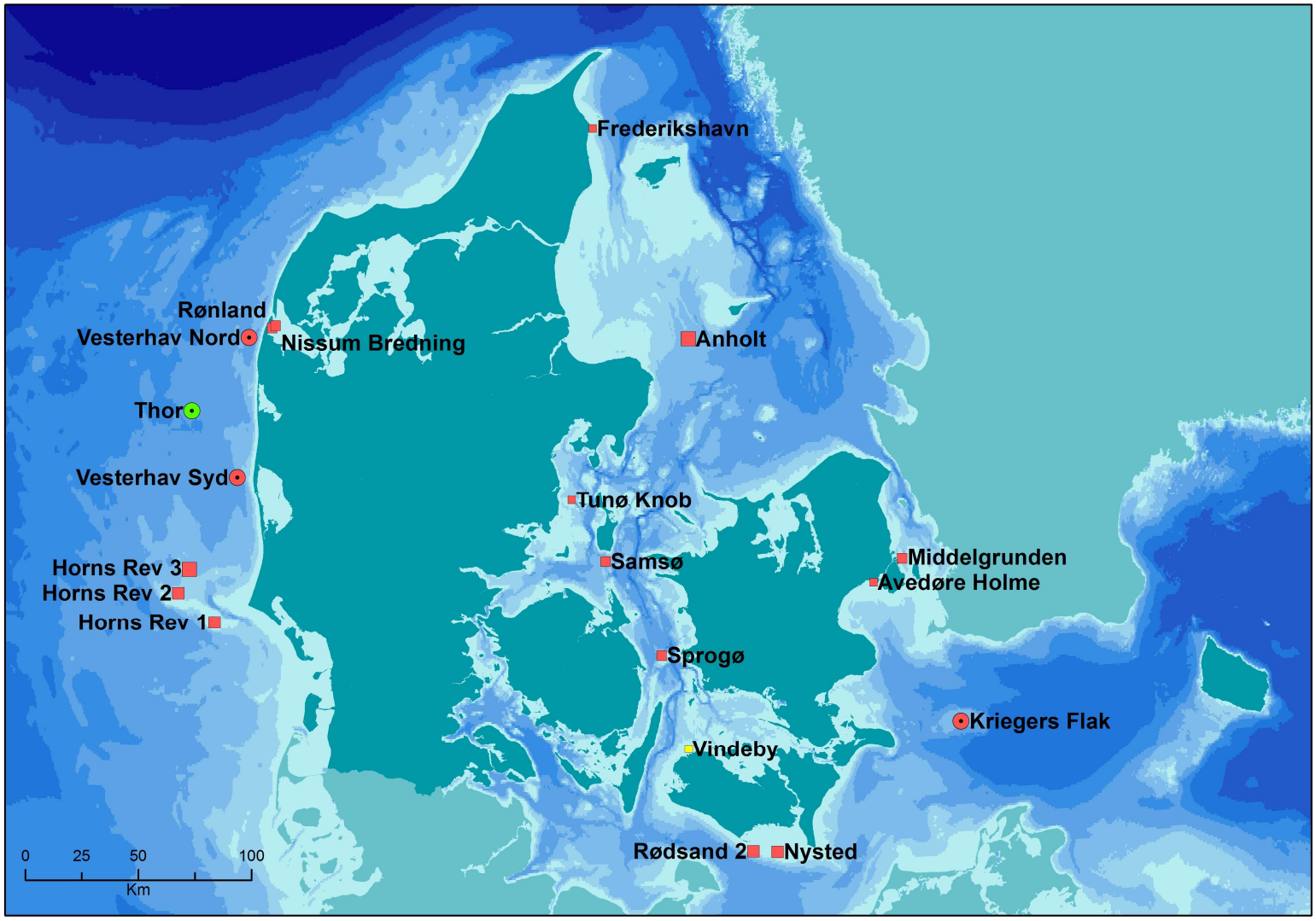
Why is MSP important for offshore wind development?

- Long-term planning
- Agreement among authorities
  - Marine Resource Management
  - Organise and balance sea interests
- Encourage investment by creating predictability, transparency and clearer rules

MSP Organization



Danish offshore wind farms



MSP - Evolution of offshore wind turbines and farms in DK

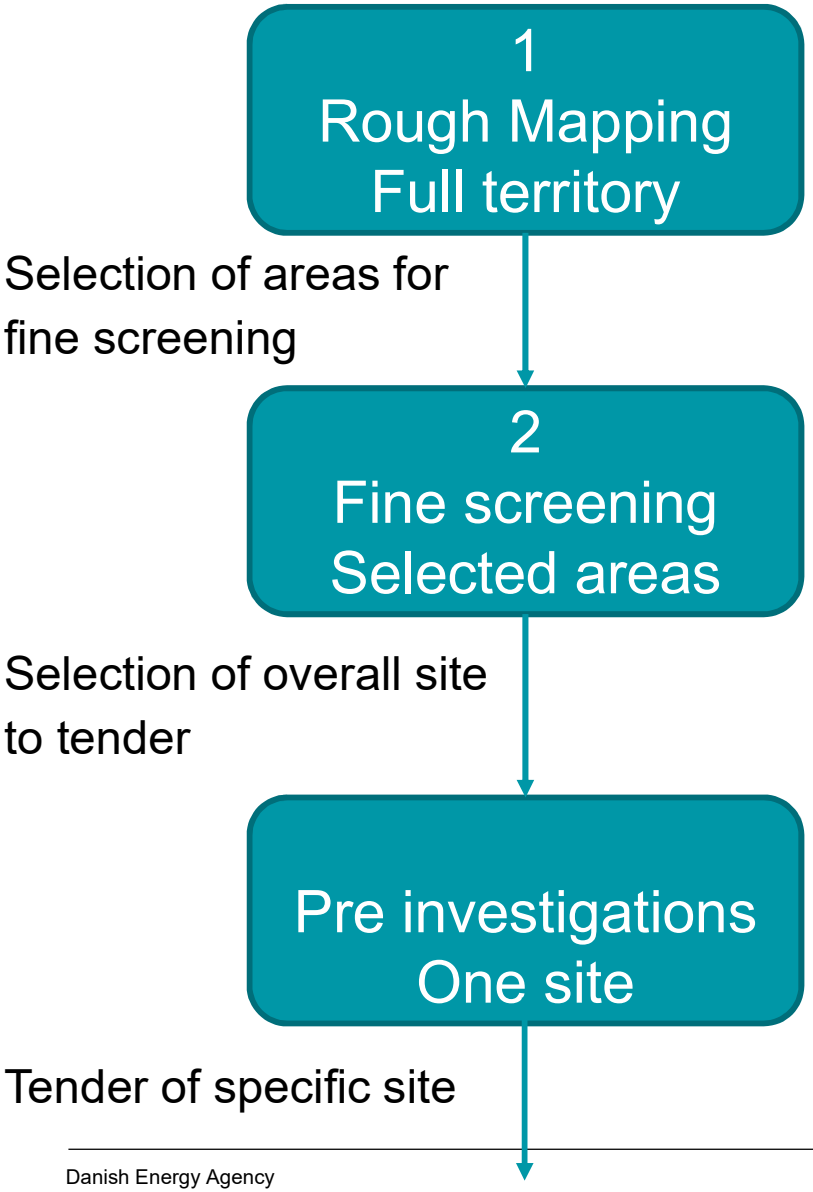
5 MW	40MW	165 MW	209 MW	400 MW	400 MW	3 X 800 MW

Energy Agreement 2018

”A large scale screening of Danish waters in the North Sea and Baltic Sea will be initiated. ***The screening must cover locations for up to 10 GW offshore wind to get a broad selection of attractive locations.*** *This shall ensure, that we can point to favourable available locations where turbines can be established and connected to the grid, when the development really accellerates.”*

“The parties agree on the **procurement of a new offshore wind farm** with a maximum capacity of **1 GW**, with planned grid connection in 2024-2027… **A detailed analysis will be conducted to identify a location, or a number of possible locations for this offshore wind farm.** The parties wish to establish three offshore wind farms in Denmark by 2030.”

Site identification in 2 steps

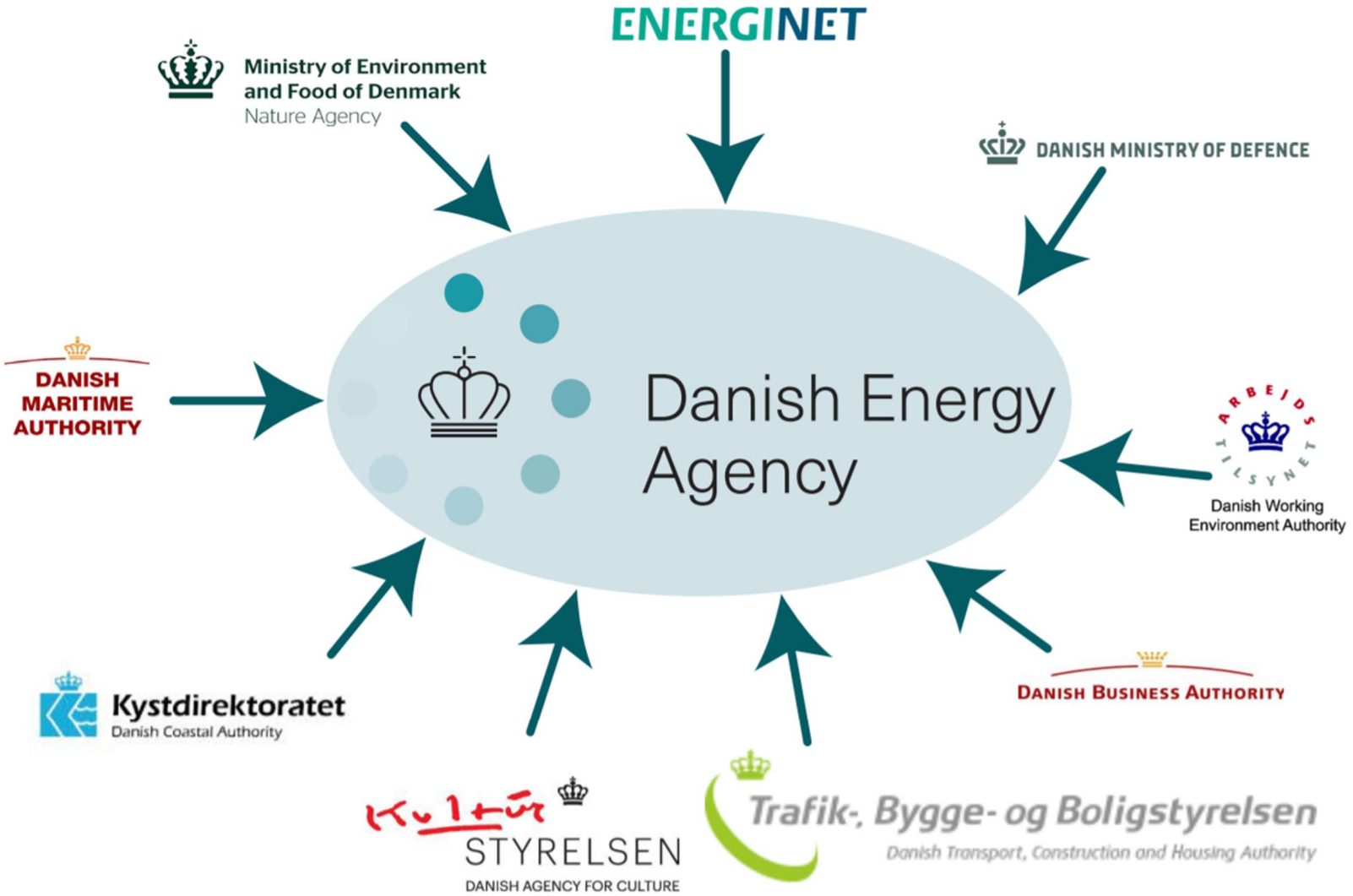


- Undertaken by the DEA
- Dialogue with all relevant authorities

- Coordinated by the DEA
- Consultancy services
- Review of existing data
- Economic ranking of the potential sites incl. grid connection

- Coordinated by the DEA/Energinet
- Consultancy services
- Collection of new data on wind, waves, seabed, birds

Extensive dialogue with all relevant authorities….



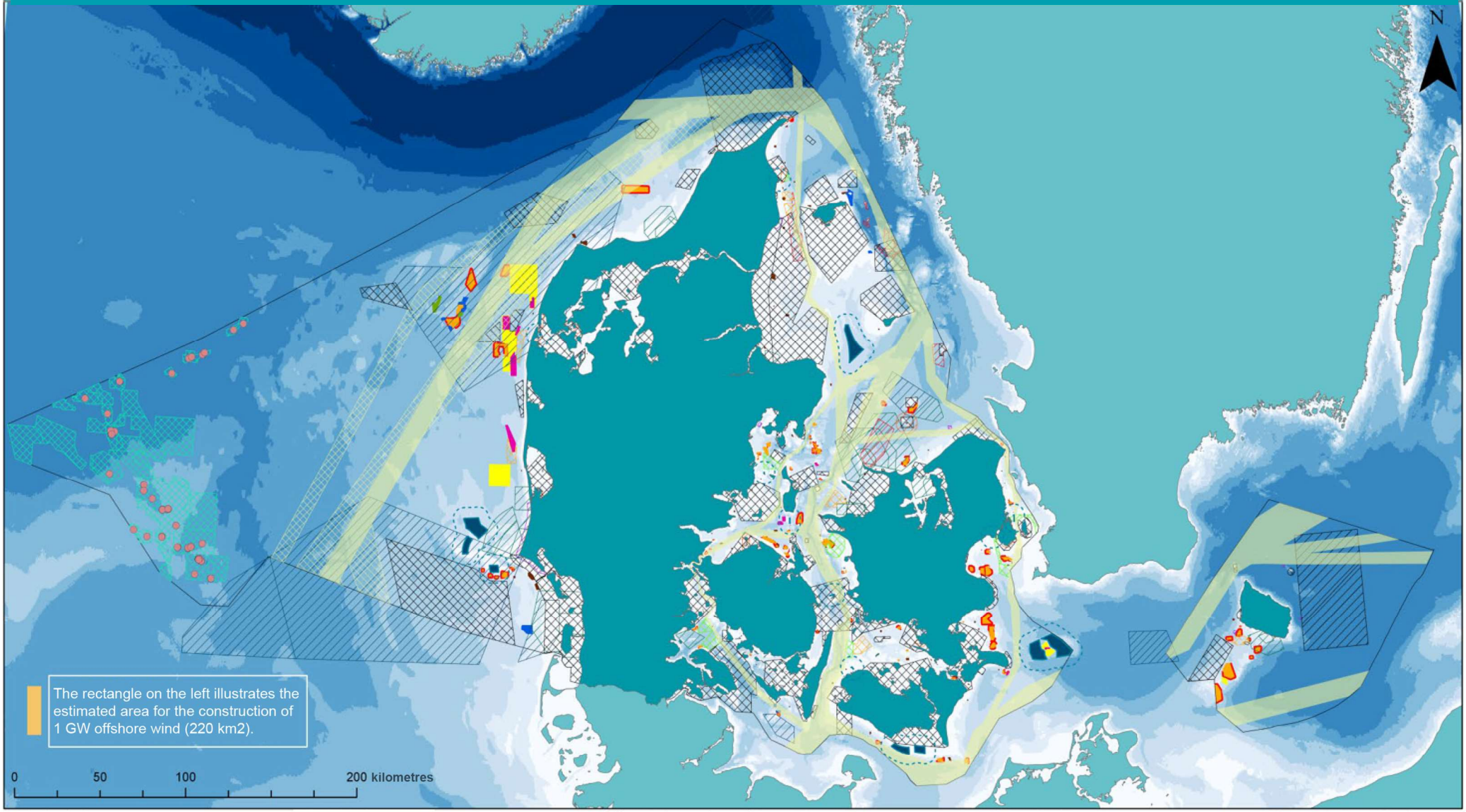
… Regarding their constraints and interests on the sea space

- Transmission System Operator (TSO): grid connection
- Ministry of Defense: national security
- Nature Agency: environmental protected areas
- Maritime Authority: navigation routes, traffic density
- Coastal Authority: access to ports, installation of cables
- Agency for Culture: archeology
- Fisheries Agency: fisheries
- Transport, Construction and Housing Authority: civil aviation
- Local municipalities: opinions
- DEA: telecommunication and power cables, gas pipes
- …

Rough Mapping: Type of interests

Type of interests	Restriction	Consideration	Comment
Fairway, infrastructure		X	International and national ferry routes and selected routes with less trafic
Fairway, shipping/transit	X		International shipping routes and areas of the North Sea with heavy trafic
Raw materials (sand, gravel etc.)		X	Potential extration and strategic resources
Extraction and deposit of raw materials	X		Areas with active permits and reserved areas
Defence	X		Military practice
Defence limited use		X	Activities within areas of limited use can in some cases be combined with offshore wind
Oil- and gas and offshore installations	X		Operators of oil and gas platforms have sole right to use the area in question
Oil and gas tender zone		X	Concessions with sole use rights can be awarded in tender rounds
Existing offshore wind	X		Existing parks incl. 6 km perimeter and sites with active contracts
Cables and pipes		X	Can be combined with offshore wind. 200 m safety distance
Environment	X		Natura 2000, maritime strategy and nature conservation.

Restricted areas



Depth (m)

- 0 - 10
- 10,1 - 15
- 15,1 - 20
- 20,1 - 30
- 30,1 - 40
- 40,1 - 50
- 50,1 - 100
- 100,1 - 150
- 150,1 - 300
- 300,1 - 800

Raw materials interests

- Raw materials - Exploration areas
- Raw materials - Building permits
- Raw materials - Auction permits
- Raw materials - Reservation areas
- Raw materials - Zones around common areas
- Raw materials - Common areas

Other relevant areas

- Dredging sites

Defence

- D
- ESD
- R
- Entry prohibited areas

Marine environment

- Natura 2000 sites
- Protected areas
- Marine strategy areas

Traffic

- Shipping, transit
- Shipping, transit freehold areas

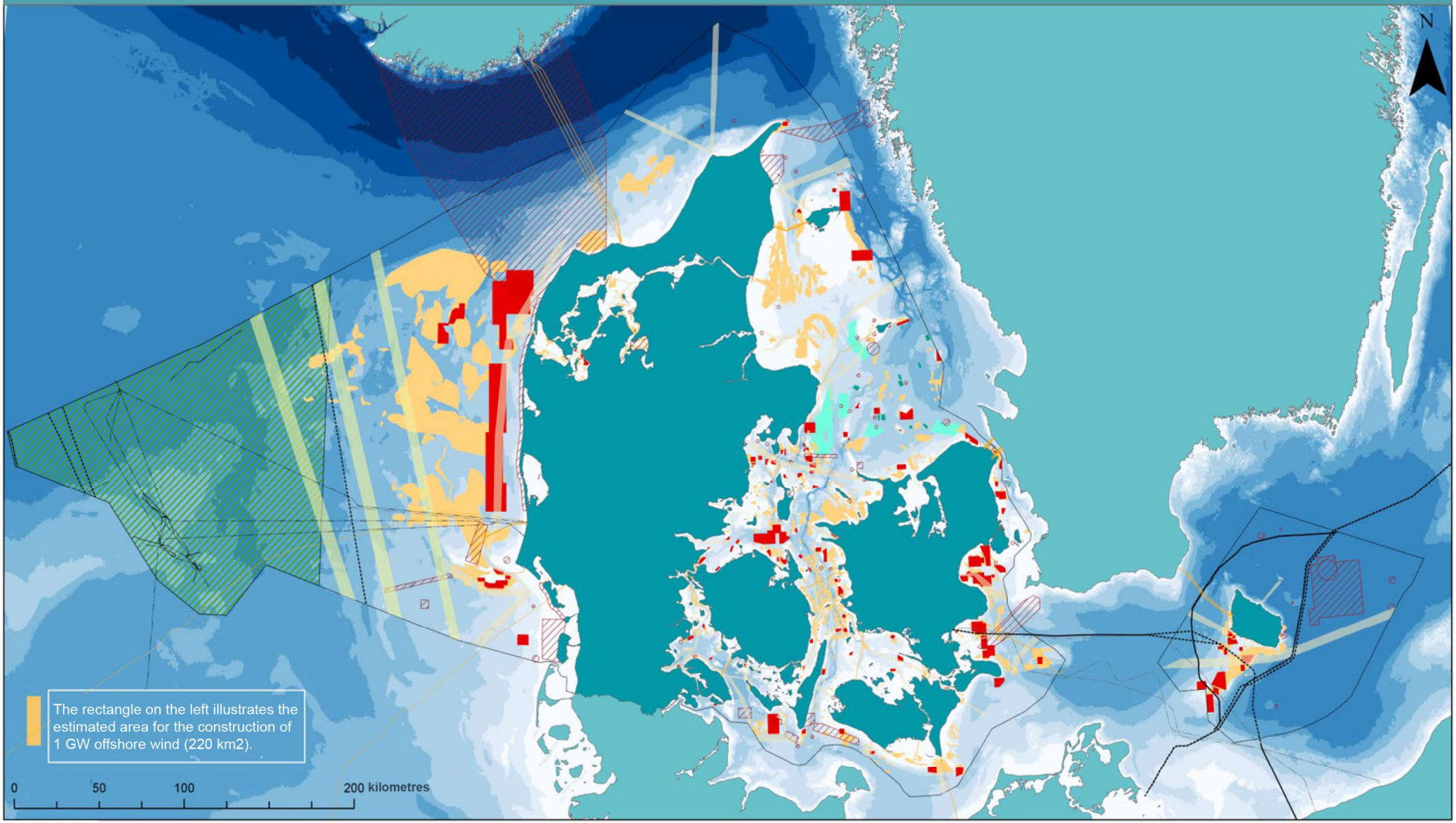
Offshore wind

- Offshore wind farms
- 6km freehold areas
- Open-door offshore applications
- Offshore coastal areas

Offshore installatioins

- Exclusivity permits
- Offshore installations

Areas for consideration



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Raw materials interests

- Raw materials - Potential common areas
- Strategic raw material resources

Offshore

- Oil and gas, tender zones

Sea farming

- Sea farming zones
- Sea farming applications

Restricted areas

- Restricted areas

Traffic

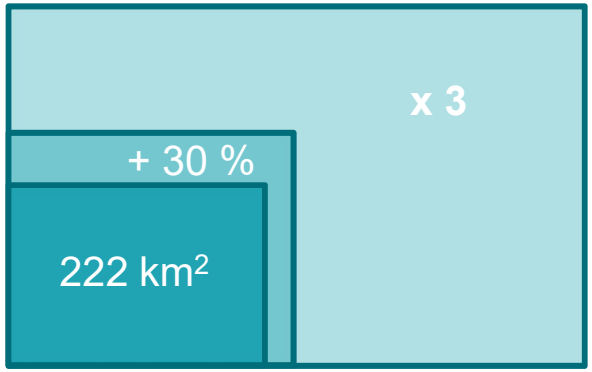
- Shipping, infrastructure
- Shipping, transit

Cables and pipelines

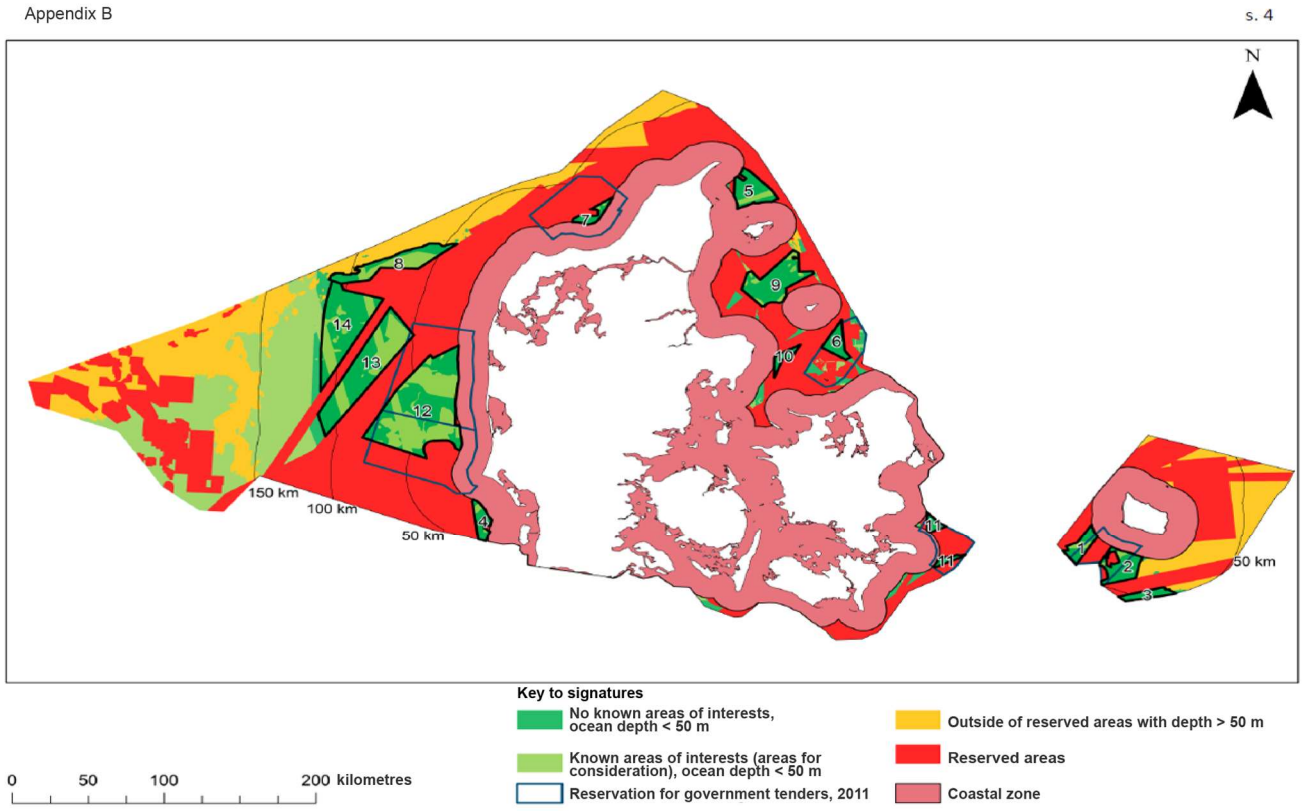
- Electric power transmission, sea cables
- Projected cable routes
- Carbon hydride, transit pipelines
- Carbon hydride, pipelines
- Projected gas pipelines

Rough Mapping: Areas requirements

Gross area needed (1GW)



Distance to shore



Final outputs: 10GW of reservation for offshore wind

Appendix B

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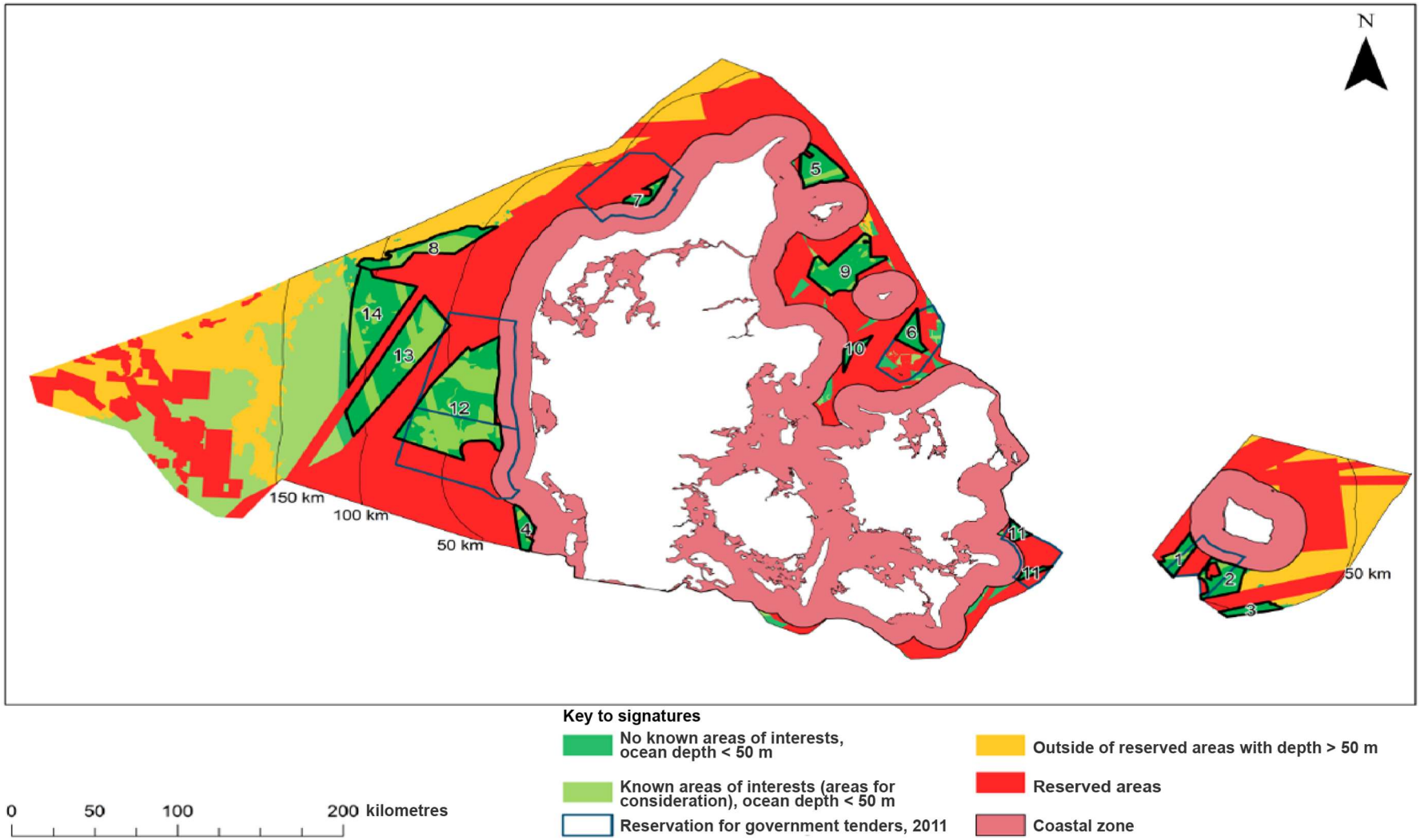


2. Fine screening

Deep dive in local sites conditions

a. Seabed conditions
b. Environmental conditions
c. Wind conditions
d. Grid connection
e. Costs (CAPEX and OPEX)
f. Economic ranking with LCOE

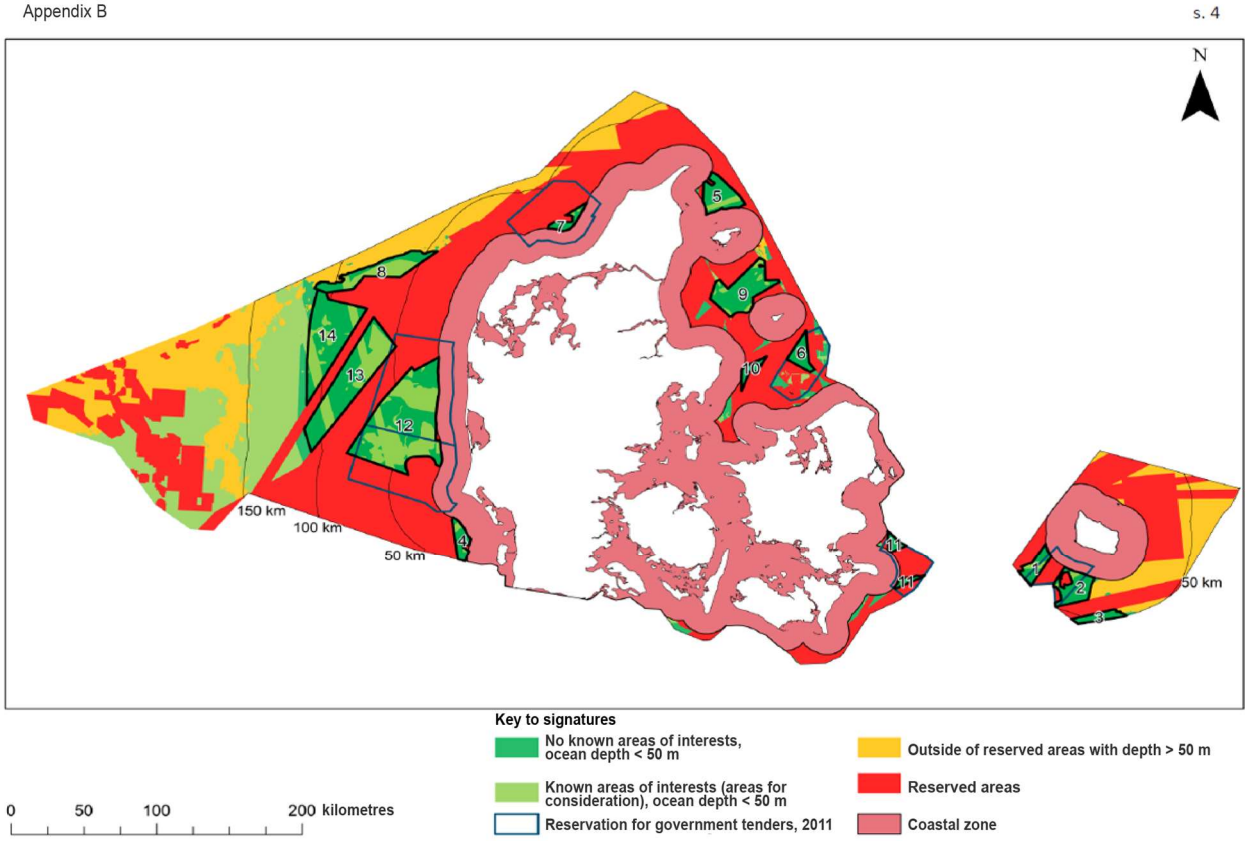
f. Economic ranking with LCOE

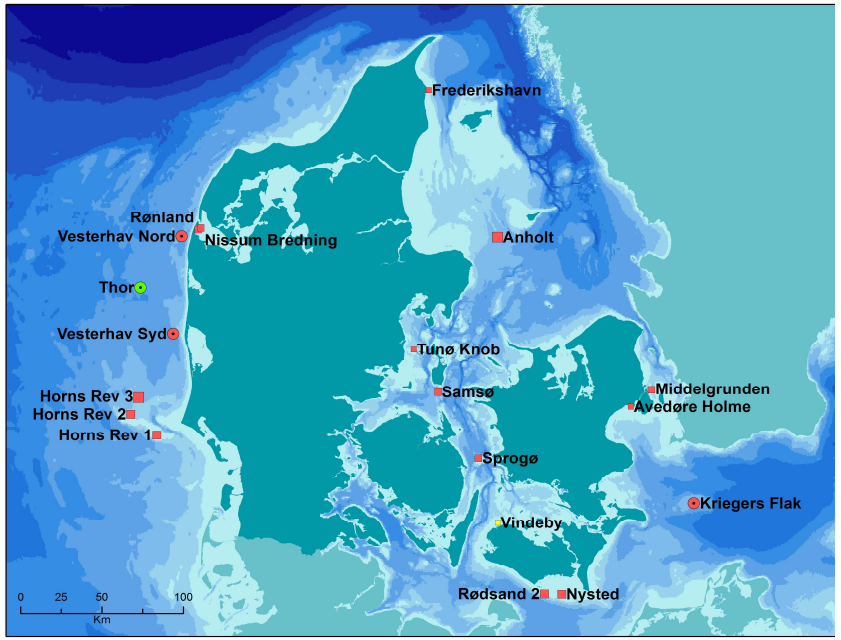
LCOE: Levelized Cost of Energy

$$LCoE = \frac{\sum_{t=1}^{n} \frac{I_t + M_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}$$

Nr.	SITE/LAYOUT	Levelized Cost of Energy		
		(kr./kWh)	(kr./MWh)	(EUR/MWh)
1	Nordsøen 4	0,45	446	60
2	Nordsøen Nord 1	0,45	448	60
3	Nordsøen Nord 2	0,46	456	61
4	Nordsøen 1	0,46	458	61
5	Hesselø 1b	0,46	462	62
6	Hesselø 1a	0,47	465	62
7	Hesselø 2a	0,47	466	62
8	Nordsøen Syd	0,47	466	63
9	Hesselø 2b	0,47	467	63
10	Kriegers Flak 1	0,47	475	64
11	Jammerbugt 2	0,48	477	64
12	Jammerbugt 1	0,48	480	64
NA	*Kriegers Flak 2*	*0,50*	*499*	*67*

Fine screening results: Thor





Summary

- Thorough process & dynamic screening and planning process
- Engagement of all relevant authorities in a continuous dialogue to decrease the risk of conflicts of interests
- From large-scale scenarios to fine screening
- Economic ranking: most attracting sites developed first

Next session:

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One stop shop

Prepare and implement offshore wind tenders

- Develop and improve tender framework conditions for offshore wind
- Prepare offshore wind tender package
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Q&A Session June 24th

Live online Q&A session discussing:

- Possible questions from presentations and the project
- Brief evaluation

If you have any questions or points that are worth discussing, please send the questions in advance to ani@ens.dk

They will be aggregated and answered by the DEA!

Inspirational topics

Which elements of the Danish MSP and site selection process for offshore wind projects could be potentially adapted in India?

What are the main Indian Gov. agencies that should be/are consulted during the identification process of offshore wind sites?