



Middelgrunden wind Denmark

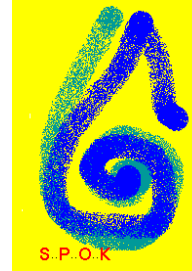
Contribution to land-sea interaction
Interreg Baltic Sea Region

by

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Background Hans Chr. Sørensen



Business and university background

- PhD, 40 years with business development

Project management large projects

- Ocean wave energy (Wave Dragon), Tidal current (Tideng)

- Offshore wind (Middelgrunden 40 MW, Samsø 23 MW, Hvidovre 7.2 MW)

Committees

- Danish Wind Turbine Owners Association, board to 2018

- European Ocean Energy Association, vice president to 2011

Content



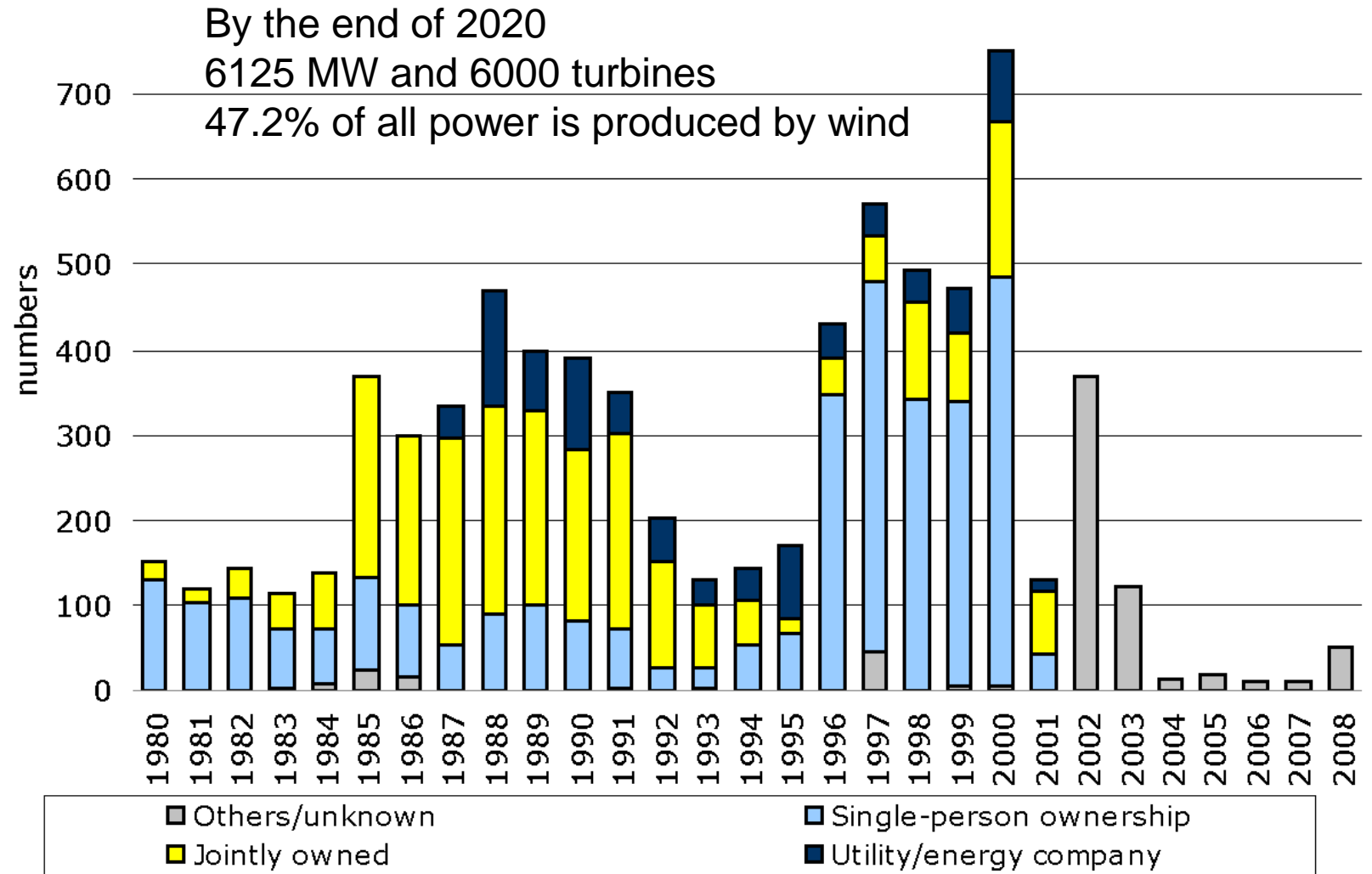
An example about establishing the Worlds largest offshore wind farm close to the city by involving local people – and how that slowly resulted in tourism

- How Middelgrunden wind was established
- The planning process and public involvement
- The continues public involvement
- Multiuse platforms - UNITED

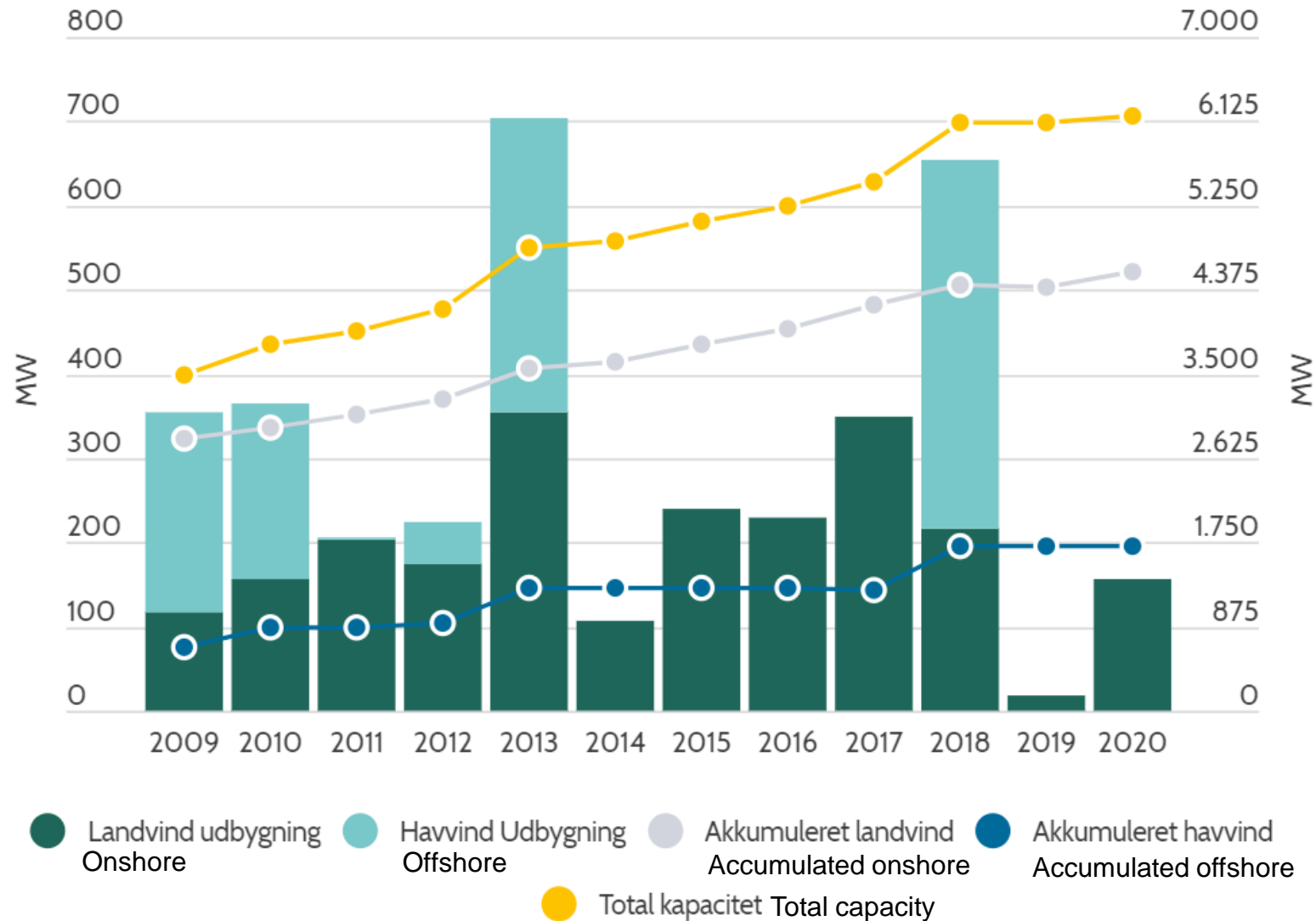
How Middelgrunden wind was established



- The tradition for wind development in Denmark from 1980 to 2000: Local people took the initiative
- Utilities build only what government asked them to build
- In Copenhagen we joint with the local utility (political pressure and practical reasons)

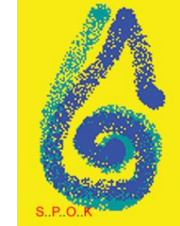


The wind turbines in Denmark 2020



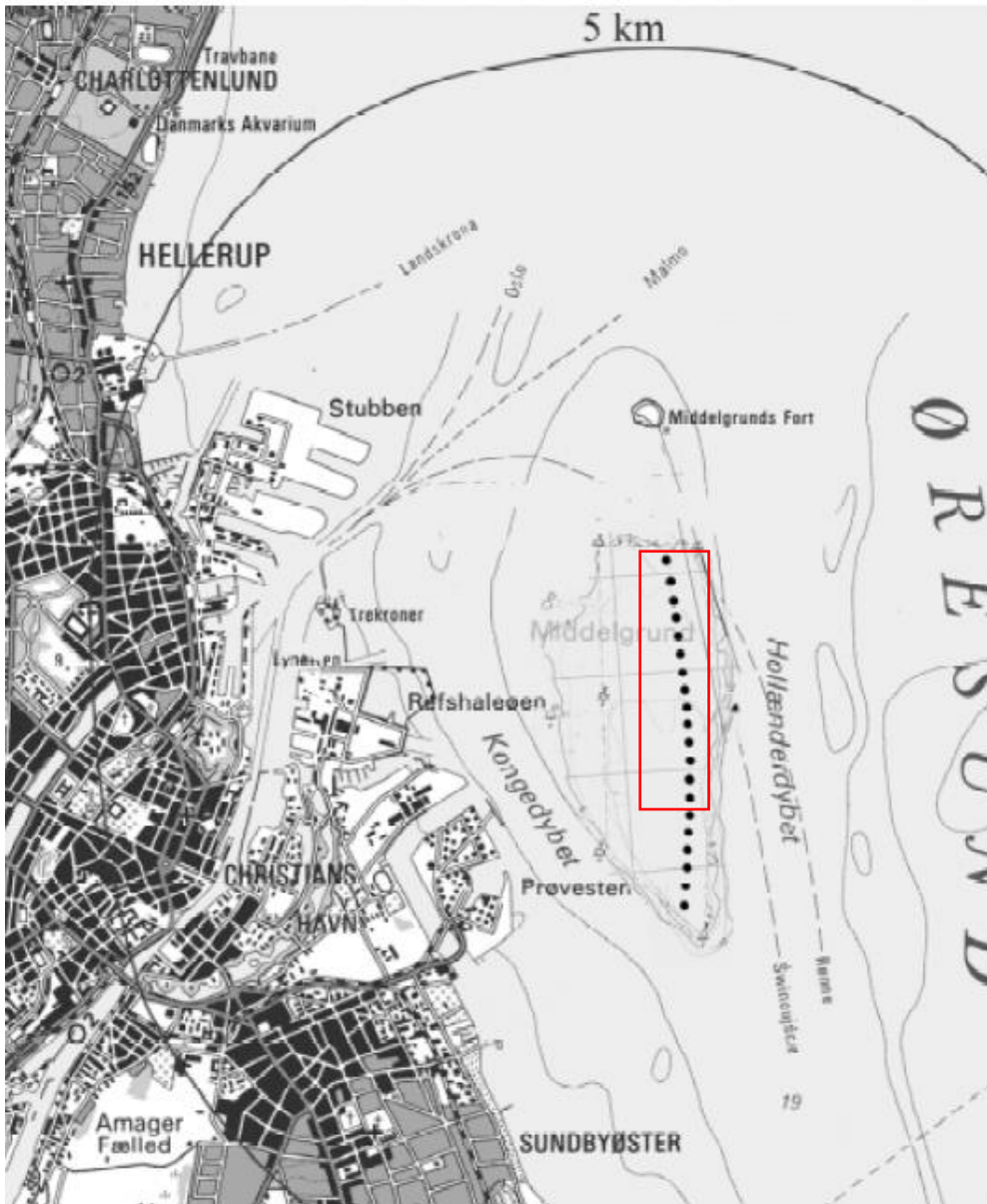
Source:
www.winddenmark.dk

The Copenhagen cooperative projects



	Lynetten	Middelgrunden	Hvidovre	Prøvestenen
Year	1995/96	1996/2000	2007/2009/ 2011	2013
Power	7 x 600kW	20 x 2MW	3 x 3.6MW	3x2MW
COOP/Utility	4/3	10/10	1/2	1/2
Shares/owners	3,600/902	40,500/8,553	10,700/2,268	4,055/1,800+
Price/share	604€	570€	670€	663€
Upfront work	Coop/Utility	Coop & Utility	Coop & Utility	Utility/Coop
Upfront payment	Coop/Utility	Grant/Utility	Utility	Utility
Cost	4.1mill€	49.5 mill€	22 mill€	8,07 mill€

The planning process and public involvement



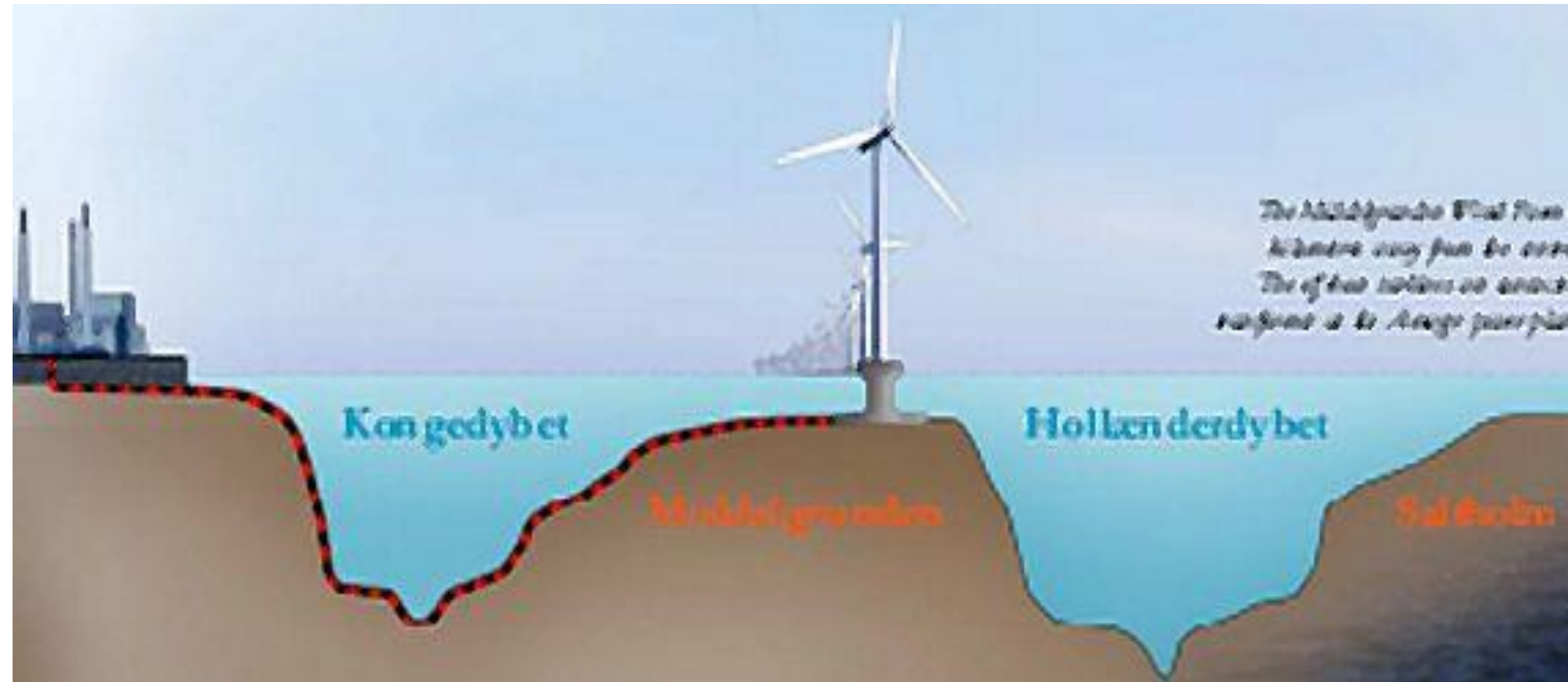
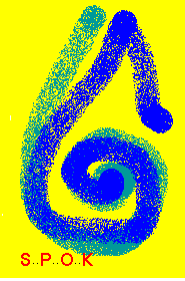
3 rows in the north part, 27 turbines –

changed to one line over the whole length, 20 turbines

Why?

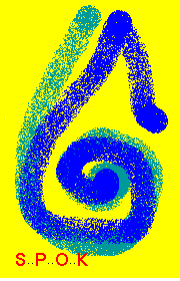
Public protests

Placed on a natural reef 6 meters water depth



Source: <https://www.h2020united.eu/>
and www.middelgrundene.dk

Our closest 1997 – potential neighbor



Visual Impact – two alternatives

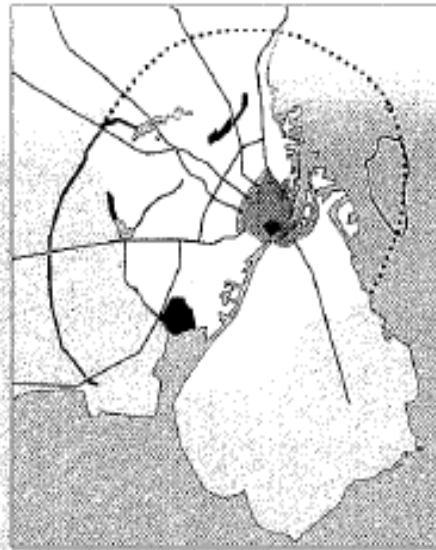


27 turbines in 3 rows

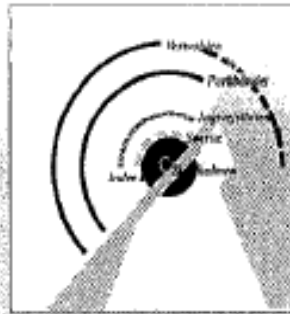


20 turbines in a curved line

Visual impact – the defence circles



Graphic: Madsen & Greenberg Arkitekter og planlæggeri A/S



ØRESUND



18 km's away
Barsebäck nuclear
power plant, 1200 MW

- Closed since 2005

Middelgrunds Rev

Teleman

MIDDELGRUNDEN

HOLLANDERBRY

KØBENHAVN

Parkens layout følger Københavns gamle forsvartsanlæg.

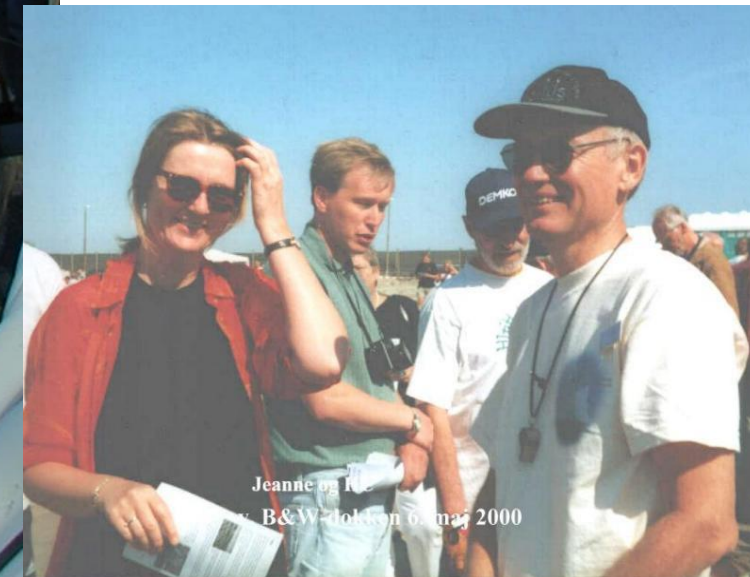
The Farm layout is following the defense system of
Copenhagen dating back to the Middle Age.

The continues public involvement



Involvement of local people in the project:

- Boat trips
- Visit building site
- Artist with wind song for kids



Casting concrete




1600 visitors
on a sunny
Sunday
visiting the
building site



The continues public involvement







Atlas
Hosted solution
Language
English
Theme: Start

- Logout
- Overview**
- Google
- Status
- Status/Oper
- Status/Grid
- Status/Trend
- Production**
- Availability
- Logbook
- Counters
- 10 min.
- Power
- Reports
- User info.
- Information
- Contact

Overview

 Total production **5494.3 kW**
Average windspeed **7.5 m/s**  ☐ Show Turbine type

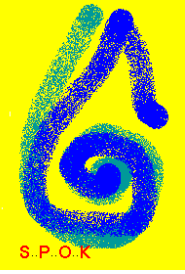
Name	Online	Event	Event description	Windspeed	Production
Middelgrunden 11	-- Online --	0	OK	7.5 m/s	509.9 kW
Middelgrunden 12	-- Online --	0	OK	8.2 m/s	594.7 kW
Middelgrunden 13	-- Online --	0	OK	7.8 m/s	718.9 kW
Middelgrunden 14	-- Online --	0	OK	8.1 m/s	646.8 kW
Middelgrunden 15	-- Online --	0	OK	8.0 m/s	726.7 kW
Middelgrunden 16	-- Online --	0	OK	7.8 m/s	767.2 kW
Middelgrunden 17	-- Online --	0	OK	7.6 m/s	686.0 kW
Middelgrunden 18	-- Online --	0	OK	6.5 m/s	264.7 kW
Middelgrunden 19	-- Online --	0	OK	6.5 m/s	337.4 kW
Middelgrunden 20	-- Online --	0	OK	6.6 m/s	242.0 kW

<http://www.middelgrunden.dk/middelgrunden/?q=en>

Login:
Username:mg
Password:mg2015

All data for production updated every 10 minutes – only for the cooperative part

Offshore wind and tourism



- Slowly visits by shareowners every 2 years turned out to be tourism
- We have 30-40 boat trips every year visiting – some of them including climbing the turbine
- To develop further we are part of the UNITED project

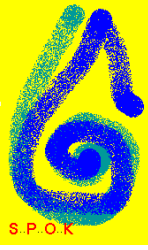


Source: <https://www.h2020united.eu/>



Offshore wind and tourism

UNITED: societal interactions and engagement



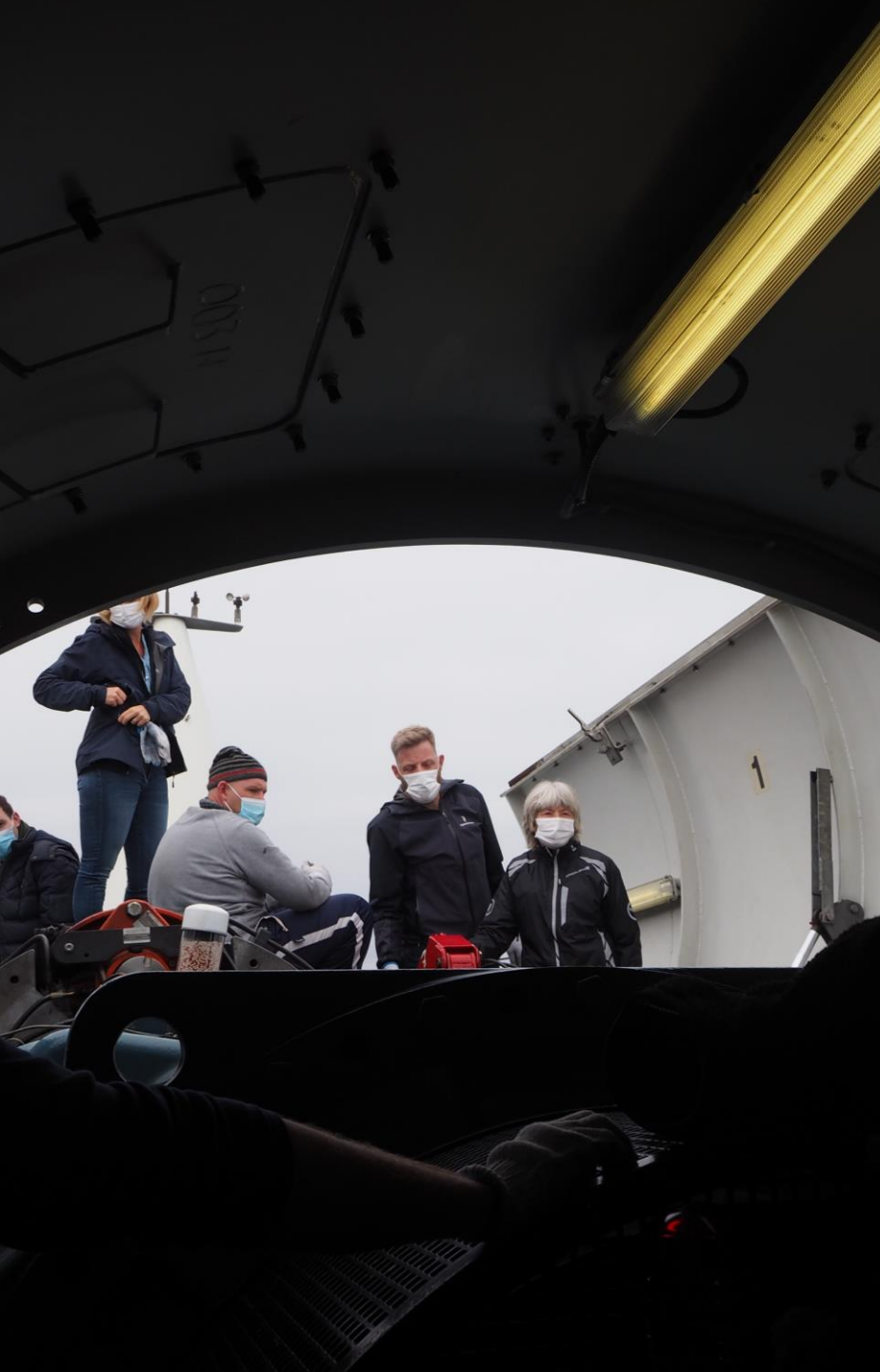
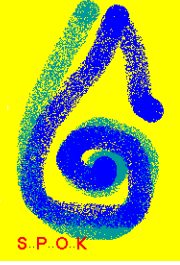
- 120 participants at open house September 20th, 2020

- New UNITED video at:

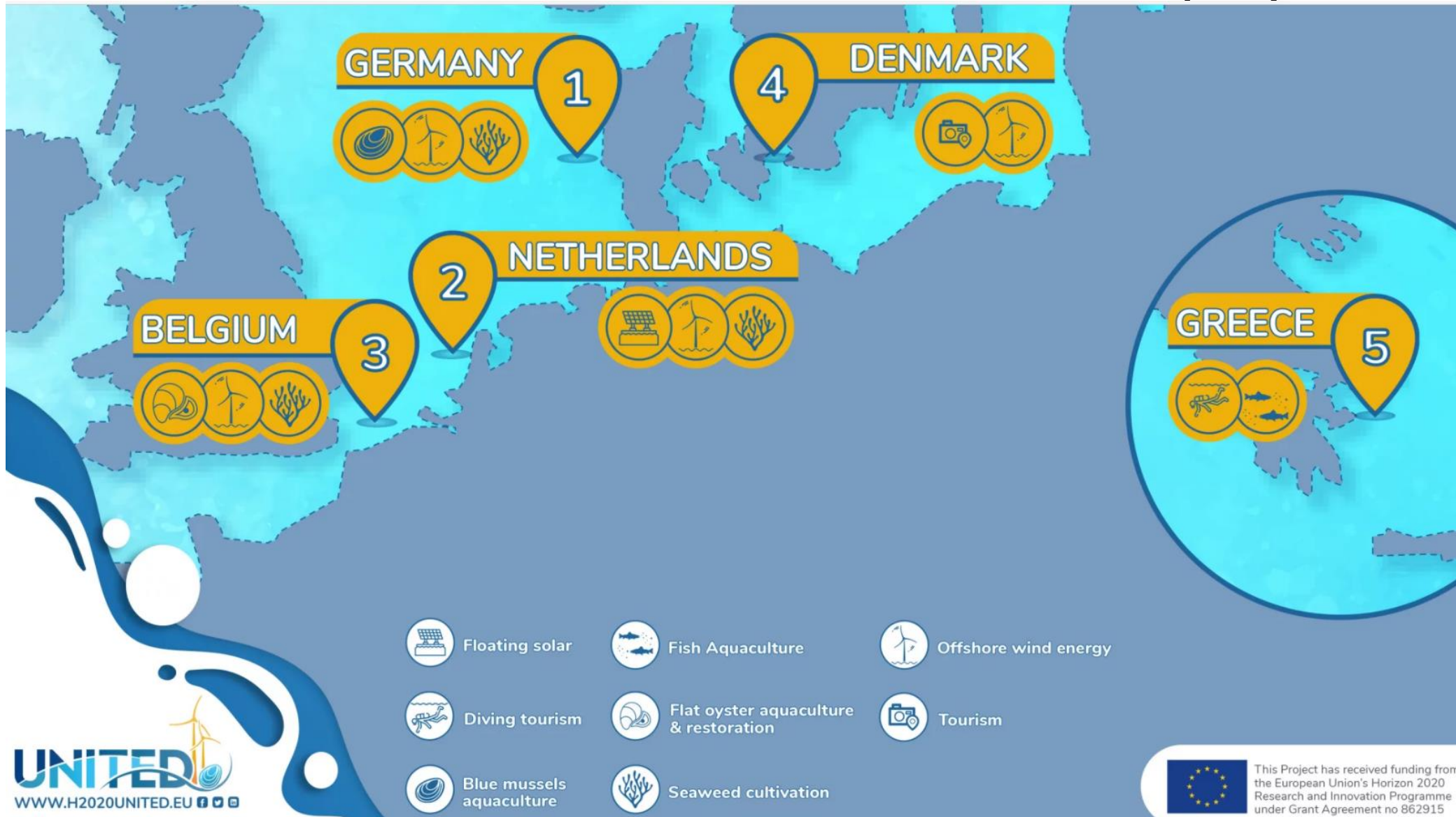
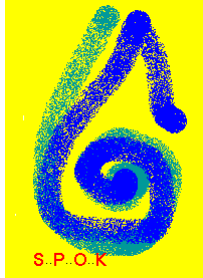
- <https://www.youtube.com/watch?v=Lb5HDBWtzJQ&t=4s>



Mouth protection was a requirement



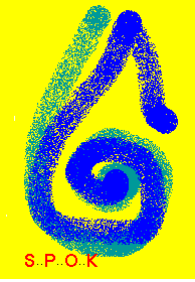
The UNITED demonstration Multi-Use Platform project



Source: <https://www.h2020united.eu/>



The Perspectives of Multi-Use Platforms

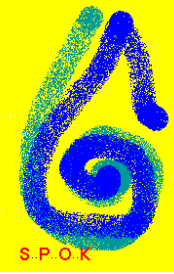


- Space offshore is limited
- Synergies can be found
- Examples from other combinations than UNITED
 - ✓ MUSICA, multi-use use of space solutions for the small islands; <http://musica-project.eu/>

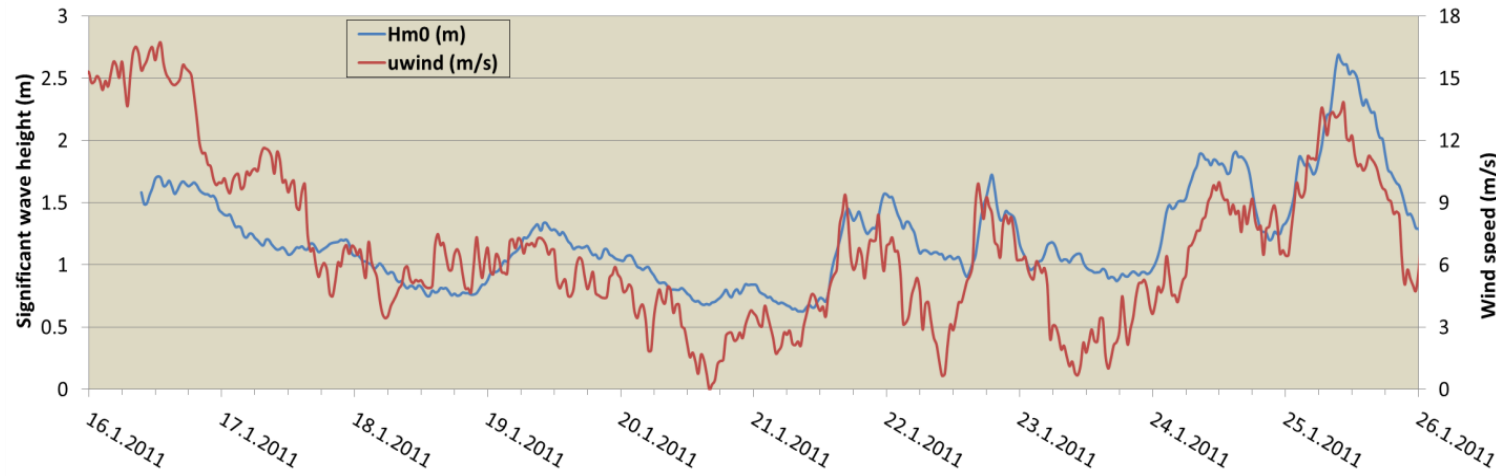
Source: <https://www.h2020united.eu/>



Wave and wind sharing the cable. Data from the North Sea



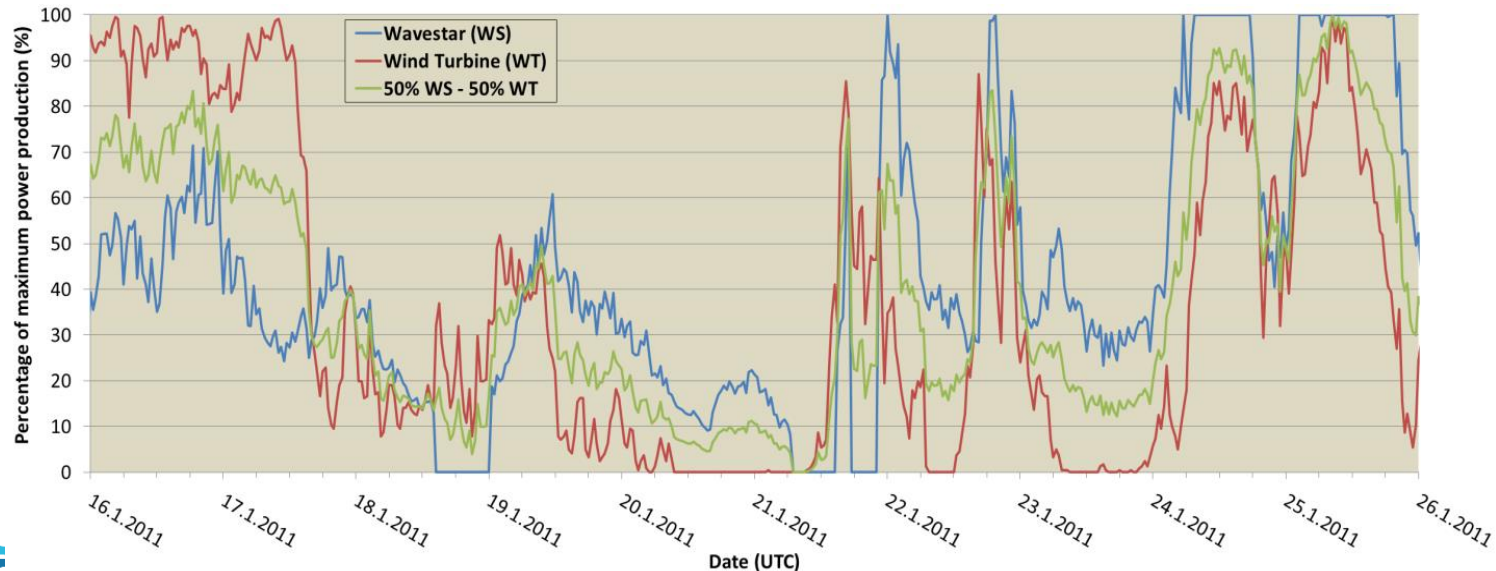
H_{m0} (m) and Wind Speed (m/s)



— H_{m0} (m)
— Wind Speed (m/s)

100 MW wind and
100 MW wave →
75 MDKK saved in
balancing cost

Percentage of maximum production (%)



— Wavestar (WS)
— Wind Turbine (WT)
— 50% WT – 50% WS



Source: ICOE
2012 report by
Julia
Fernandez
Chozas, H. C.
Soerensen et.
al





Danish Cooperative model for wind

- Shared ownership, one person one vote independent of shares
- Typically no loans – up front payment of total cost *
- One share equal to a production of 1,000 kWh/y
- Historically: ownership equal to own consumption of electricity
- Typically 3-5 shares => 3,000 – 5,000 kWh/y up to 2008
 - * Typically 350€ to 670€ a share
 - * A few banks are giving loans for individuals with security in revenue only

Simple tax rules possible – and needed:

- No tax when production revenue less than 940€/y
- Simple tax revenue form
- Only an advantage with less than about 10-20 shares**

** Else use standard for companies: profit less depreciation, but then remember auditor for the tax authorities



Offshore wind in Denmark – up to 2030

Two models:

Government Call for Tender

- ✓ 350 MW Nearshore almost ready
- ✓ Thor 1200 MW by 2024 in the North Sea ongoing
- ✓ Hesselø 1200 MW by 2027 in Kattegat just starting up

Open Door Procedure*

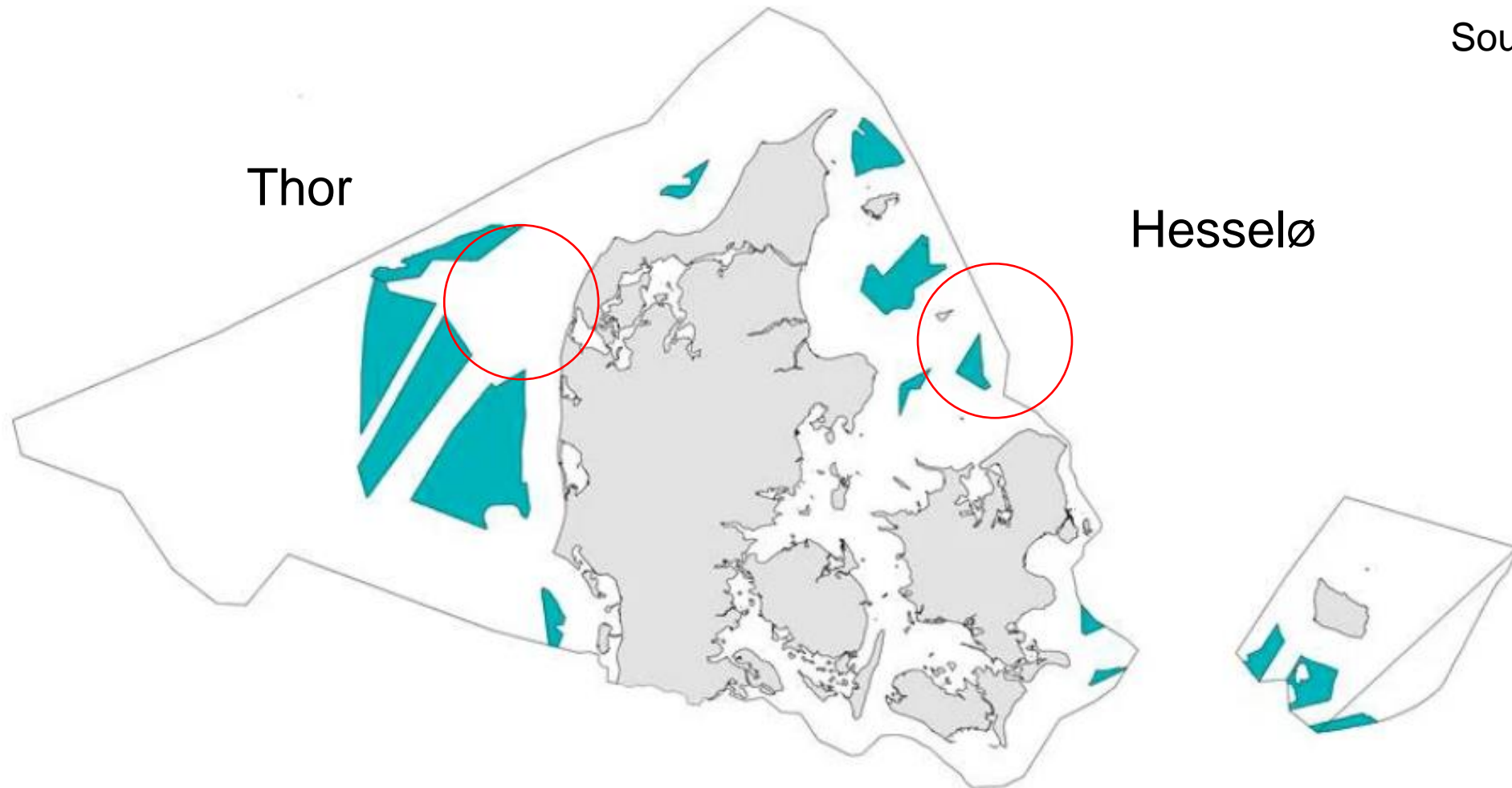
- ✓ Several proposals under discussion

* Without incentives

The Danish Potential for offshore wind is 12.4 GW



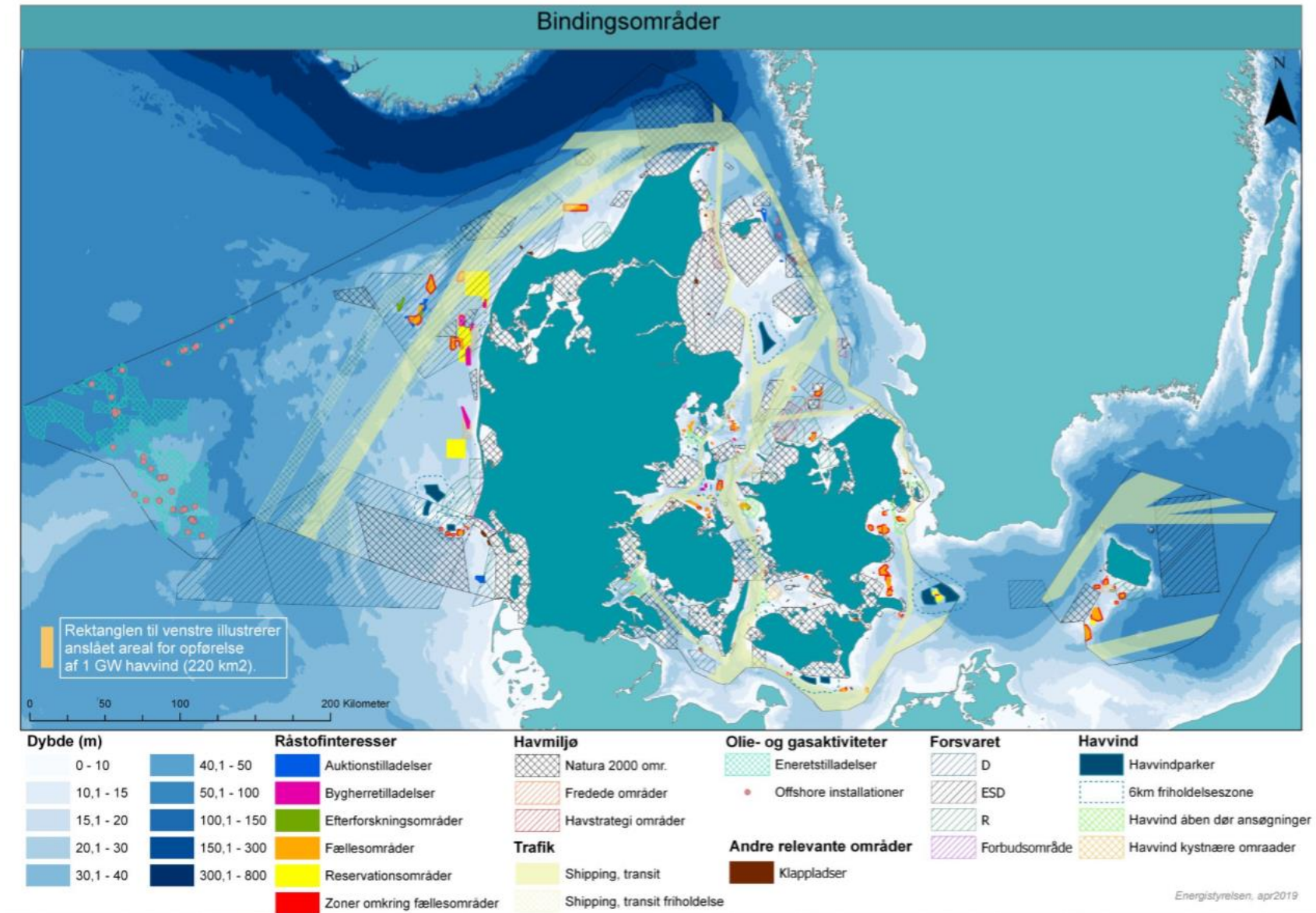
Source: ENS



The potential in Denmark is large as there is space enough



Source: ENS



By end of 2020 we have 25 GW offshore wind power in the Europe.

Energy island by 2030-33 in the North Sea



- 3-10 GW
- Facilities for PtX

Energy Island
surrounded by RE
plants

