inetum realdolmen
Positive digital flow

Windparken:

wat, hoe en waarom?

Dirk Schelkens

- **Management & offshore safety consultant**
- **Board Member Belgian Offshore Cluster vzw**

De Belgian Offshore Cluster behartigt de belangen van de toeleveraars voor de windindustrie op zee. Dit onafhankelijke platform is zowat de ‘glue’ tussen sector, de overheid en internationale organisaties.

Van waar waait de wind op de Noordzee?

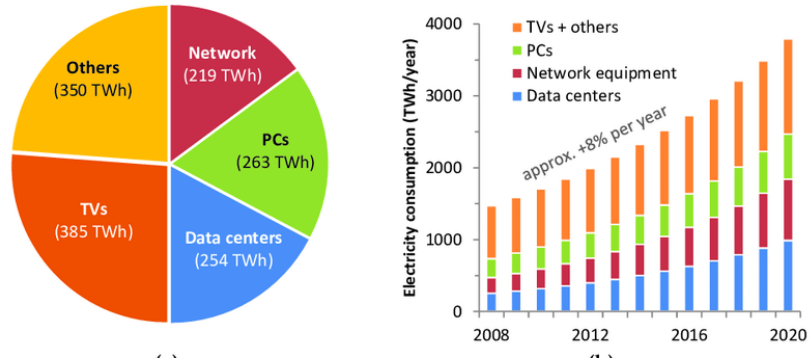
DIRK SCHELKENS

VRAAG NAAR ENERGIE

- **Verhoogde Energieconsumptie in industrie en huishoudelijk gebruik.**

Vereisten

- ✓ **Carbon management**
- ✓ **Circulaire economie**
- ✓ **Aandacht voor de milieu-impact**
- ✓ **Groene energie/ hernieuwbaar**
- ✓ **Energie-efficiëntie**



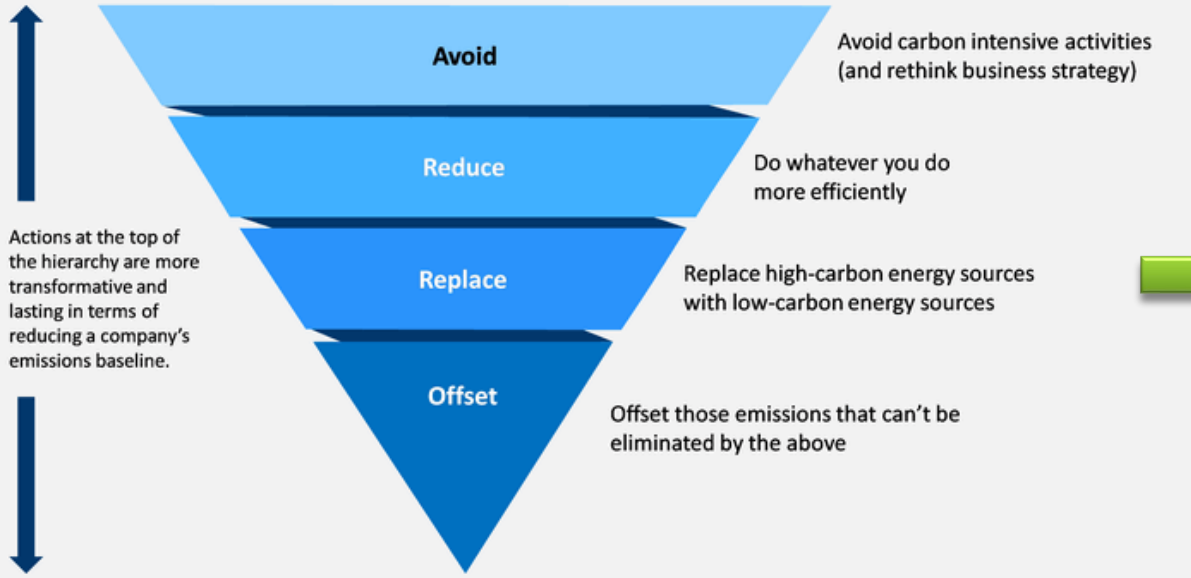
The worldwide electricity consumption of ICT during operation (redrawn from Pickavet 2008, [5]). (a) Situation in 2008, each category represents a similar share in the total ICT power consumption. (b) Projection from 2008 to 2020, the total ICT power consumption doubles every 9 years

CARBON MANAGEMENT

CARBON MANAGEMENT

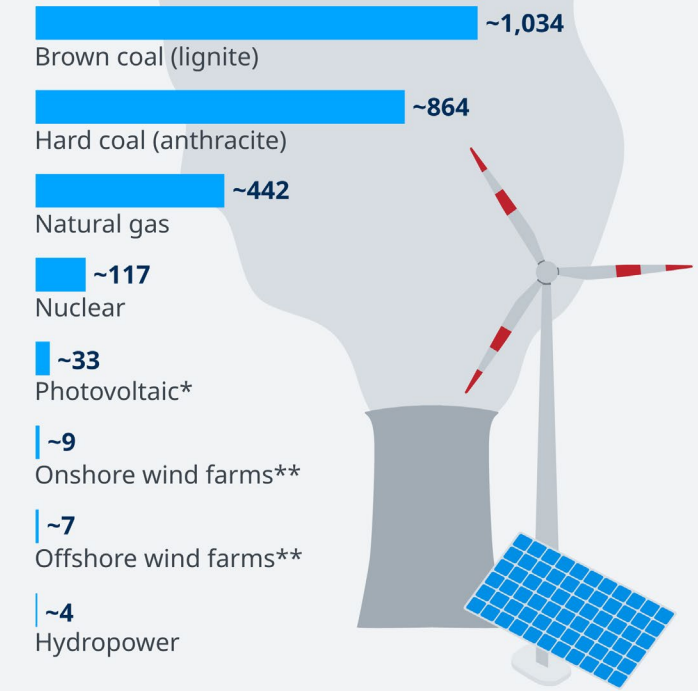
Carbon Management Hierarchy - Best Practice Approach

The Carbon Management Hierarchy



How does electricity affect the environment?

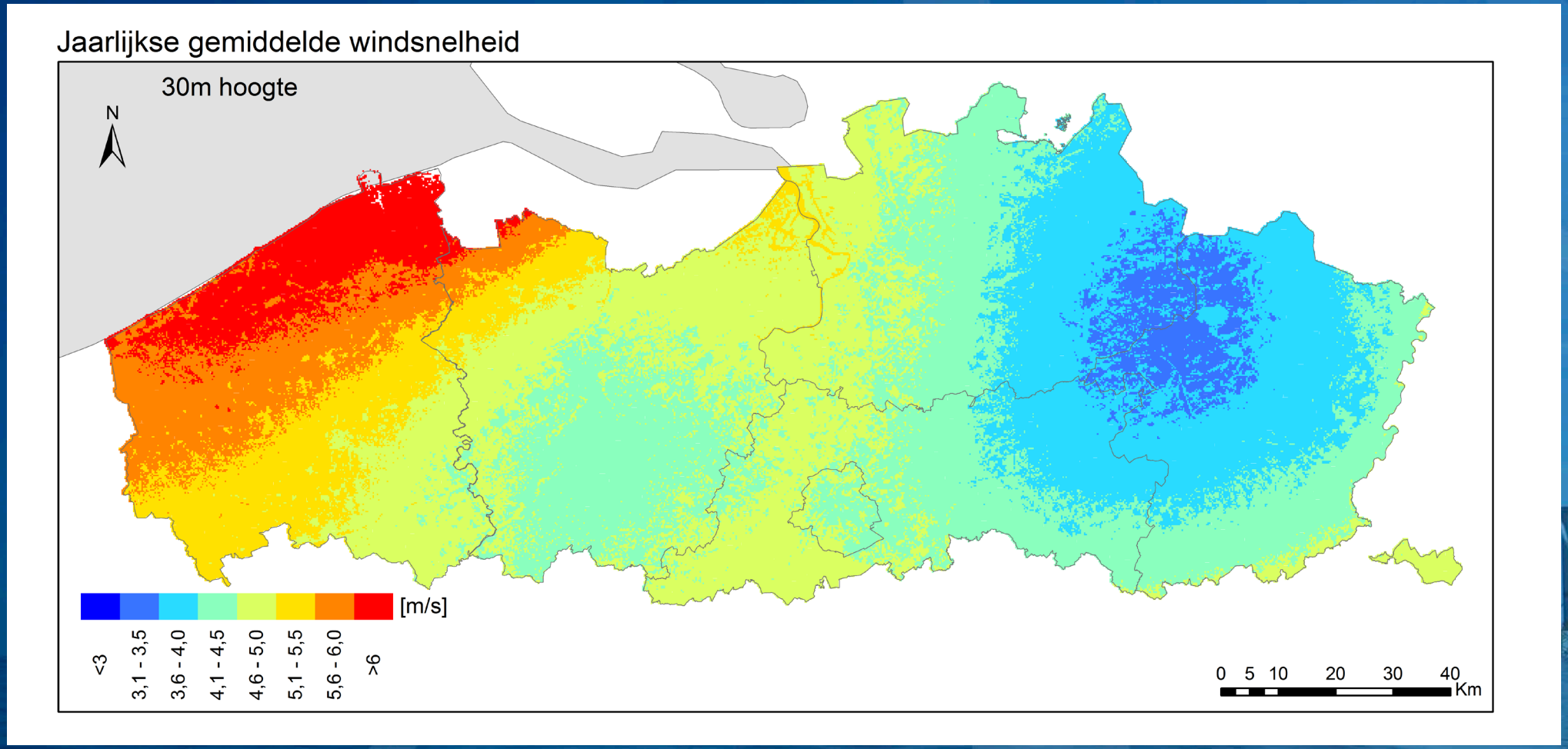
CO_2 equivalent (gram per kilowatt-hour)*



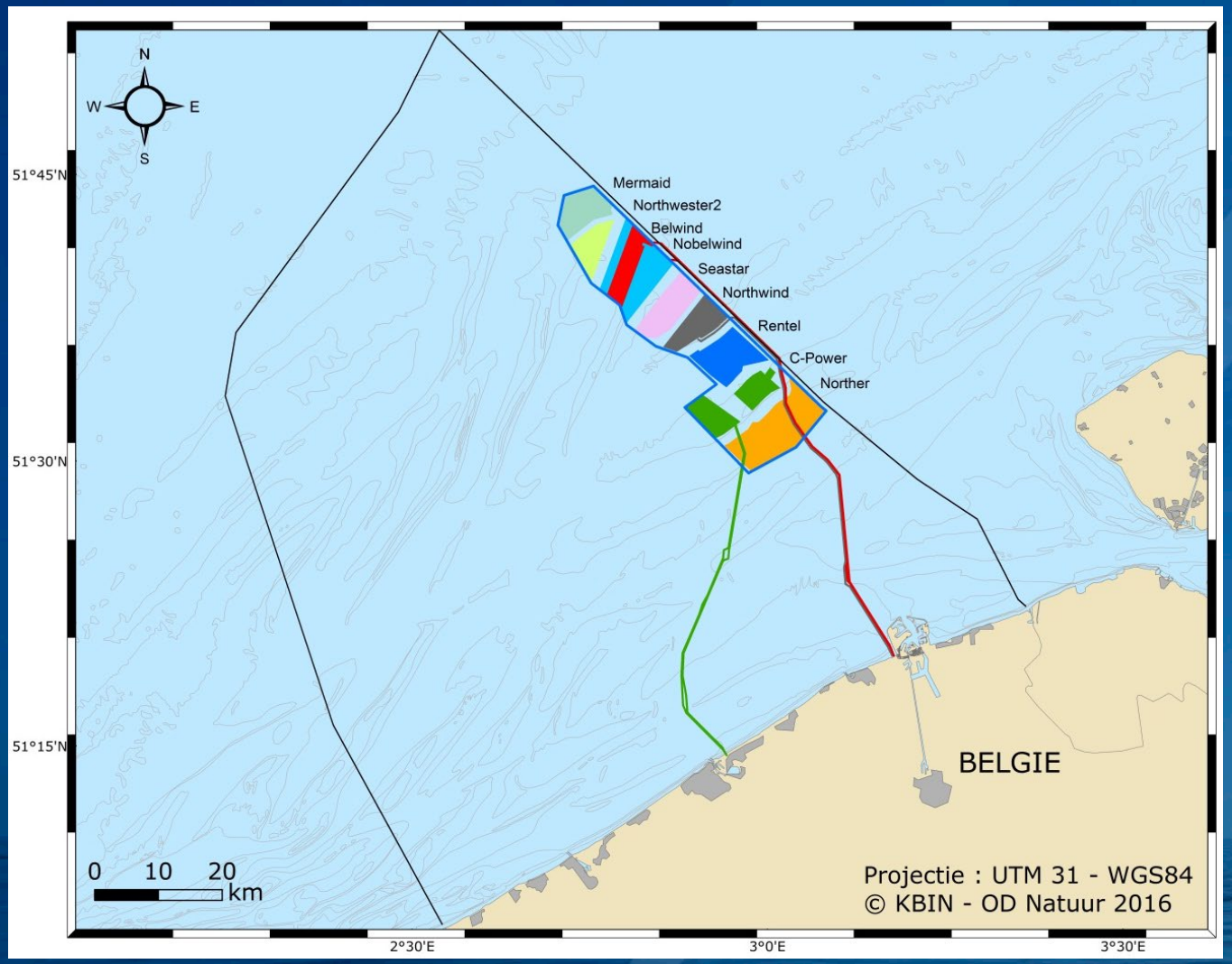
** complete life cycle*
*** solar panels using silicon*
**** most recent generation of wind turbines*

Source: German Environment Agency (Umweltbundesamt) 2020, WISE

OOGSTEN WAAR TE OOGSTEN VALT



RUIMTELIJK MARITIEM PLAN



Op initiatief van de minister voor Noordzee werd op het Belgisch deel van de Noordzee een zone van 238 km² afgebakend voor de productie van hernieuwbare energie In die zone zijn tegen 2020 399 windturbines gepland, goed voor een totale capaciteit van meer dan 2.200 MW.

Uitgaande van een capaciteitsfactor van 40% voor de windparken kan gesteld worden dat windparken op zee tegen 2020 zouden instaan voor 10% van de elektriciteitsproductie in België, of een equivalent van bijna de helft van het elektriciteitsverbruik door gezinnen.

9 CONCESSIES = 225 KM² - 2262 MW

C-POWER

BELWIND

NORTHWIND

NOBELWIND

RENTEL

NORTHER

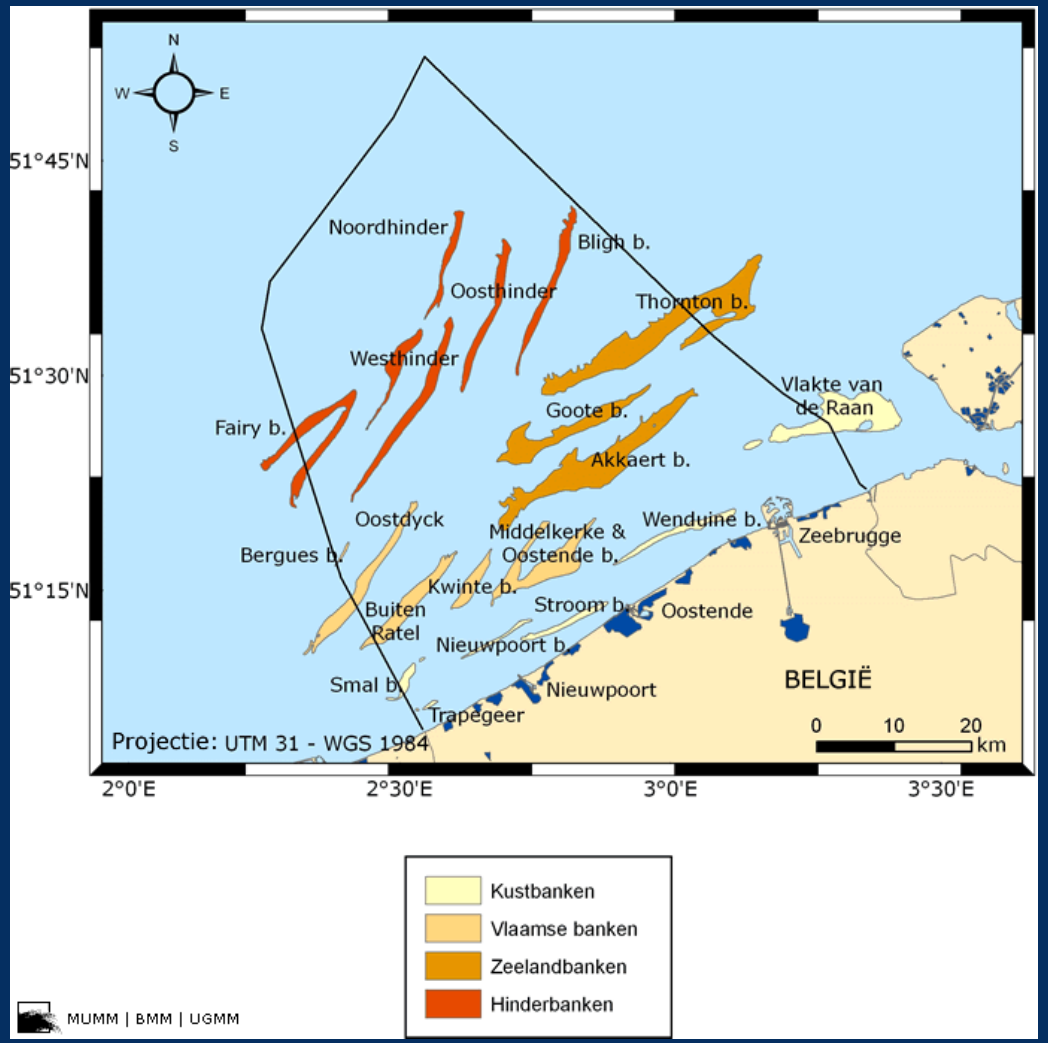
NORTHWESTER 2

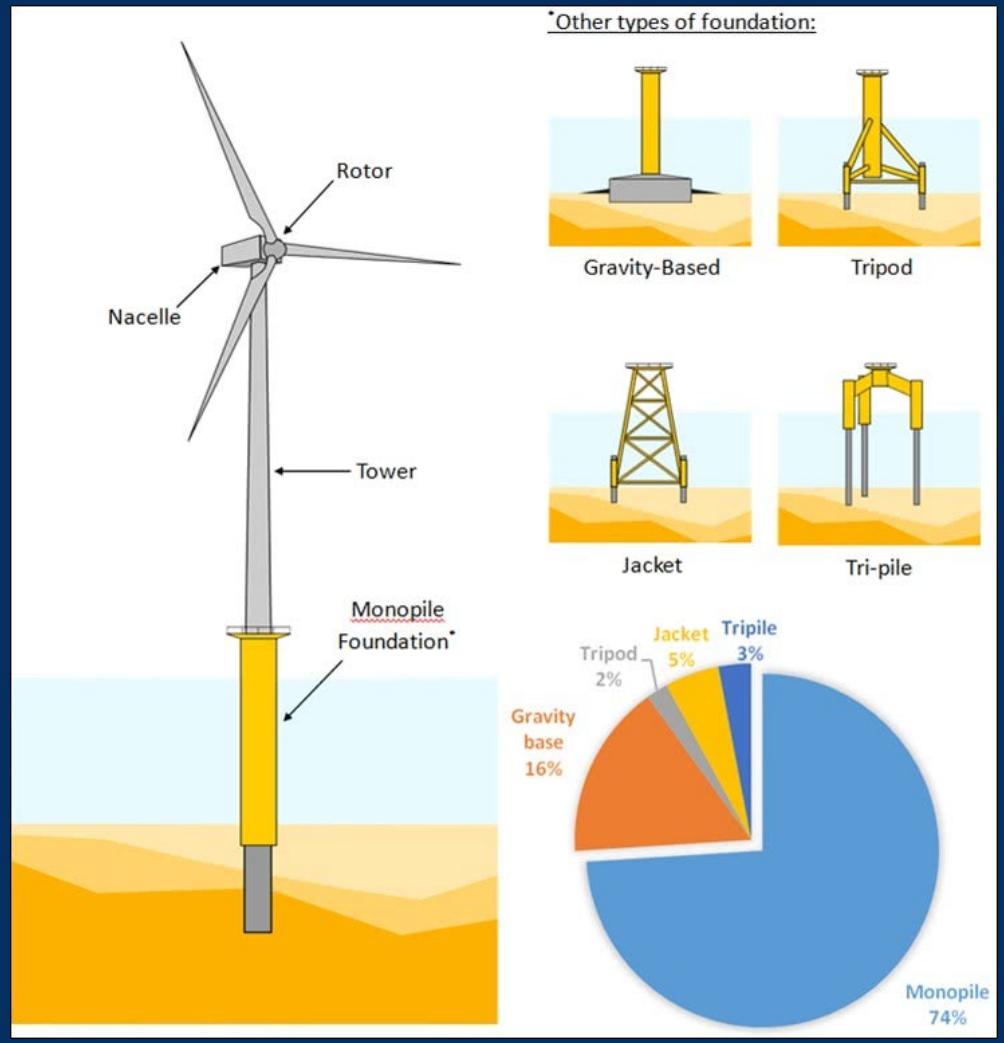
SEAMADE - ZONE MERMAID

SEAMADE - ZONE SEASTAR

https://www.belgianoffshoreplatform.be/en/projects/

WAAROM - THORNTONBANK





NORTHER

Depth:	20 - 35 m
Distance to shore:	23 km
Acreage:	44 km²
Capacity Wind:	370 MW
Turbines:	44 (8,4 MW)

Turbines

Foundation:	Monopile
Height:	180 m
Rotor diameter:	164 m

Vestas

C-POWER

Depth:	14 - 28 m
Distance to shore:	30 km
Acreage:	19,84 km²
Capacity Wind:	325 MW
Turbines:	54 (6x 5 MW, 48x 6,15 MW)

Turbines

Foundation:	6x Gravity Based, 48x Jacket
Height:	158 m
Rotor diameter:	126 m

SENVION wind energy solutions

RENTEL

Depth:	22 - 36 m
Distance to shore:	34 km
Acreage:	22,72 km²
Capacity Wind:	309 MW
Turbines:	42 (7,35 MW)

Turbines

Foundation:	Monopile
Height:	196 m
Rotor diameter:	154 m

SIEMENS

NORTHWIND

Depth:	16 - 29 m
Distance to shore:	37 km
Acreage:	14,5 km²
Capacity Wind:	216 MW
Turbines:	72 (3MW)

Turbines

Foundation:	Monopile
Height:	127 m
Rotor diameter:	112 m

Vestas

SEAMADE - ZONE SEASTAR

view

Depth:	22 - 38 m
Distance to shore:	40 km
Acreage:	19,54 km²
Capacity Wind:	252 MW
Turbines:	30 (8,4 MW)

Turbines

Foundation:	Monopile

SIEMENS

NOBELWIND

Depth:	26 - 38
Distance to shore:	47 km
Acreage:	19,8 km2
Capacity Wind:	165 MW
Turbines:	50 (3,3 MW)

Turbines

Foundation:	Monopile
Height:	135 m
Rotor diameter:	112 m

Vestas

BELWIND

Depth:	15 - 37 m
Distance to shore:	49 km
Acreage:	17 km²
Capacity Wind:	171 MW
Turbines:	56 (55x 3 MW, 1x 6 MW)

NORTHWESTER 2

Depth:	25 - 40 m
Distance to shore:	51 km
Acreage:	12 km²
Capacity Wind:	219 MW
Turbines:	23 (9,5 MW)

SEAMADE - ZONE MERMAID

Depth:	24,4 - 39,5 m
Distance to shore:	54 km
Acreage:	16,7 km²
Capacity Wind:	235 MW
Capacity Waves:	20 MW
Turbines:	28 (8,4 MW)

view p

Turbines

Foundation:	Monopile
Height:	117 m
Rotor diameter:	90 m

Vestas

Turbines

Foundation:	Monopile
Rotor diameter:	164 m

Vestas

Turbines

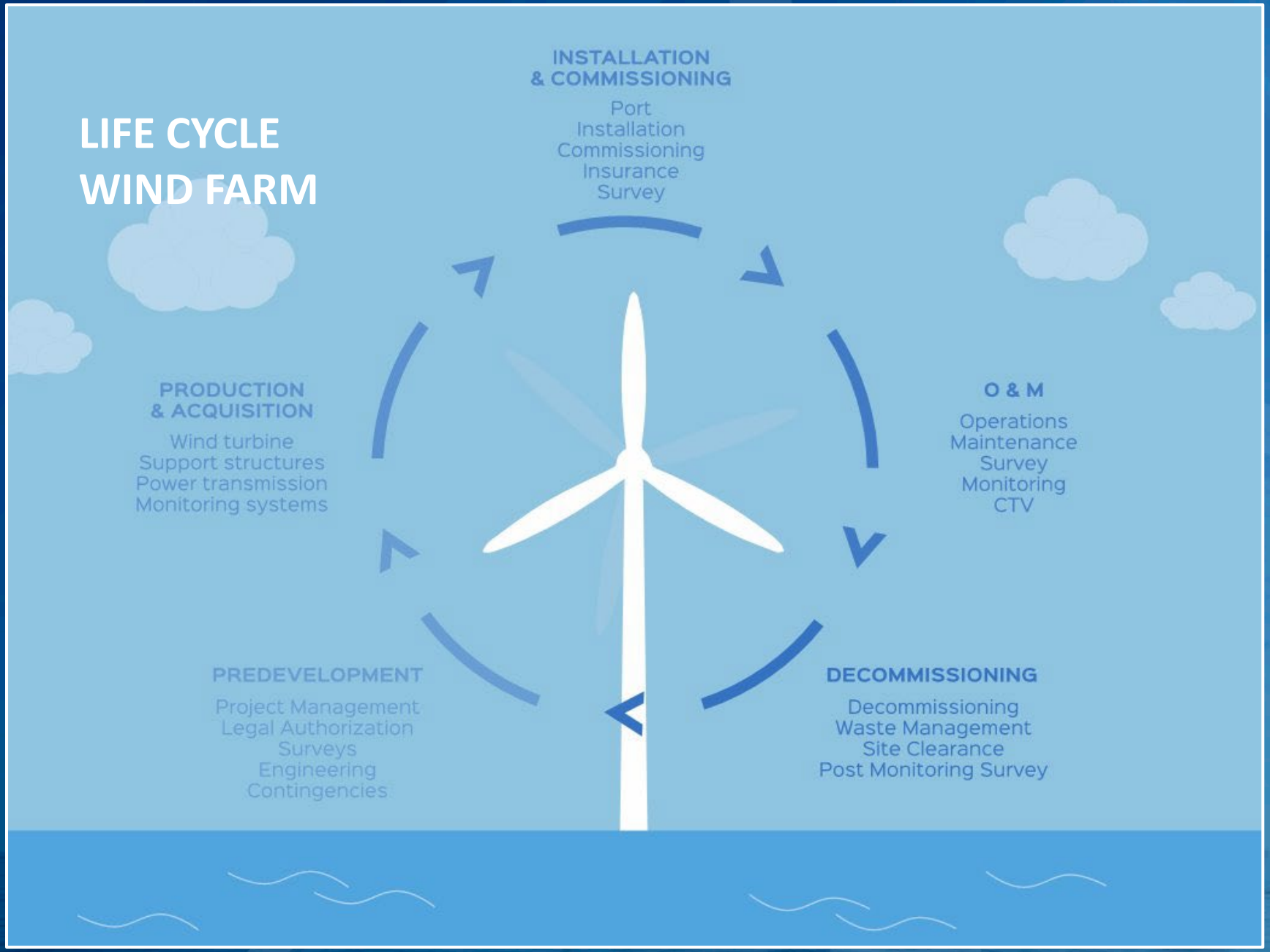
Foundation:	Monopile

SIEMENS

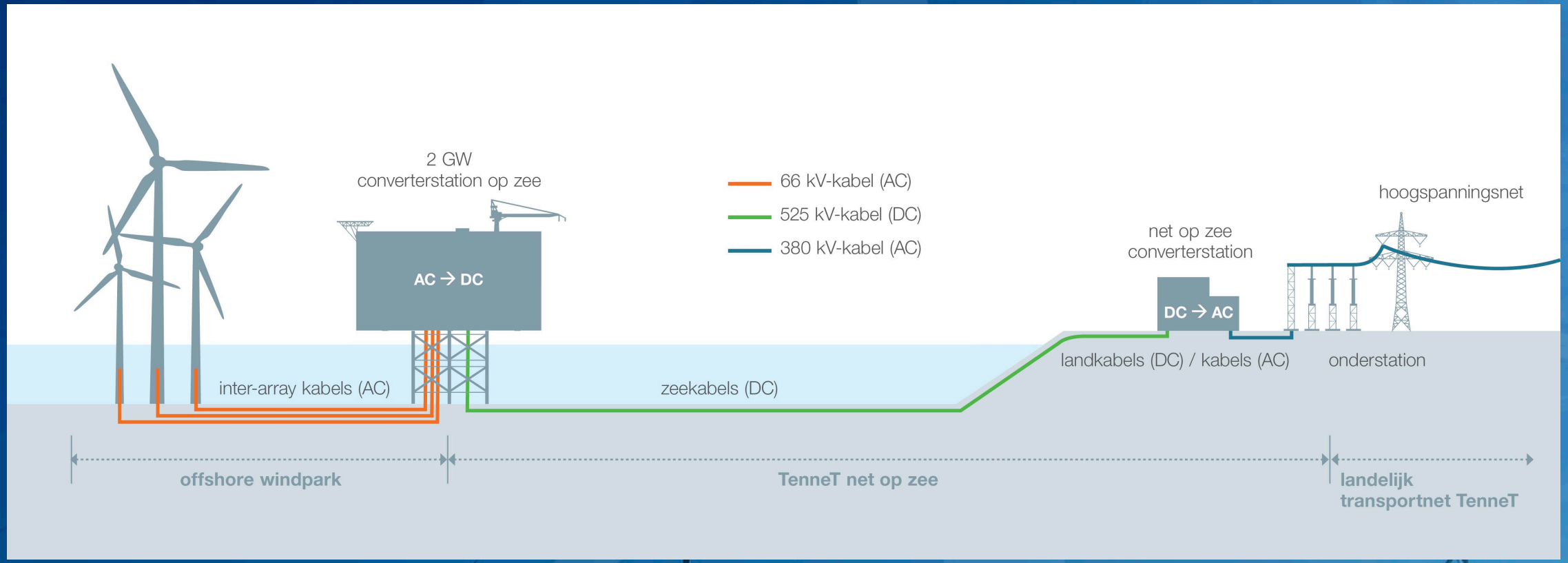
Vestas V90
3MW - Belwind

Vestas V164
9,5MW – Northwester 2

LIFE CYCLE WIND FARM



DESIGN VAN EEN OFFSHORE WINDPARK



kV-vermogens afhankelijk van het park-design

DESIGN VAN EEN OFFSHORE WINDPARK

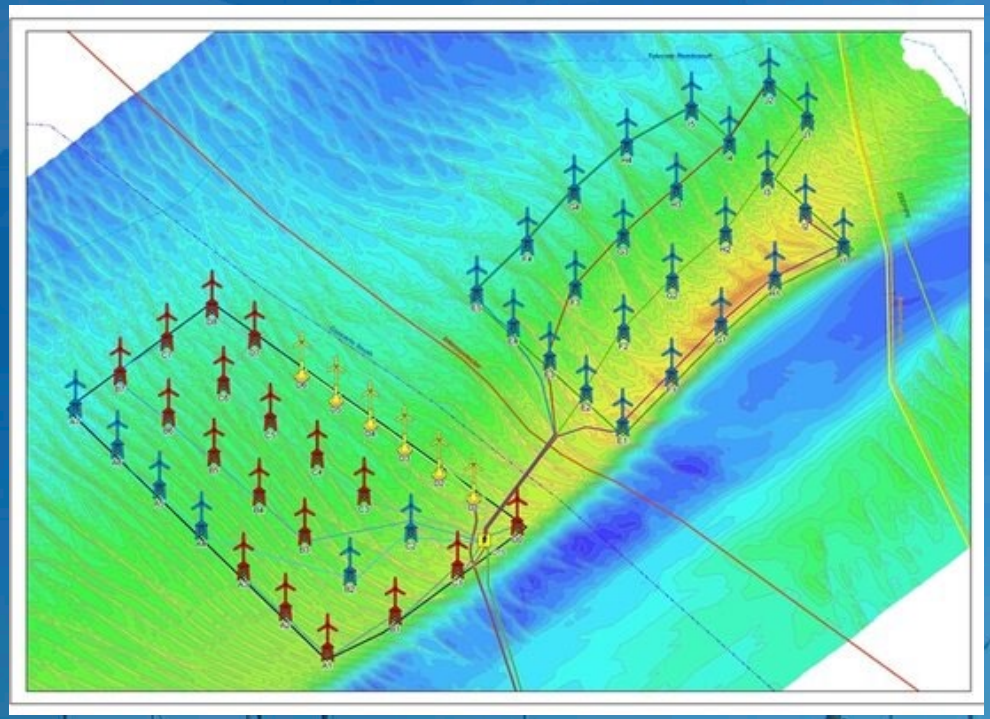
C-Power:

Infield cables: 33 KV
- +/- 58 km
- max 6 turbines per string

2 export cables: 150 KV
- +/- 40 km
- 85 kg/m
- 6000 ton

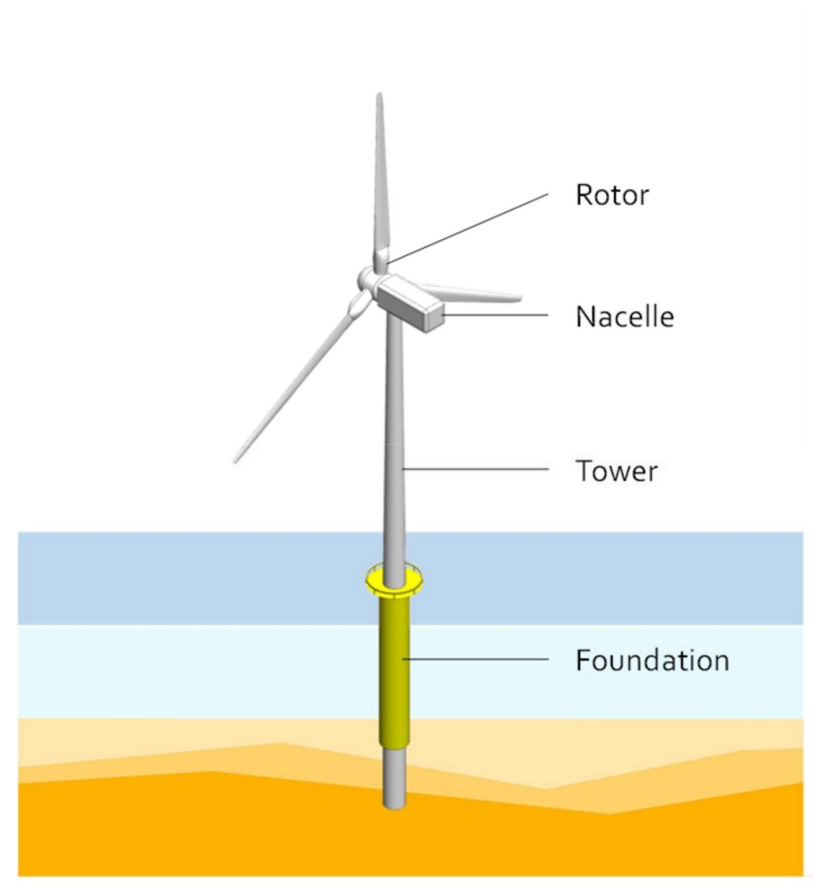
Fiber-optic cable

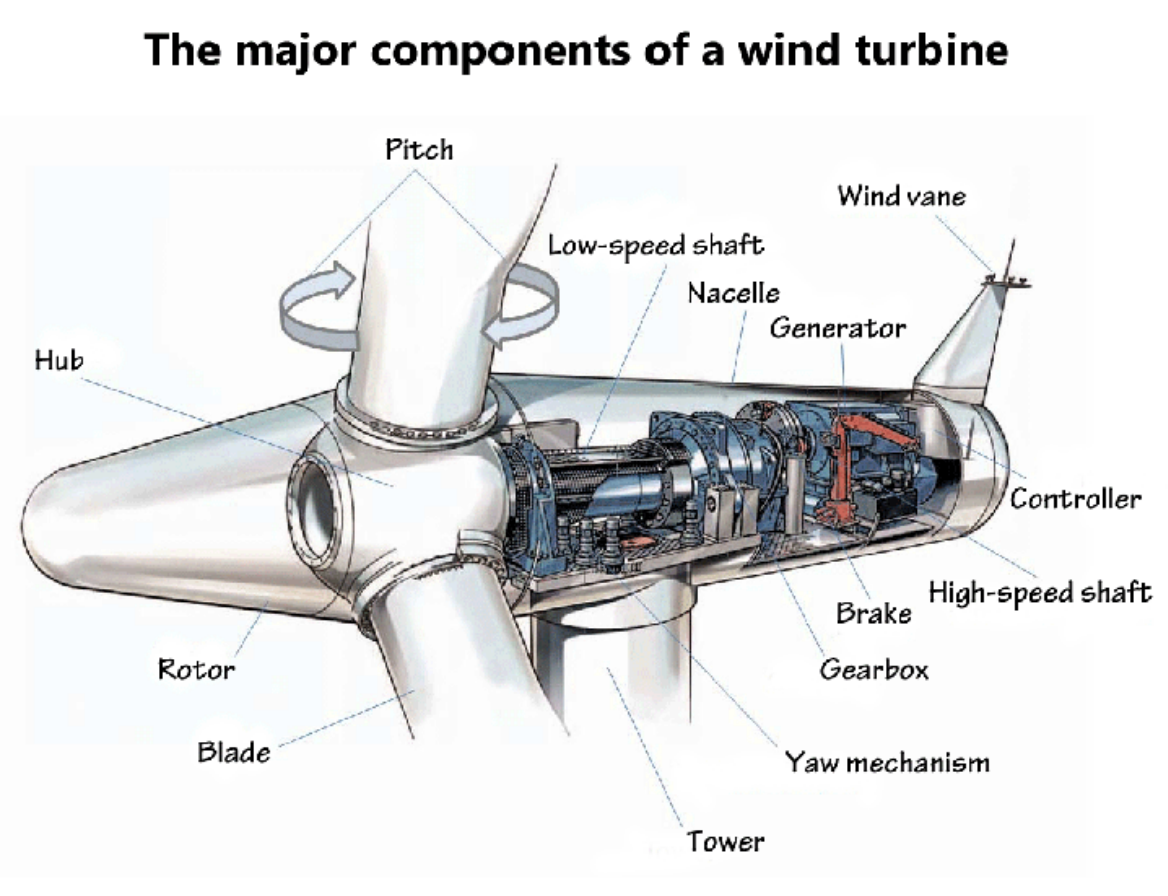
1 m diepte in de zeebodem



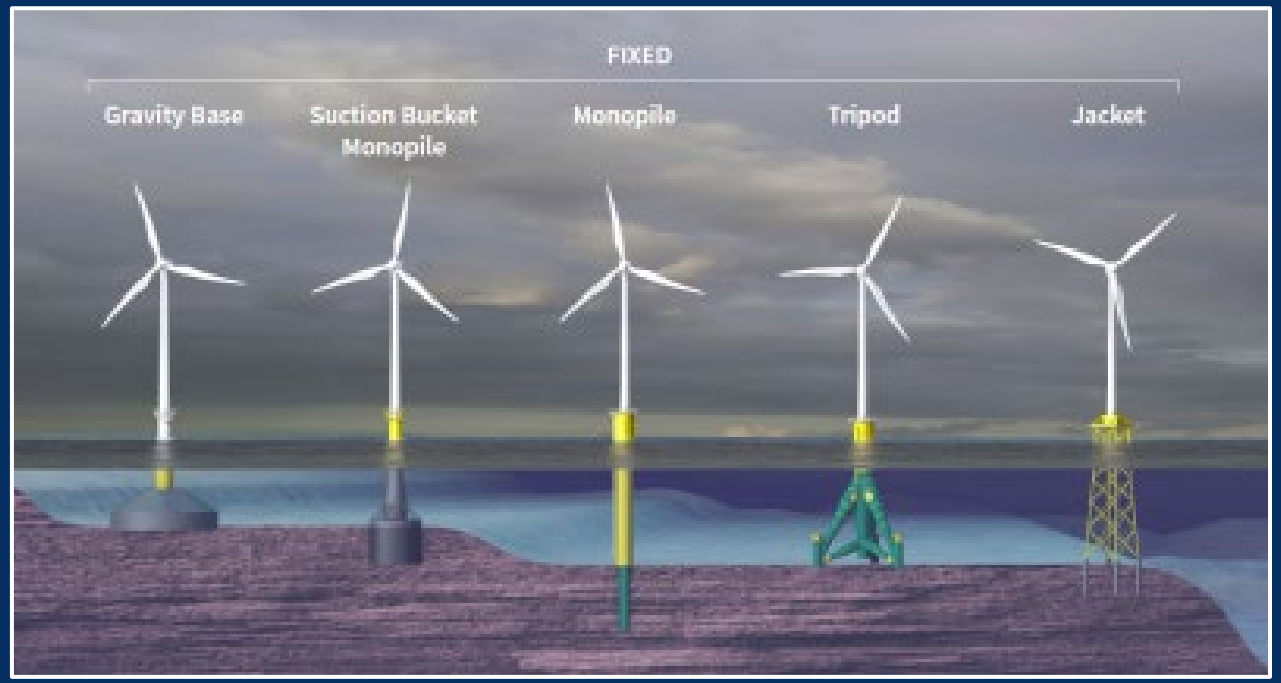

norther

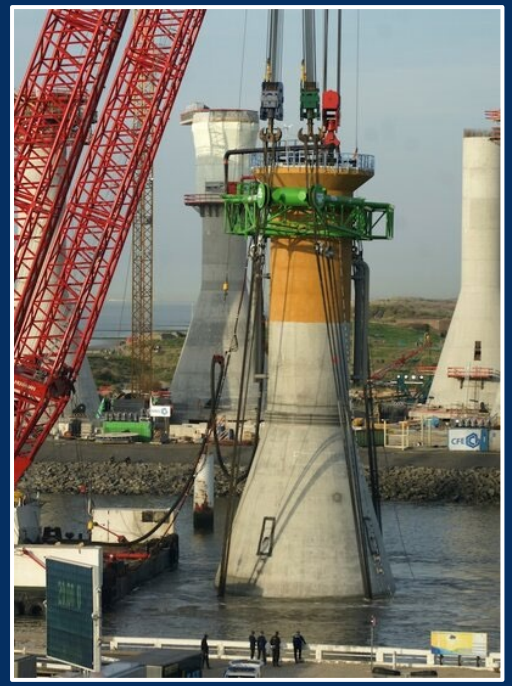
OFFSHORE WIND TURBINE



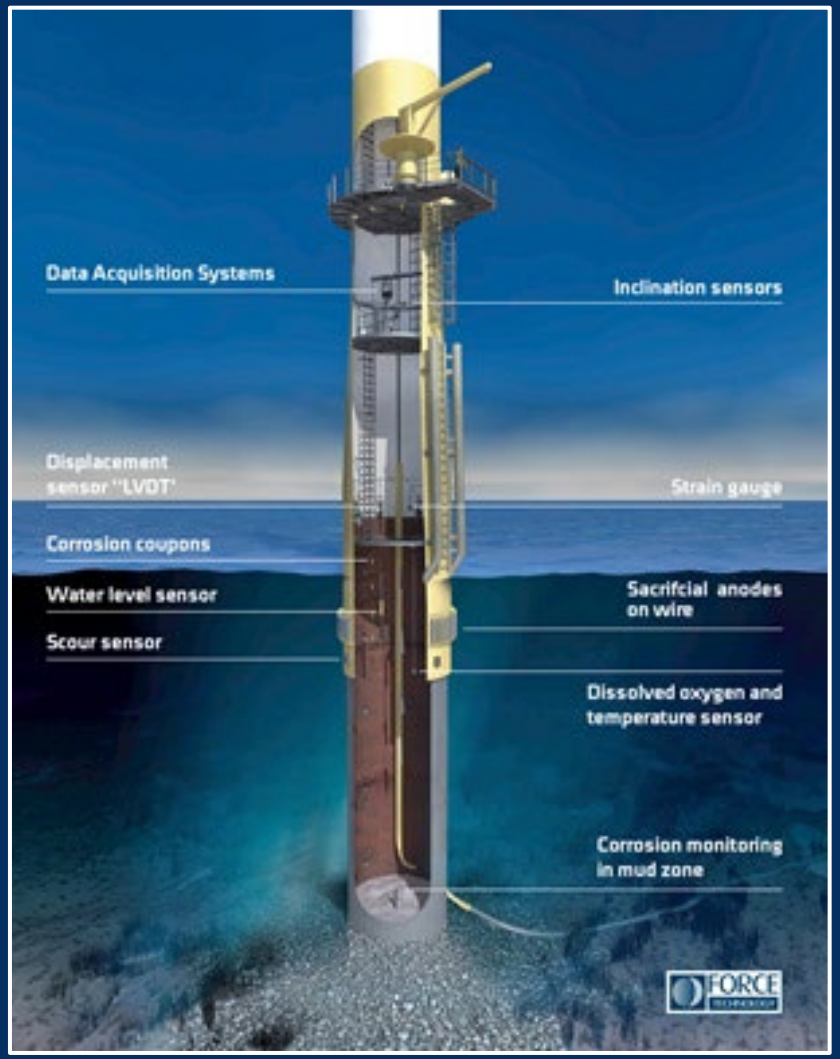


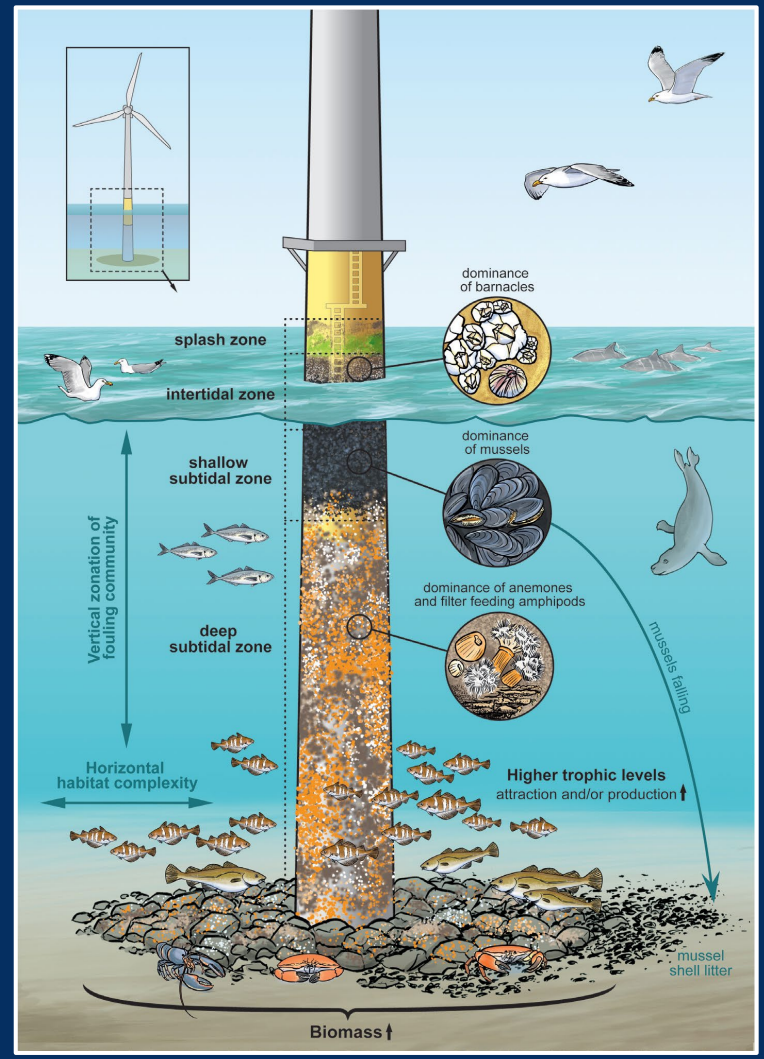
BOUW VAN EEN WINDTURBINE: FUNDERING & TP



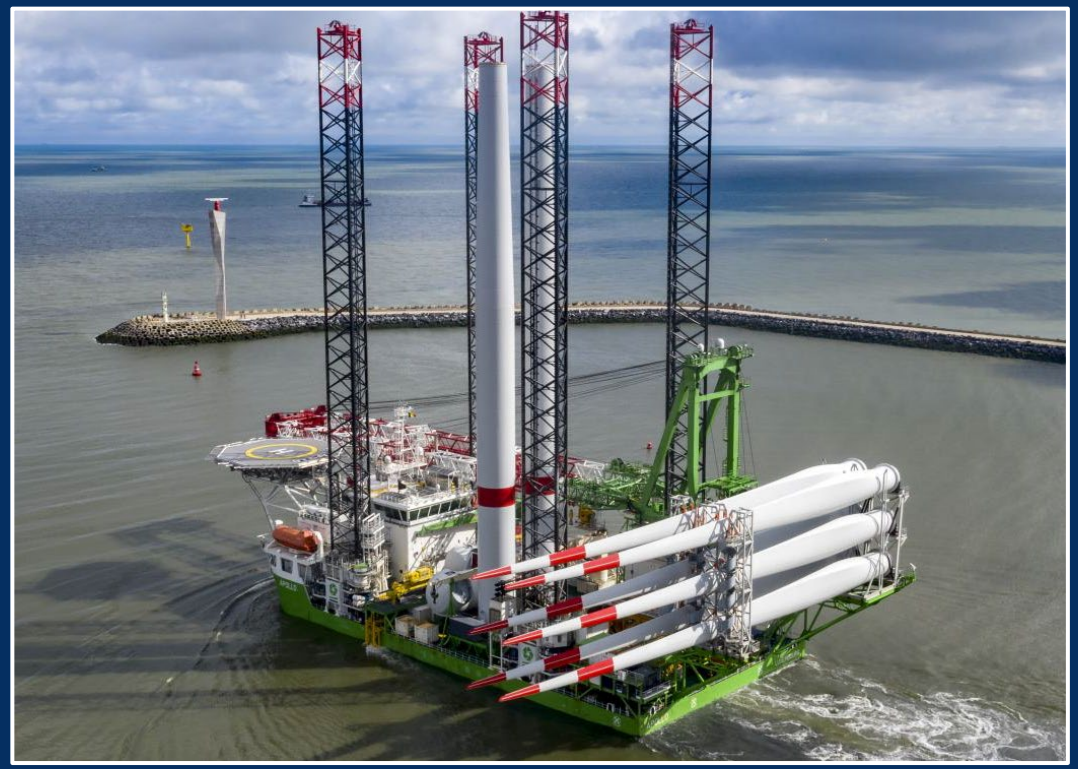


BOUW VAN EEN WINDTURBINE: FUNDERING & TP


Data Acquisition Systems
Inclination sensors
Displacement sensor "LVDT"
Strain gauge
Corrosion coupons
Water level sensor
Sacrifcial anodes on wire
Scour sensor
Dissolved oxygen and temperature sensor
Corrosion monitoring in mud zone
FORCE


dominance of barnacles
splash zone
intertidal zone
dominance of mussels
shallow subtidal zone
Vertical zonation of fouling community
dominance of anemones and filter feeding amphipods
deep subtidal zone
mussels falling
Horizontal habitat complexity
Higher trophic levels
attraction and/or production
mussel shell litter
Biomass

BOUW VAN EEN WINDTURBINE: TURBINE - BLADES



BOUW VAN EEN WINDTURBINE: BLADES

BOUW VAN EEN WINDTURBINE: OTS

BOUW VAN EEN WINDTURBINE: CABLE LAYING

O&M – CREW TRANSFER

DE TOEKOMST VAN OFFSHORE ENERGY

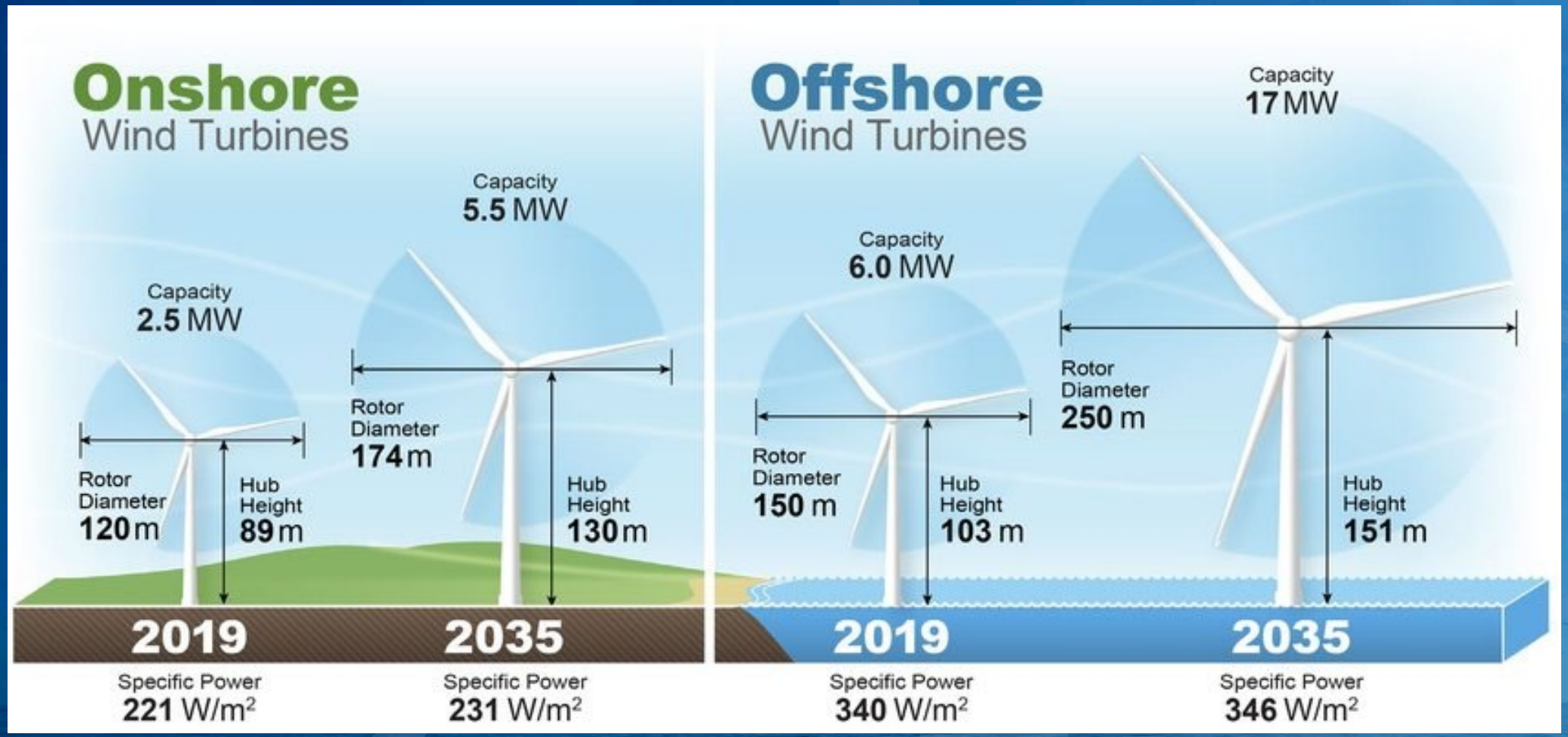
Morgen …

- ✓ Groter, Groter, Grootst
- ✓ Prinses Elisabeth Zone – marien ruimtelijk plan
- ✓ Prinses Elisabeth Energie-eiland
- ✓ Offshore interconnectors
- ✓ Deep water floating wind

Volgende week …

- ✓ Floating solar energy
- ✓ Storing of energy
- ✓ Wave energy
- ✓ Tidal energy

GROTER, GROTER, GROOTST



GROTER, GROTER, GROOTST

Deme Orion

CONSTRUCTION YEAR // 2019

GENERAL	type	Offshore Heavy Lift DP3 Installation Vessel
	classification	Det Norske Veritas & Germanischer Lloyd
DIMENSIONS	length	216.50 m
	breadth	49.00 m
	depth	16.80 m
CRANE	capacity	main 5,000 ton
		aux 1,500 ton
POWER & PROPULSION	dynamic positioning	DP3
	propulsion	4 x 4,500 kW Azimuth Thrusters
		2 x 4,200 kW Retractable Thrusters
		2 x 2,500 kW Tunnel Thrusters
	installed power	44,190 kW (Dual Fuel)
OPERATIONAL CONDITIONS	pay load (max)	30,000 ton
	free deck area	8,000 m²
	operating draft (max)	11.00 m
OTHER	accommodation	160 persons (extendable to 239 persons)
	helideck	installed
	moonpools	space claim for 19,6 m x 10,5 m
	auxiliary crane	2 x 100 ton, knuckle boom, manriding
	other	8 points mooring system

* Under construction

Jan de Nul – Les Alizés

Classification	Offshore Construction Vessel - Lifting DYNAPOS-AM/AT-R (DP Class 2) Unrestricted navigation Clean Ship ND07 - Green passport EU
Flag	Luxembourg
Length Overall	236.8 m
Breadth	52 m
Maximum Draft	10.5 m
Moulded Depth	16 m
DWT	61,000 t

CRANE SYSTEM

Crane Make	Huisman
Max. Lifting Capacity	Main block 5,000 t at 36 m
Auxiliary Block	1,500 t at 46 m
Lift above Deck	Main block: 125 m at 21.5 m Auxiliary block 167 m at 29.5 m
Depth Range	Auxiliary block 600 t at 100 m water depth Auxiliary block 380 t at 440 m water depth
Cargo Deck	9,300 m^2
Max. Deck Load:	30t/m^2

ACCOMMODATION

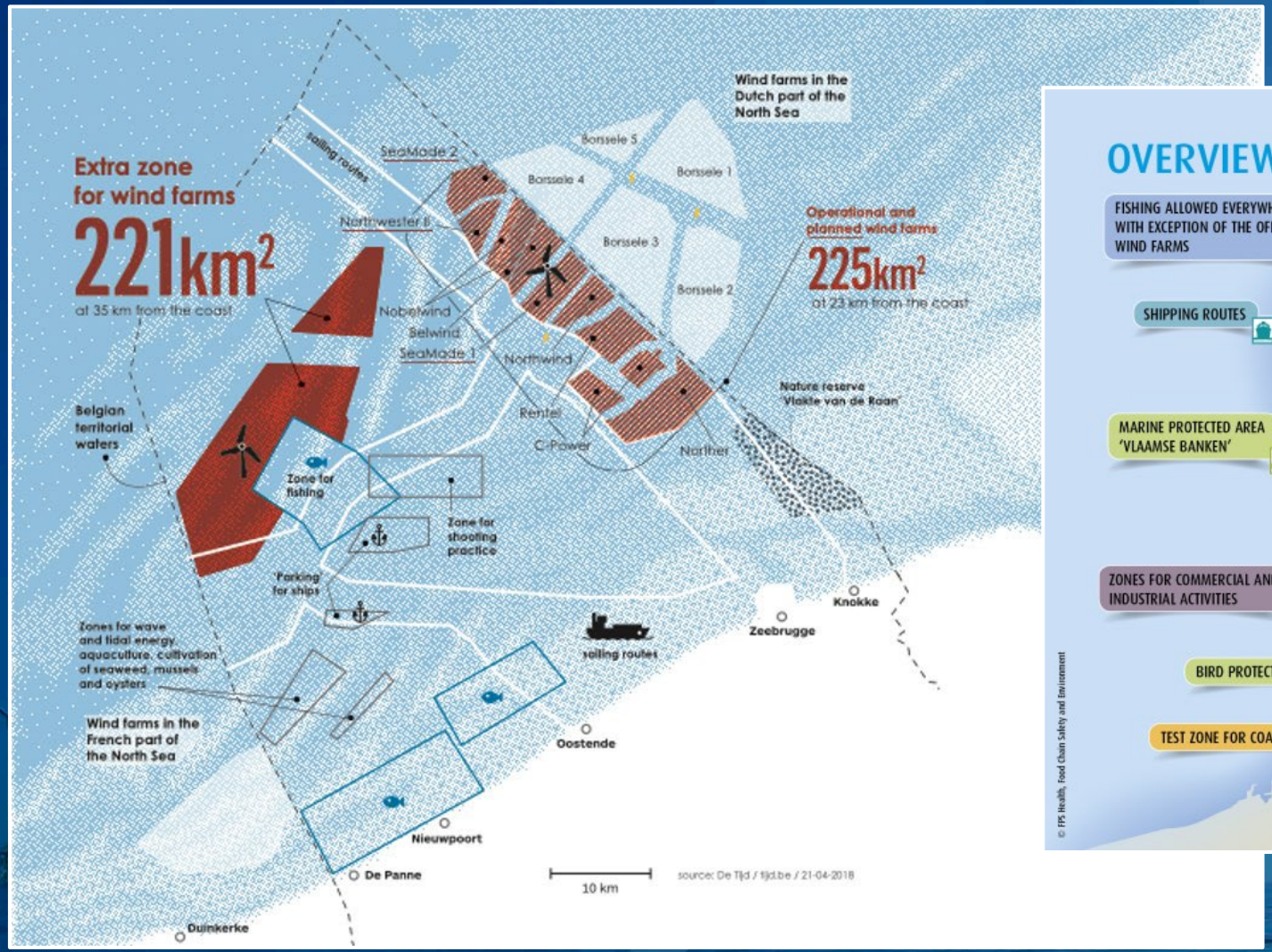
Accommodation	120 single, 15 double cabins
Heli Deck	D 22.8 m, MTOW 14.6 t, Sikorsky S-61N, S-92 and Agusta-Westland EH-101

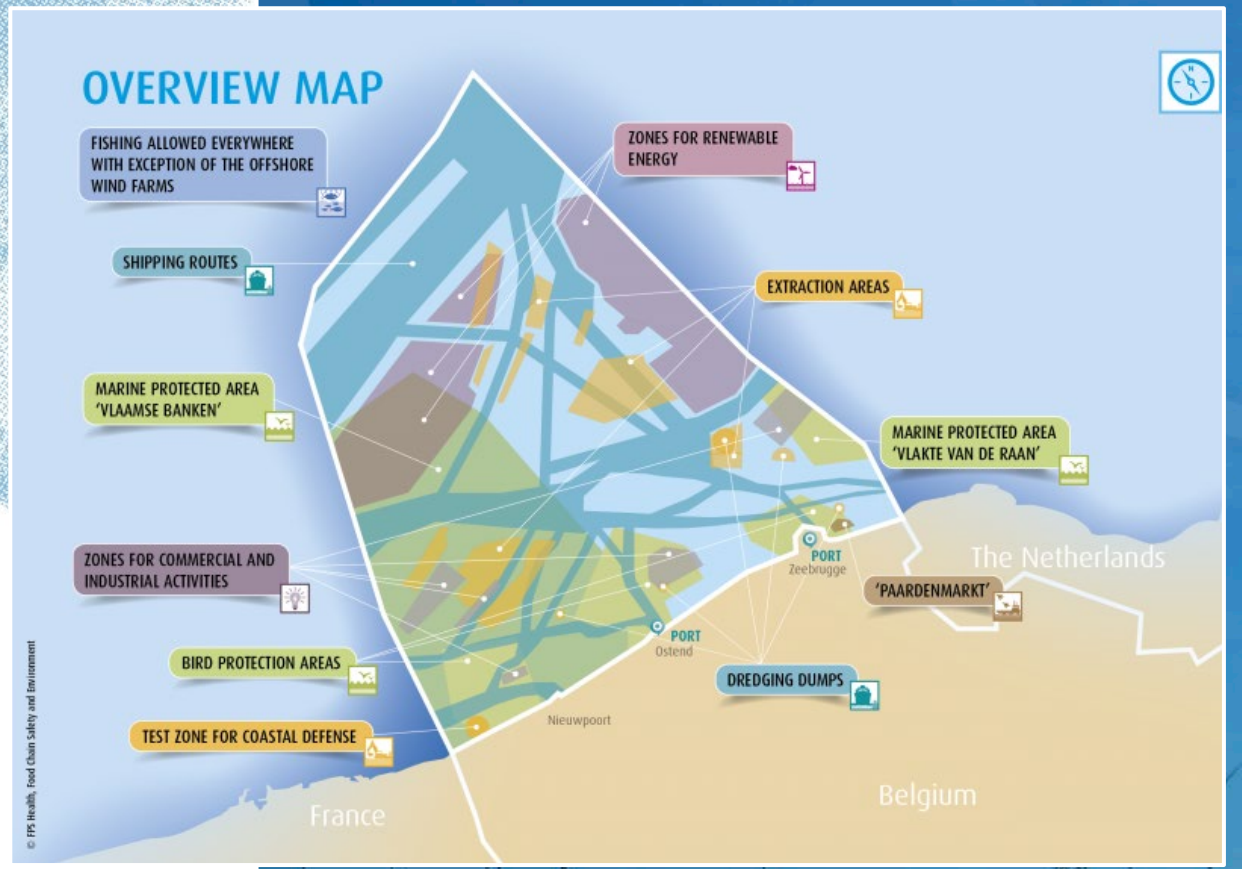
MACHINERY - PROPULSION

Main Gen. Sets	Diesel Engines MAN 6 x 7,200 kW 3 x 6,600 V, 60 Hz
Emergency Gen. Set	600 kW
Harbour Gen. Set	1,700 kW
Emissions	ULEv (Ultra Low Emission vessel) IMO Tier III Euro stage V Inland Waterway (using DPF)
Main Propulsion	4 x azimuth thrusters 3,000 kW
Retractable Thrusters	2 x 3,250 kW
Bow Thrusters	2 x 2,600 kW
Max. Speed	13 kn

https://www.jandenul.com/nl/nieuws/jan-de-nul-laat-offshore-installatieschip-les-alizes-te-water

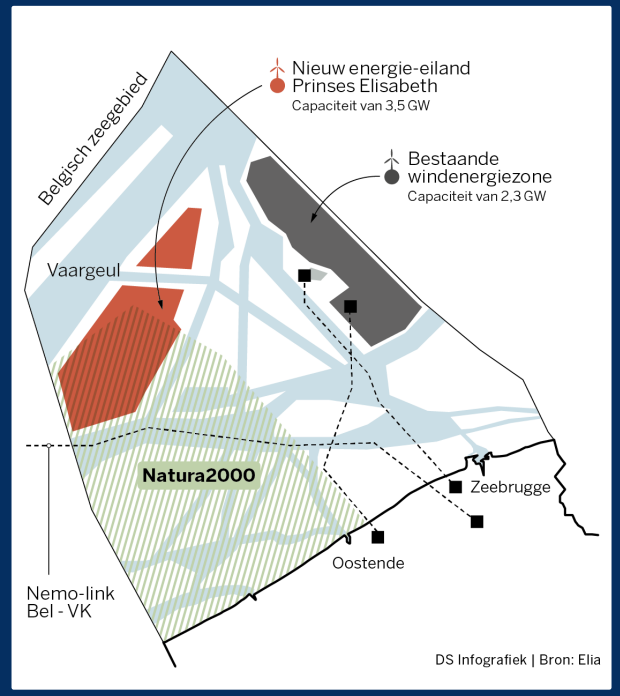
MARIEN RUIMTEPLIJK PLAN

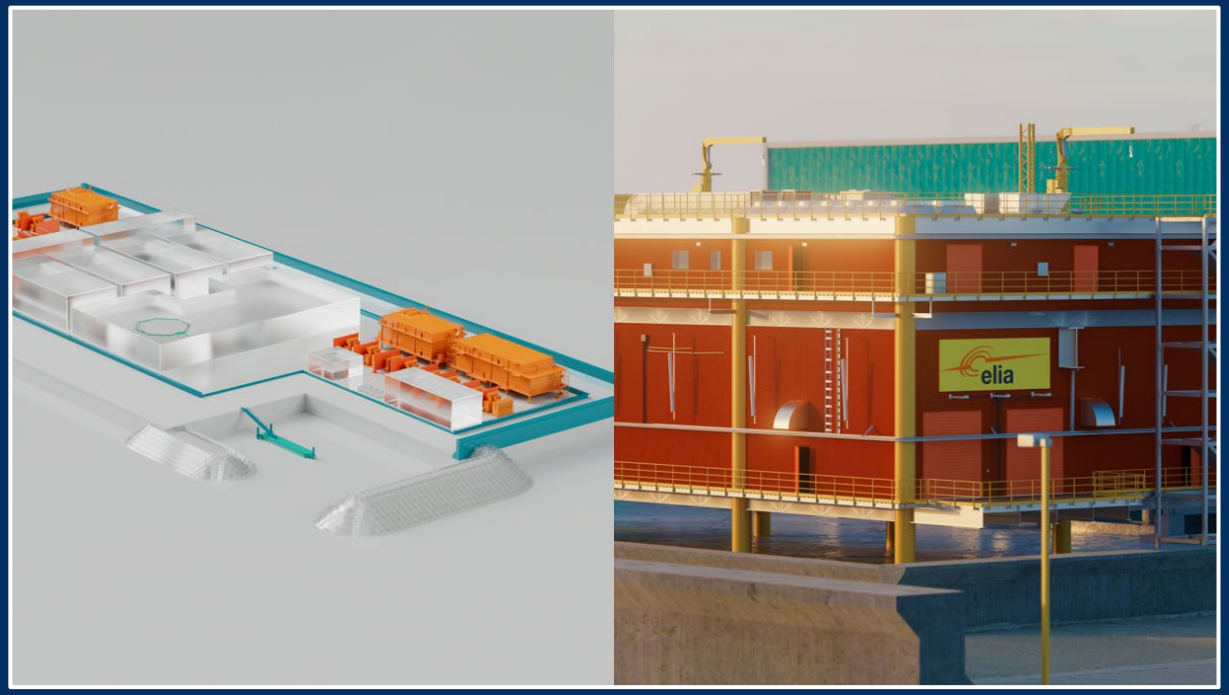




PRINSES ELISABETH EILAND - ELIA

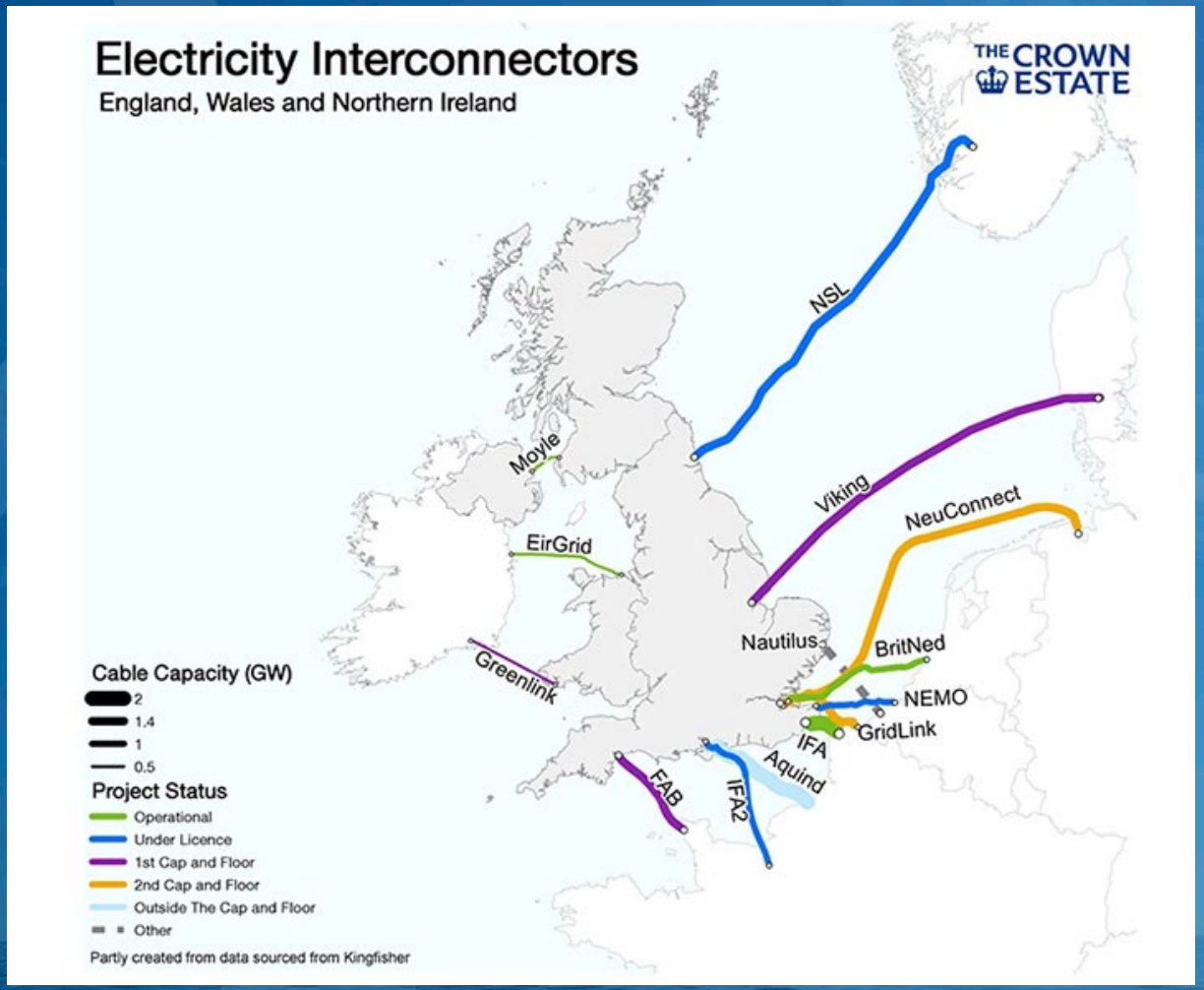
Het Prinses Elisabeth Eiland is het eerste energie-eiland ter wereld. Het is een **elektriciteitshub** waar kabels van zowel de **2de offshore wind zone** (Prinses Elisabeth zone) toekomen als van **toekomstige interconnectoren** met andere Europese landen zoals bv. het Verenigd Koninkrijk en Denemarken

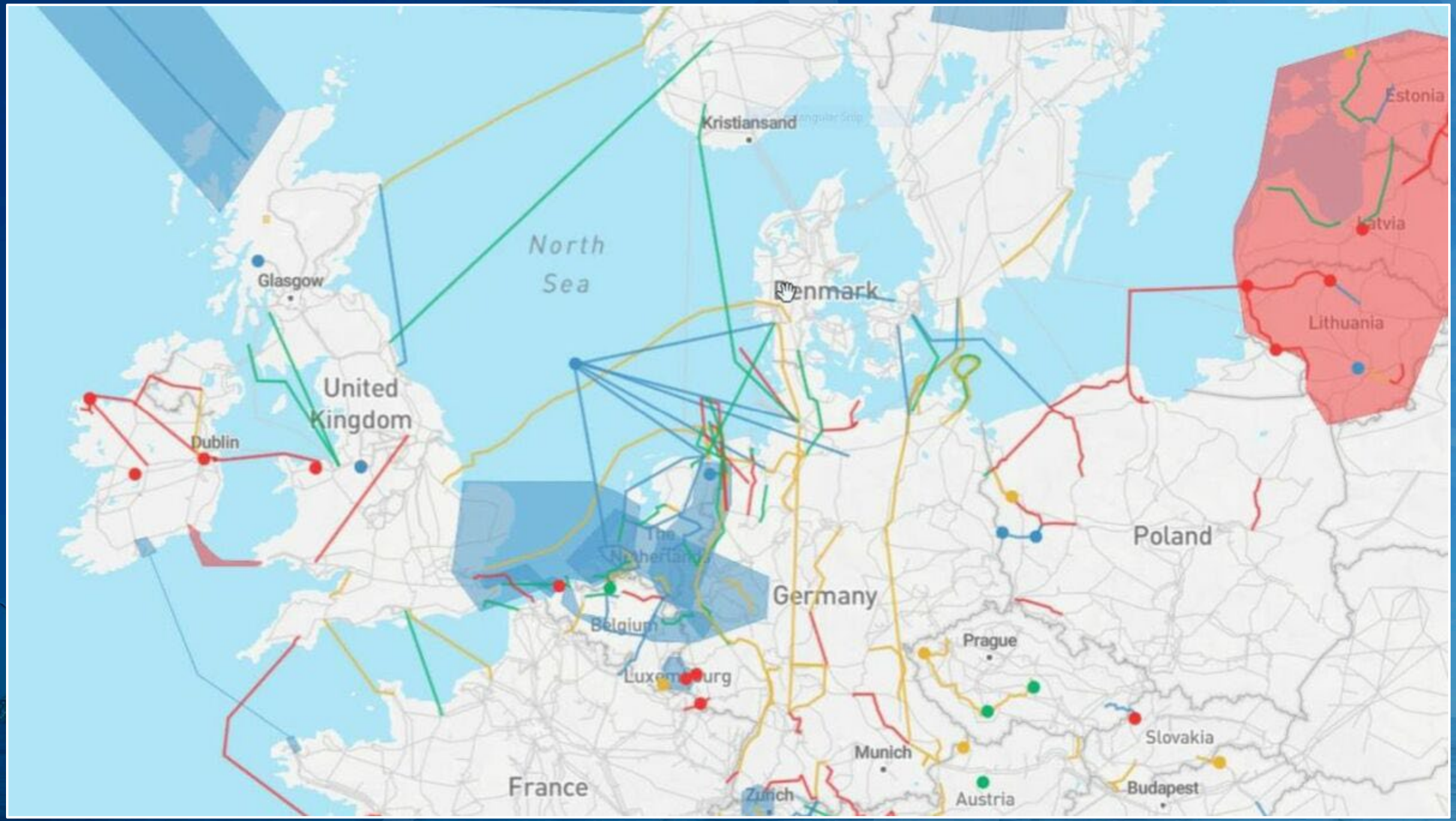


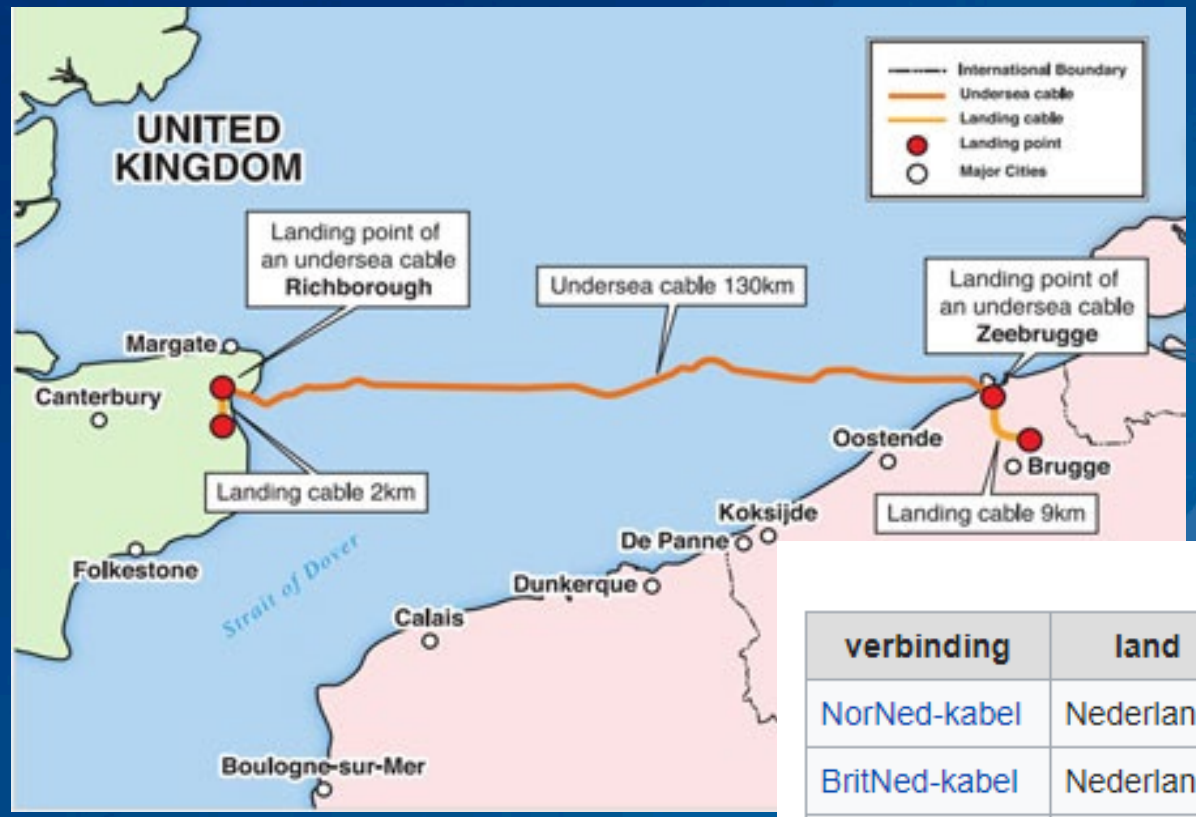


https://www.elia.be/nl/infrastructuur-en-projecten/infrastructuurprojecten/prinses-elisabeth-eiland

OFFSHORE INTERCONNECTOR & LINKS




Kristiansand
Estonia
North
Sea
Glasgow
Latvia
Lithuania
United
Kingdom
Dublin
Poland
Germany
Belgium
Prague
Slovakia
Munich
France
Zurich
Austria
Budapest

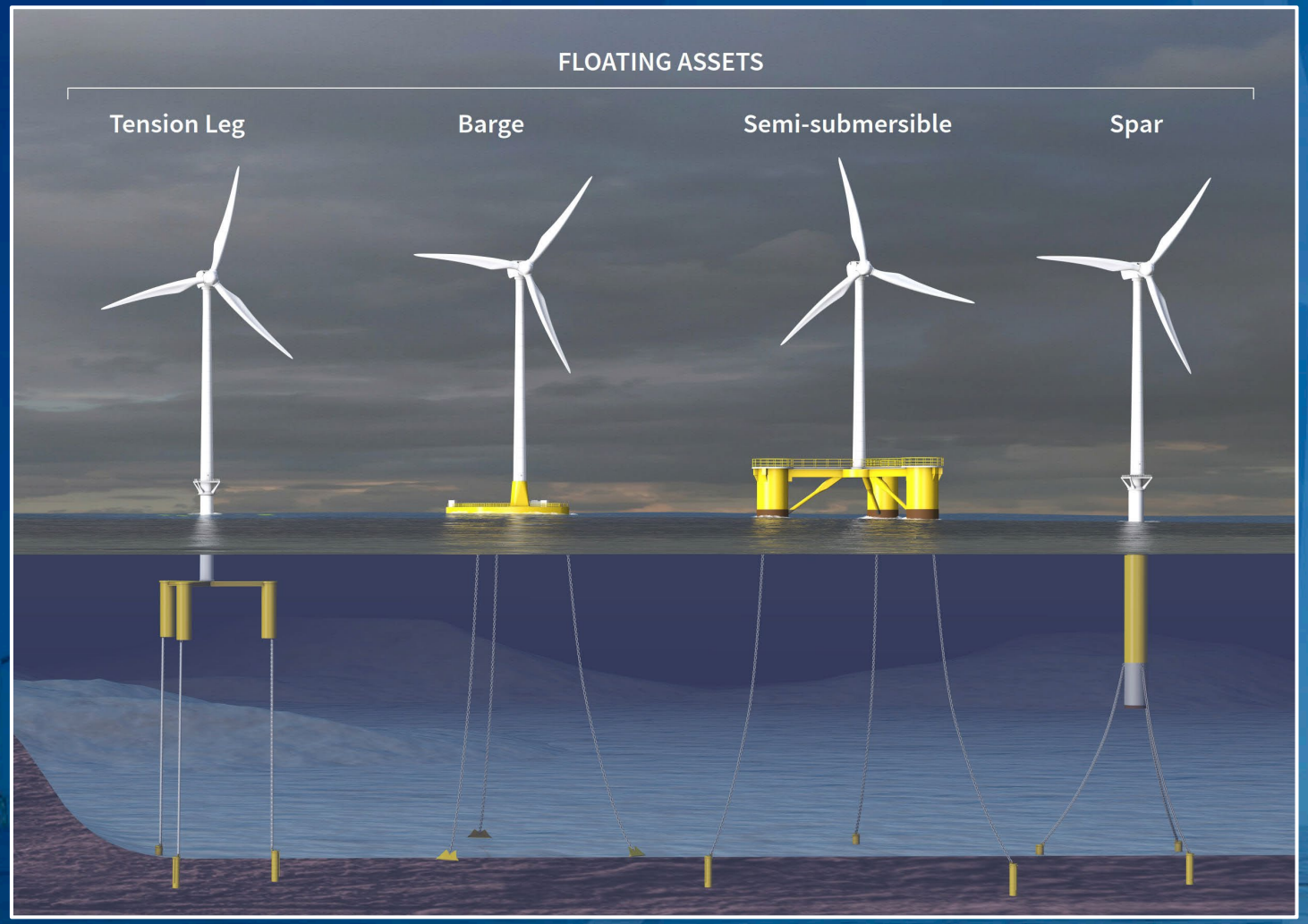


Nemo Link

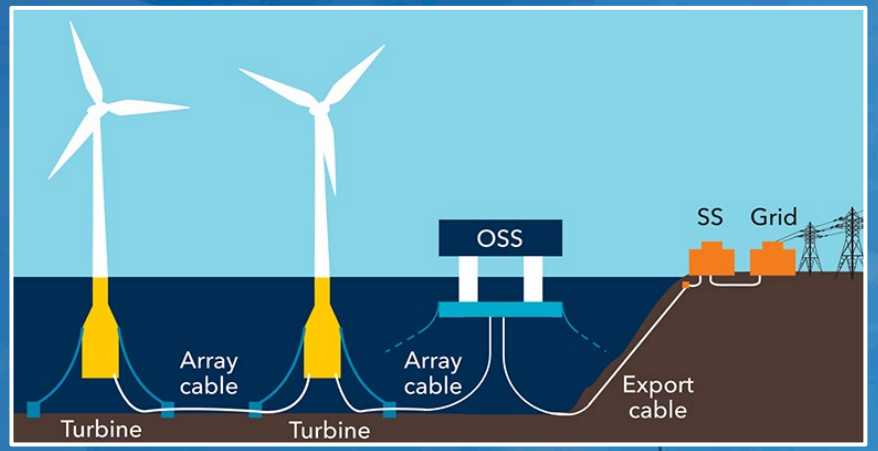
elektriciteitskabels in de Noordzee

verbinding	land	land	vermogen MW	spanning kV	jaar in gebruik
NorNed-kabel	Nederland	Noorwegen	700	450	2008
BritNed-kabel	Nederland	Engeland	1000	450	2011
Nemo Link	België	Engeland	1000	400	2019
COBRA-kabel	Nederland	Denemerken	700	320	2019
NordLink	Duitsland	Noorwegen	1400	500	2020
NorGer-kabel	Duitsland	Noorwegen	1400	450 - 500	2021
North Sea Link	Noorwegen	Verenigd Koninkrijk	1400	525	2022

DEEP WATER OFFSHORE WIND



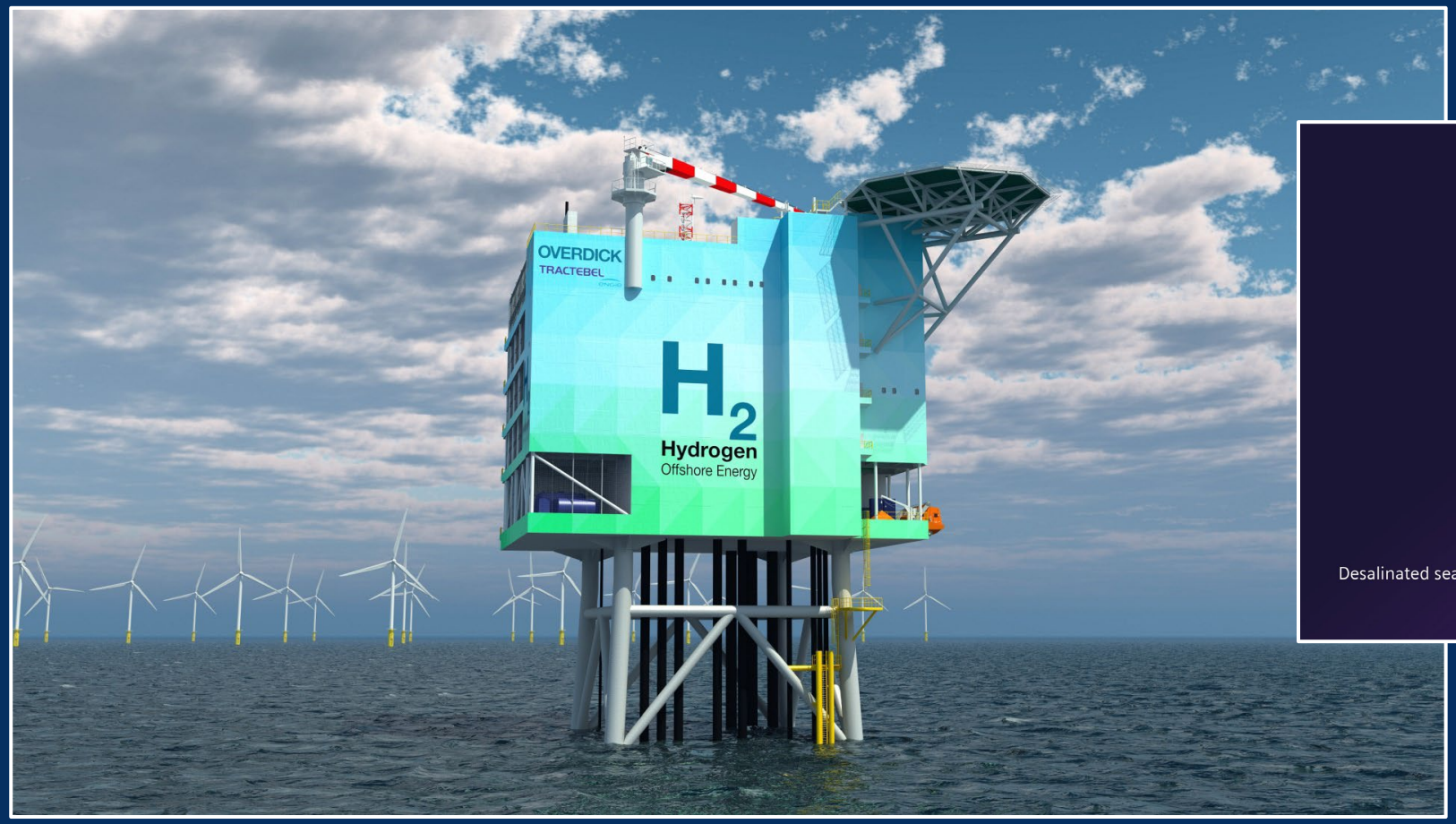
Floating wind

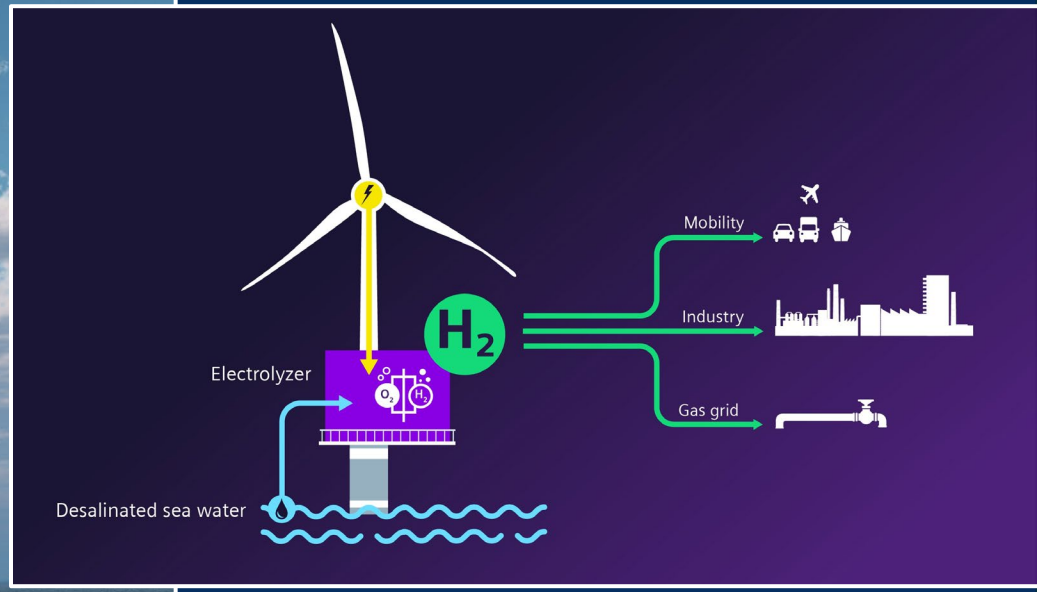


FLOATING SOLAR - SEAVOLT

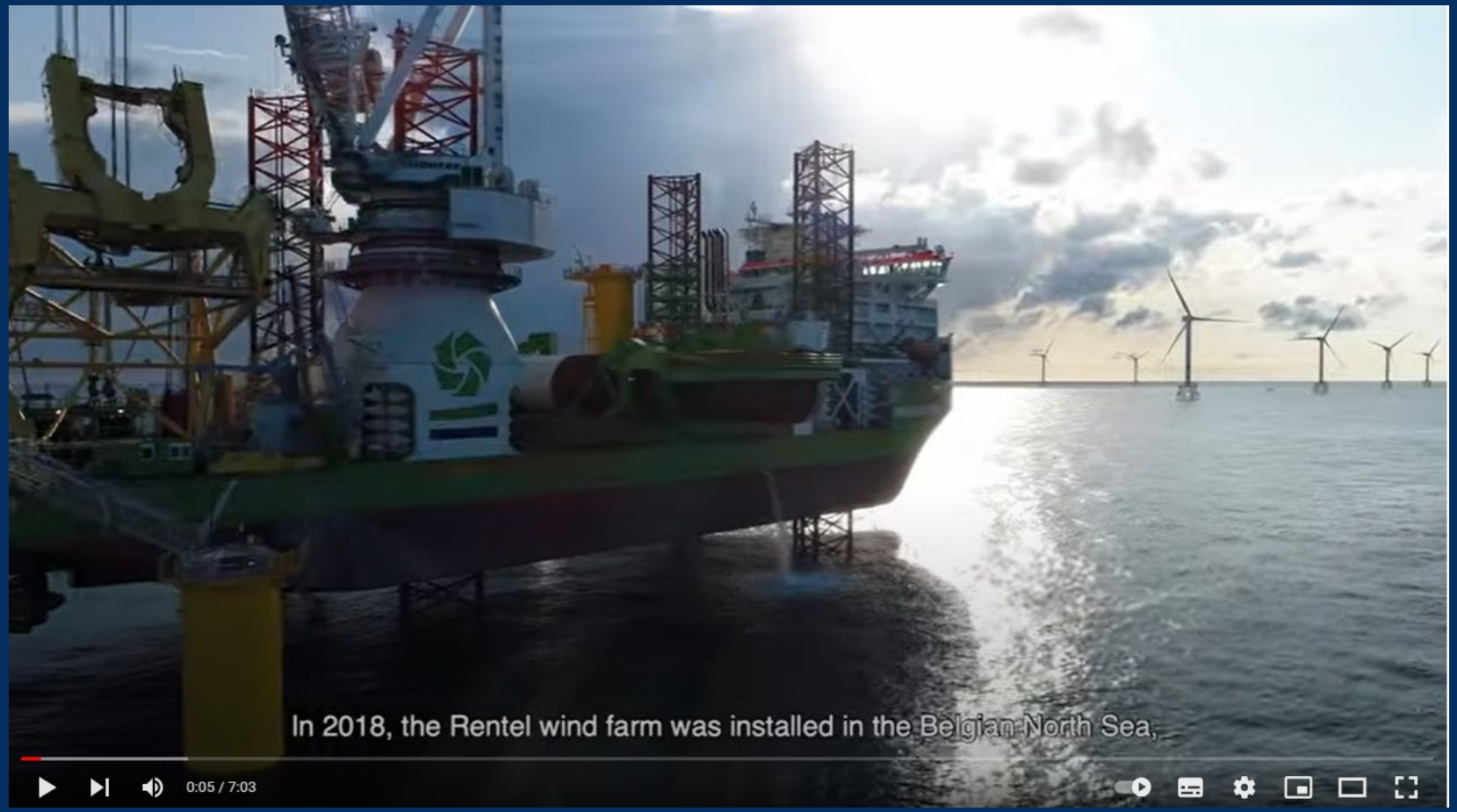
Tractebel
Jan De Nul
Deme

GREEN HYDROGEN - TRACTEBEL





OFFSHORE WIND TURBINE



https://youtu.be/IrTVcNnUYDc


THANK YOU &
ENJOY YOUR BOAT TRIP !

inetum realdolmen
Positive digital flow

Q&A