Offshore Wind

Powering a clean, independent future

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Offshore development expert

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A moment for safety

Together we provide a safe working environment. We learn from mistakes and sharing ideas, concerns and asking questions are a matter of course.

We also draw attention to the following safety measures in case of evacuation of the premises.

Follow the escape route as indicated

Use the stairs instead of the lift

Go to the assembly point

Follow the instructions of the in-company emergency responder

We design, build and operate the offshore grid, working together with almost 700 employees from offices in Arnhem, Eemshaven, Maasvlakte, Borssele, IJmuiden and also in Butan (ID), Malaysia and Singapore.


The North Sea is our **green engine**, with offshore wind as the strategic backbone of an **Affordable**, **Clean** and **Independent** energy system.
TenneT

Dutch Targets

Total installed wind capacity of **6.1 GW** in Dutch North Sea in 2028

2033 **23 GW**
2040 **30 - 40 GW**
2050 **70 GW**

Offshore grid connections

7 **in operation and**

8 **planned**

Where we come from - Timeline Dutch Offshore Wind + Offshore Grid

Policy <2013

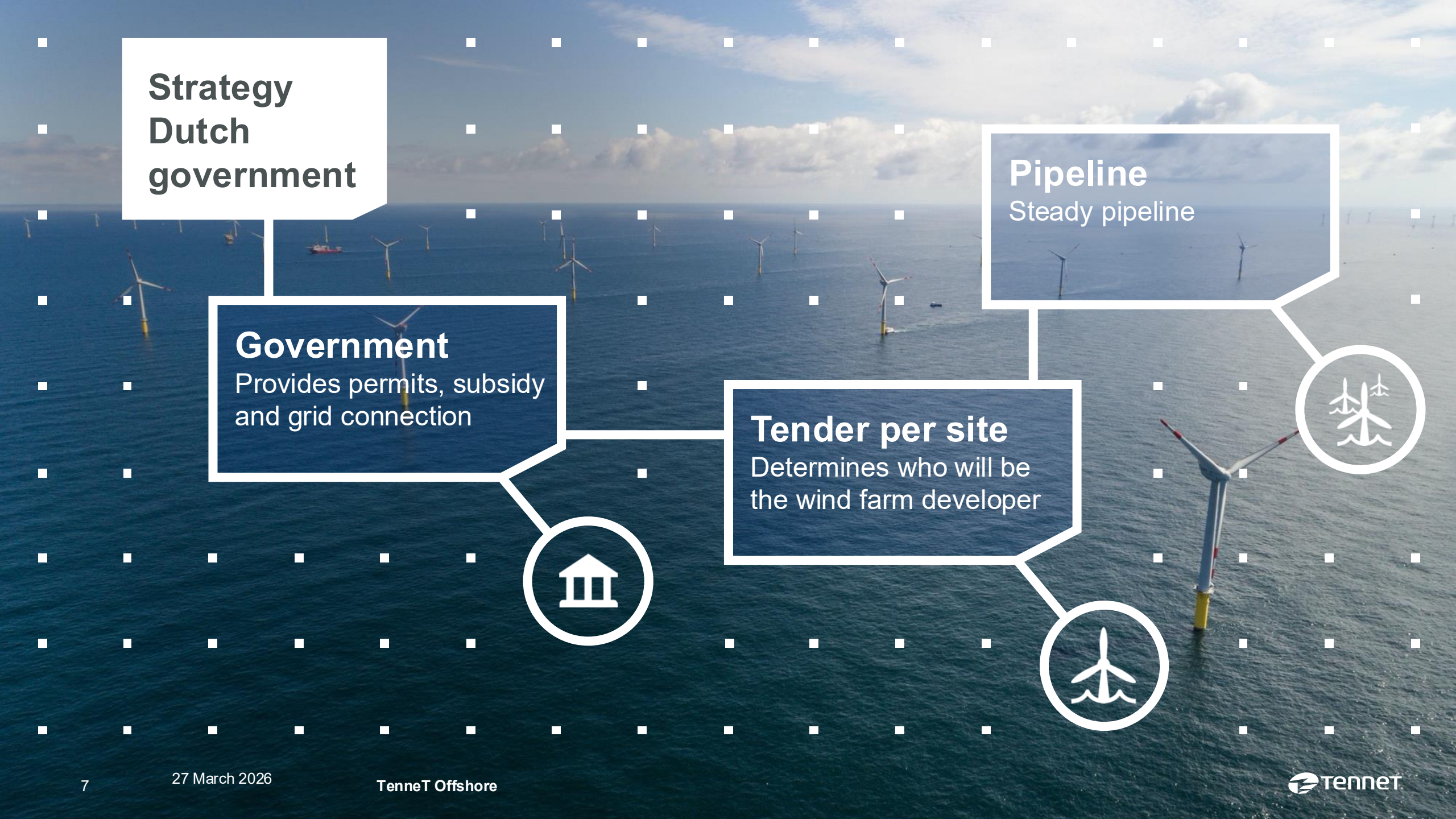
- No timeline
- No centralized planning
- No offshore grid operator
- **~1 GW**
- ~4% of current electricity consumption

Strategy Dutch government

Government
Provides permits, subsidy and grid connection

Tender per site
Determines who will be the wind farm developer

Pipeline
Steady pipeline



Task allocation offshore wind - NL

National government

- Selects locations for offshore wind
- Conducts site surveys and Environmental Impact Assessment
- Issues permit
- Organises tender for wind sites, including subsidies when necessary

Windfarm developers

- Bid in competitive tender to obtain permit for exploitation of wind site
- Design, finance, construct and operate the wind farm
- Decommission at end of lifetime

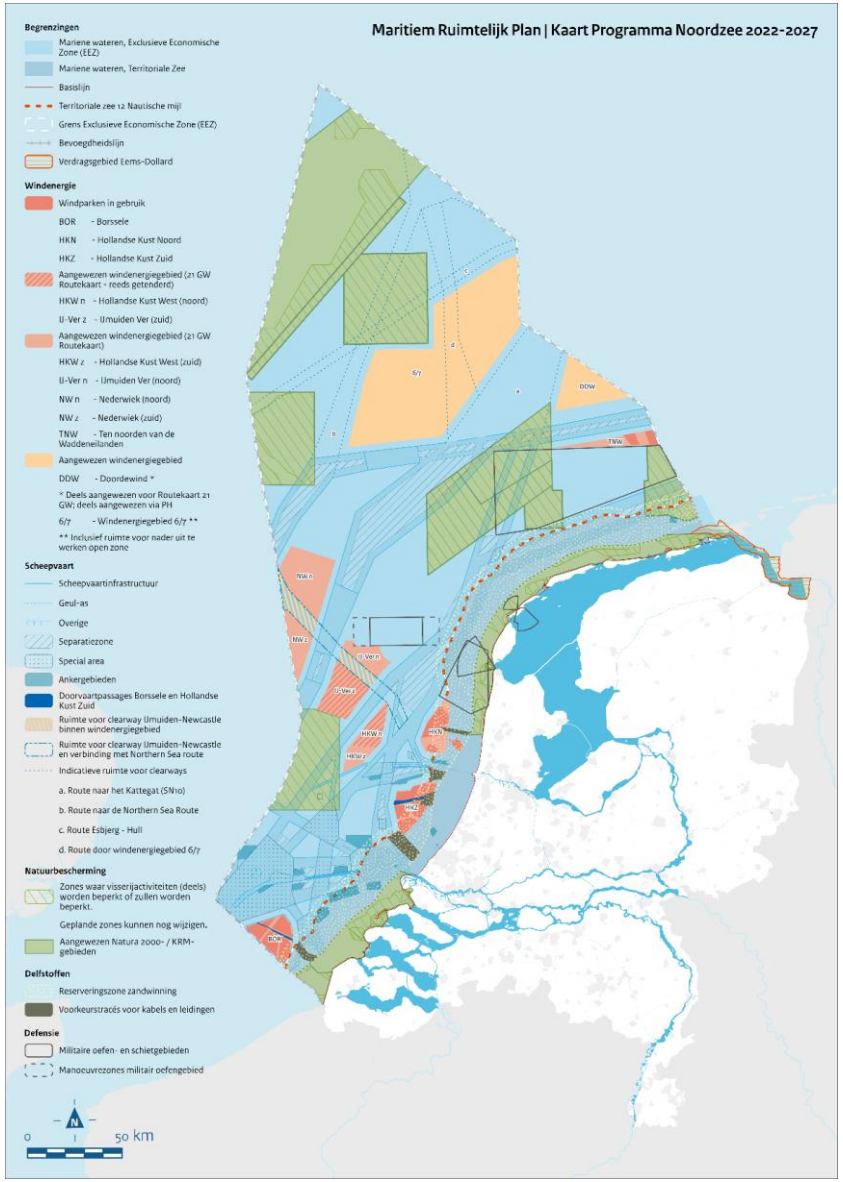
TSO TenneT

- Design, finance, construct and operate the grid connection from offshore wind farm to the onshore grid
- Decommission at end of lifetime

Maritime spatial planning in the Netherlands

- Nature areas
- Shipping lanes, anchor areas
- O&G extraction (incl CO2-storage)
- Cables and pipelines
- Sand extraction
- Military training areas
- Fisheries

- Wind energy areas



Where we come from - Timeline Dutch Offshore Wind + Offshore Grid

Policy 2013

- Offshore Wind roadmap 2023
- **4.5 GW**
- ~16% of current electricity consumption
- TenneT offshore grid operator
- +5x 700MW AC
  - Borssele - 1.4GW
  - Hollandse Kust (zuid) - 1.4 GW
  - Hollandse Kust (Noord) - 0.7GW

700 MW AC

Standardisation

Cost efficient

7 x 700 MW

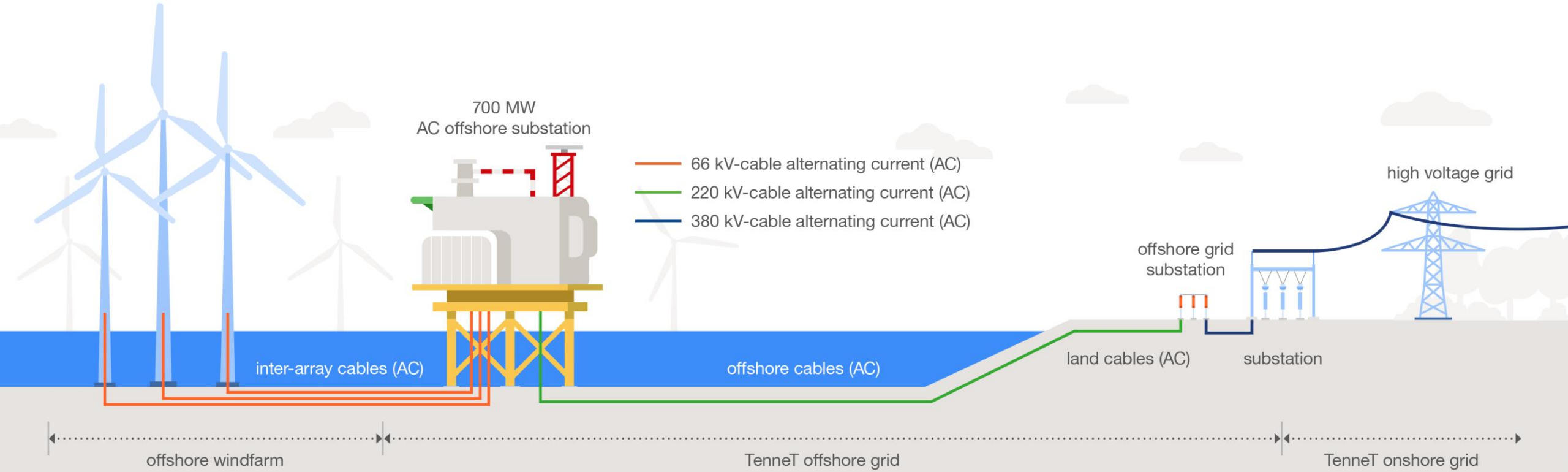
Export cable: 220 kV

Steady pipeline

Aligned planning with offshore wind farm

Less impact on environment

AC Grid Connection



Where we come from - Timeline Dutch Offshore Wind + Offshore Grid

Policy 2018

- Offshore Wind roadmap 2030
- **10.6 GW**
- ~40% of current electricity consumption
- +3x 700MW AC
  - Hollandse Kust (west) - 1.4 GW
  - ~~Ten noorden van de Waddeneilanden - 0.7 GW~~
- +2x 2000MW DC
  - IJmuiden Ver Alpha – 2 GW
  - IJmuiden Ver Beta – 2 GW

Where we come from - Timeline Dutch Offshore Wind + Offshore Grid

Policy 2022

- Offshore Wind roadmap 2030+
- **~21.3 GW**
- ~ 75% of current electricity consumption
- +1x 700MW AC
  - Hollandse Kust (west) – Gamma – 0.7 GW
- +5x 2000MW DC
  - IJmuiden Ver Gamma – 2 GW
  - Nederwiek 1 – 2 GW
  - Nederwiek 2 – 2 GW
  - Nederwiek 3 – 2 GW
  - Doordewind 1 – 2GW
- In operation by 2033 (current planning)

2 GW HVDC
Innovation & standardisation

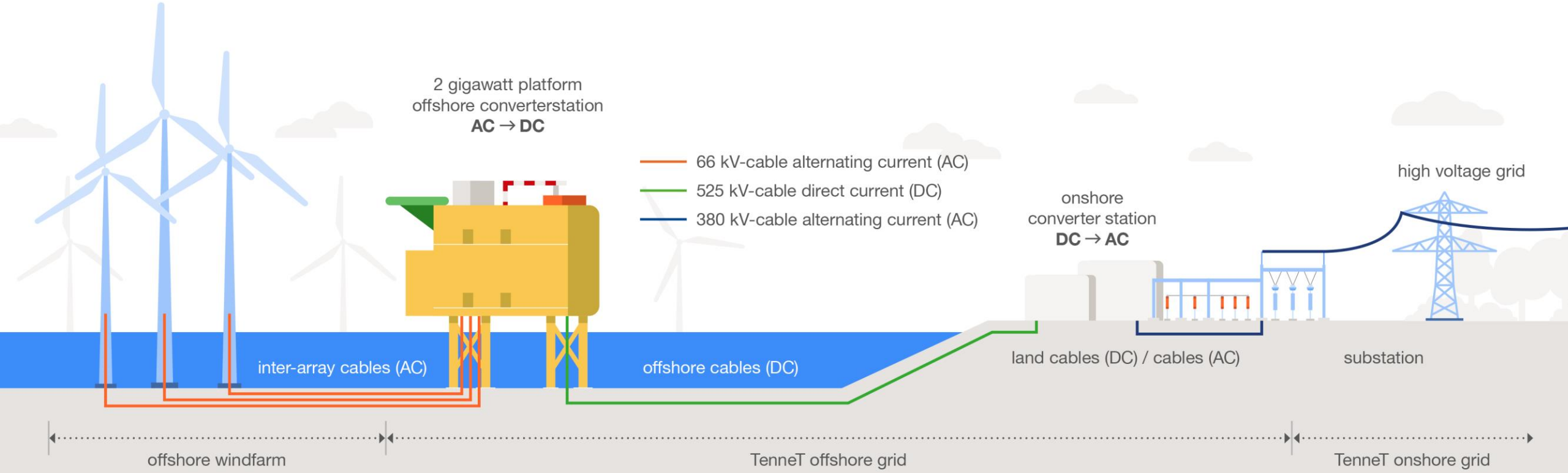
By scaling up to 2 GW HVDC:

- 2 platforms instead of 6
- 2 cable corridors instead of 6

- Less disturbance onshore and offshore
- Less space needed

Framework cooperation contracts **securing capacity** for 8 Dutch 2 GW grid connection systems in a tight market and **driving capacity investments** by suppliers.

2GW DC Grid Connection



Innovative 2GW platform

- Collecting the electricity generated by wind turbines (via cables from the wind turbines to the platform).
- Converting the electricity (66 kV) to a higher voltage level.
- Converting alternating current (AC) to direct current (DC) so it can be transmitted through a sea cable to the onshore converter station.

Main components:

- **The supporting structure,** the jacket. It is usually made of steel and anchored with piles.
- **The superstructure,** the topside. This is the converter station which is unmanned but can be accessed via a helideck for operation and maintenance.

Cable

The 525 kV direct current cables transport the electricity from the platform to the converter station onshore.

The 2 GW cable configuration consists of a bundle of four cables:

- 525 kV DC + pole
- 525 kV DC – pole
- Dedicated metallic return cable
- Fibre optic cable

Bundling is required for installation in the near- and offshore section.

Converter station

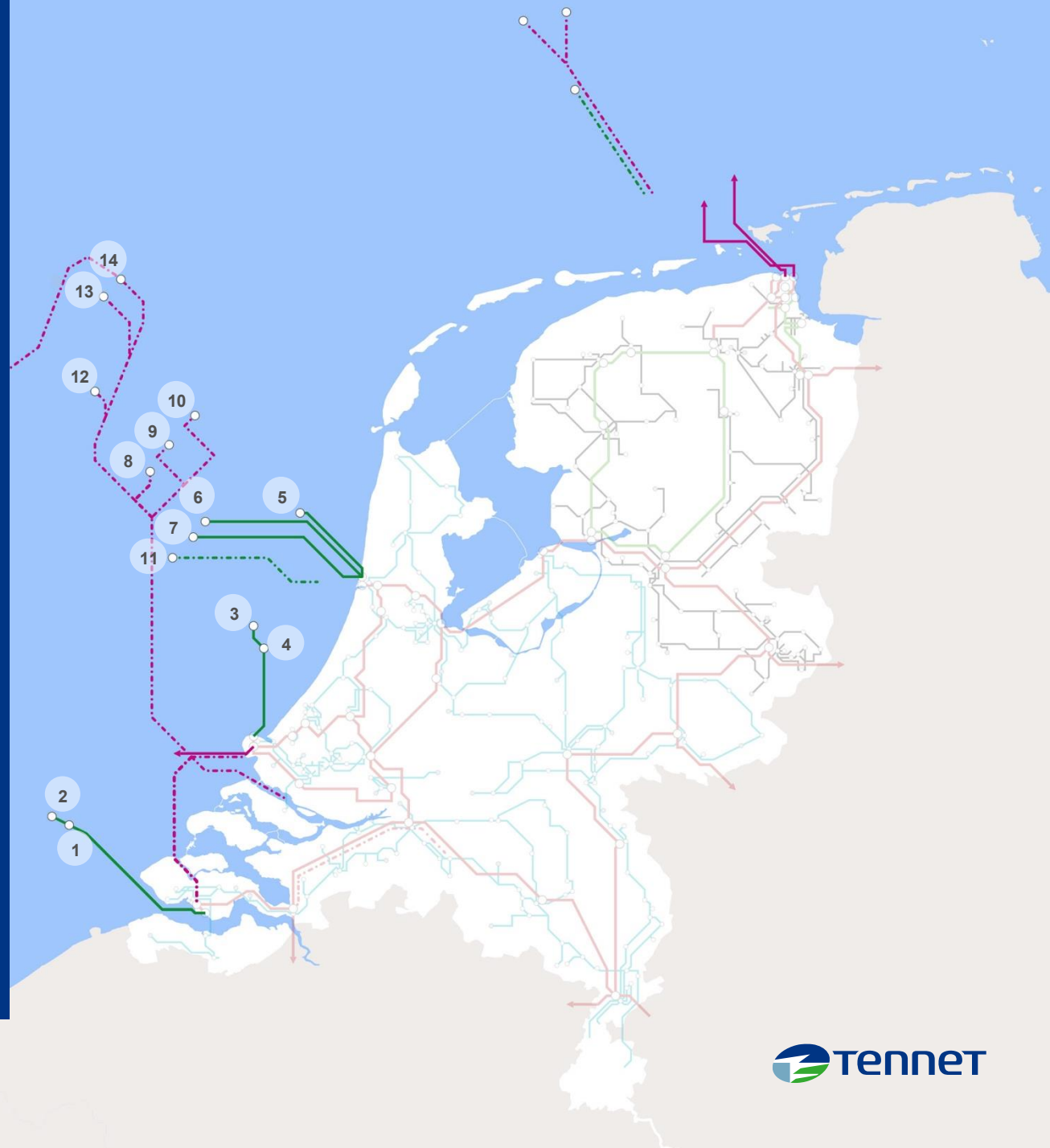
At the converter station, the 525 kV direct current arriving via the offshore cable is converted into 380 kV alternating current. This is necessary because the national high-voltage grid also operates at 380 kV alternating current.

Main components:

- Converters: Convert direct current into alternating current (inverters).
- Reactors: Provide 'filtering' to prevent interference signals from converting direct current to alternating current, and vice versa.
- Transformers: Convert the voltage from the converter to 380 kV.
- 380 kV switchyards: The connection to the high-voltage transmission line of the 380 kV substation.

Offshore Grid Connections The Netherlands

1.	Borssele Alpha	700	MW (AC)	2019
2.	Borssele Beta	700	MW (AC)	2020
3.	Hollandse Kust (zuid) Alpha	700	MW (AC)	2022
4.	Hollandse Kust (zuid) Beta	700	MW (AC)	2022
5.	Hollandse Kust (noord)	700	MW (AC)	2023
6.	Hollandse Kust (west Alpha)	700	MW (AC)	2024
7.	Hollandse Kust (west Beta)	700	MW (AC)	2025
8.	IJmuiden Ver Alpha	2.000	MW (DC)	2029
9.	IJmuiden Ver Beta	2.000	MW (DC)	2030
10.	IJmuiden Ver Gamma	2.000	MW (DC)	2031
11.	Hollandse Kust (west), III	700	MW (AC)	t.b.c.
12.	Nederwiek 1	2.000	MW (DC)	2031
13.	Nederwiek 2	2.000	MW (DC)	2032
14.	Nederwiek 3 + LionLink	2.000	MW (DC)	2032
15.	Doordewind 1	2.000	MW (DC)	2033
16.	Doordewind 2	2.000	MW (DC)	2034

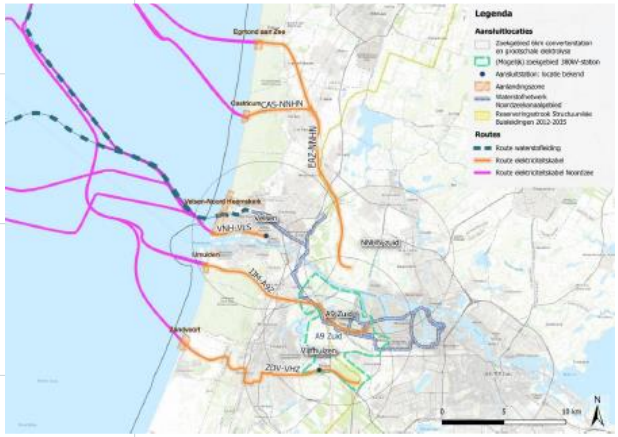


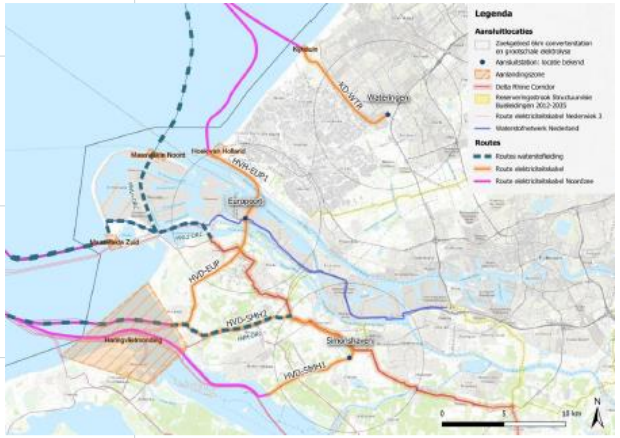
Where we go to- Timeline Dutch Offshore Wind + Offshore Grid

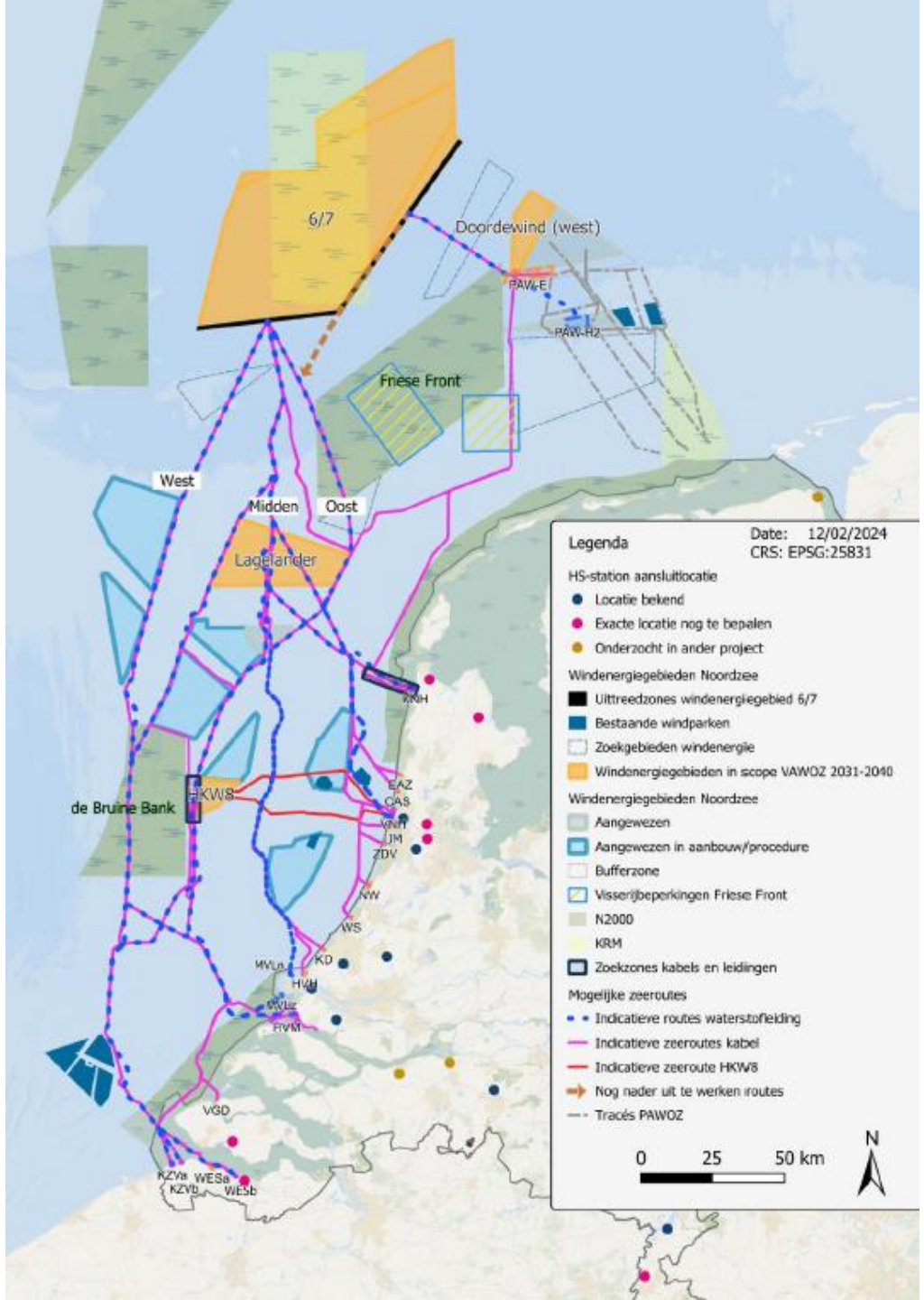
Policy >2025

- Offshore Wind roadmap 2040
- Doordewind 2 +2 GW
- Wind Infrastructure Plan North Sea: **30 – 40 GW** by 2040
- Far offshore

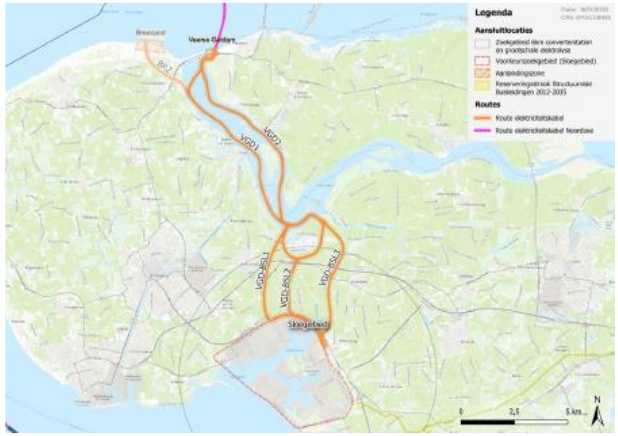

Legenda
Aansluitlocaties
Routes
KNH-NHN2
KNH-NHN1
NHN/Noord

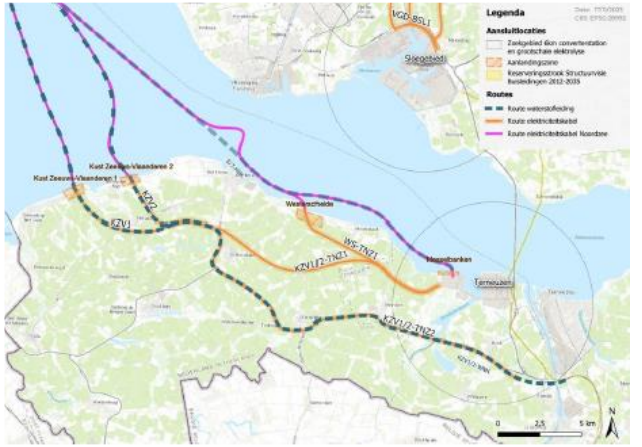

Legenda
Aansluitlocaties
Routes
EAZ-MHN
VHH-VIS
ZDV-VHZ

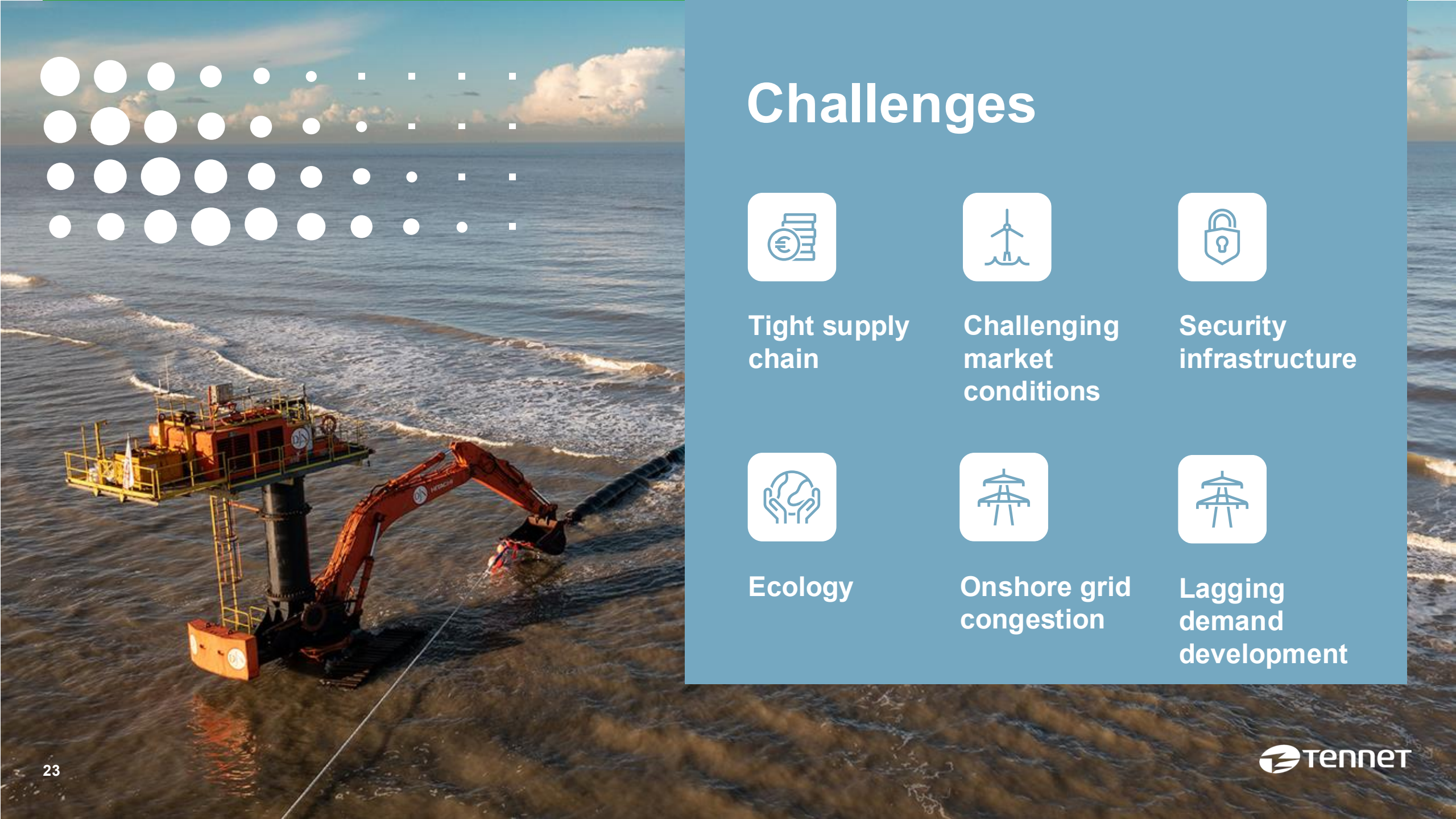

Legenda
Aansluitlocaties
Routes
HVH-EUP1
HVD-EUP
HVD-SHN1
HVD-SHN2


6/7
Doordewind (west)
PAW-E
PAW-HZ
Friese Front
West
Midden
Oost
Lagelander
de Bruine Bank
HKW8
KNH
EAZ
CAS
VHH
JM
ZDV
NW
WS
KD
HVH
HVM
VGD
KZVa
KZVb
WESa
WESb
Legenda
Date: 12/02/2024
CRS: EPSG:25831
HS-station aansluitlocatie
Locatie bekend
Exacte locatie nog te bepalen
Onderzocht in ander project
Windenergiegebieden Noordzee
Uittreedzones windenergiegebied 6/7
Bestaande windparken
Zoekgebieden windenergie
Windenergiegebieden in scope VAWOZ 2031-2040
Windenergiegebieden Noordzee
Aangewezen
Aangewezen in aanbouw/procedure
Bufferzone
Visserijbeperkingen Friese Front
N2000
KRM
Zoekzones kabels en leidingen
Mogelijke zeeroutes
Indicatieve routes waterstofleiding
Indicatieve zeeroutes kabel
Indicatieve zeeroute HKW8
Nog nader uit te werken routes
Tracés PAWOZ
0 25 50 km
N


Legenda
Aansluitlocaties
Routes
Tilburg

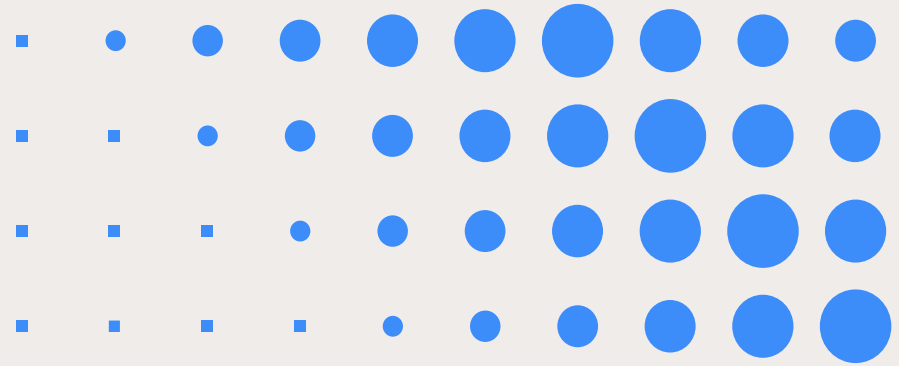

Legenda
Aansluitlocaties
Routes
VGD1
VGD2
Slaggenbelt


Legenda
Aansluitlocaties
Routes
VGD_BSL1
Slaggenbelt
KZV1
KZV2
KZV1/2-TNZ1
KZV1/2-TNZ2
Maasvlakte
Tarmeuzen



Challenges

- Tight supply chain
- Challenging market conditions
- Security infrastructure
- Ecology
- Onshore grid congestion
- Lagging demand development



TenneT is a leading European grid operator. We are committed to providing a secure and reliable supply of electricity 24 hours a day, 365 days a year, while helping to drive the energy transition in our pursuit of a brighter energy future – more sustainable, reliable and affordable than ever before. In our role as the first cross-border Transmission System Operator (TSO) we design, build, maintain and operate 25,000 kilometres of high-voltage electricity grid in the Netherlands and large parts of Germany, and facilitate the European energy market through our 17 interconnectors to neighbouring countries. We are one of the largest investors in national and international onshore and offshore electricity grids, with a turnover of EUR 8.4 billion and a total asset value of EUR 55 billion.
Every day our 9,700 employees take ownership, show courage and make and maintain connections to ensure that the supply and demand of electricity is balanced for over 43 million people.

Lighting the way ahead together

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