

# Grid development in the North Seas

## TSO perspective on hybrid projects

April-2-2019

C1: Public Information

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# TenneT at a glance

- Europe's first cross-border grid operator for electricity
- Top five grid operator in Europe
- International offshore division
- 23.000 km high-voltage lines
- 4.700 km offshore cable
- 41 million end-users
- ~4.000 employees
- Asset base: EUR 20.4 bn
- Capex 2018: EUR 2.3bn
- Revenues EUR 4.2bn
- EBIT: EUR 800 mln
- 99,9986% security of supply



# NL outlook offshore wind

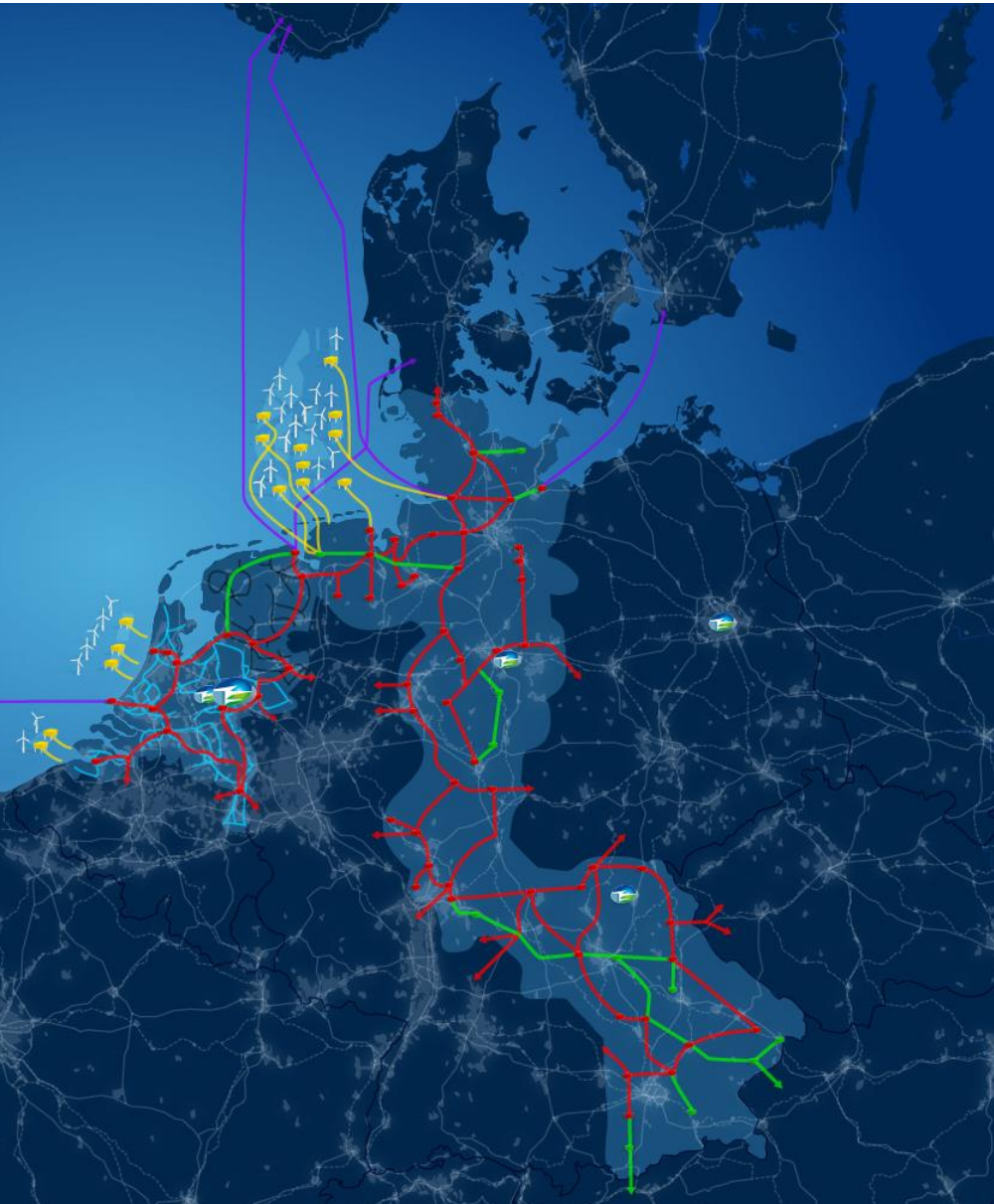


**Dutch Government Agreement (2017):**  
49-55% CO<sub>2</sub> reduction in 2030

**Dutch Offshore Roadmap 2030 (2018):**  
+6,1 GW

**Dutch Climate Agreement (expected):**  
expansion +2-6 GW towards 2030

**Paris Agreement (2016):**  
80-95% CO<sub>2</sub> reduction in 2050  
+30-75 GW estimate (PBL, NSWPH)

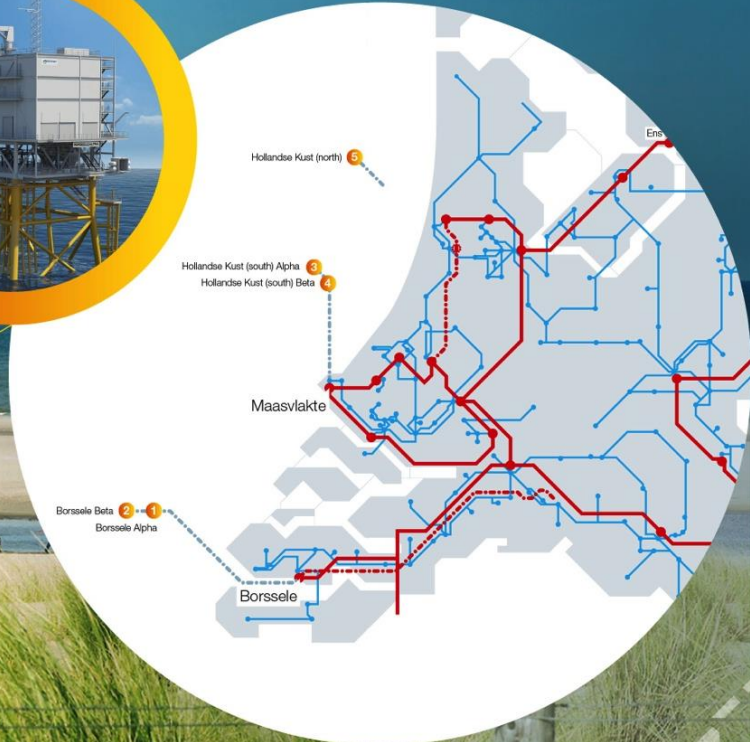


# TenneT Offshore

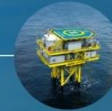


## NL: 3,500 MW in 2023

- 1 **Borssele Alpha**  
AC – 62 km – 700 MW – Borssele  
*Commissioning in 2019*
- 2 **Borssele Beta**  
AC – 69 km – 700 MW – Borssele  
*Commissioning in 2020*
- 3 **Hollandse Kust (south) Alpha**  
AC – 43 km – 700 MW – Maasvlakte  
*Commissioning in 2021*
- 4 **Hollandse Kust (south) Beta**  
AC – 34 km – 700 MW – Maasvlakte  
*Commissioning in 2022*
- 5 **Hollandse Kust (north)**  
AC – 700 MW – cable route and landing location  
being investigated. *Commissioning in 2023*



## Germany: 10,400 MW in 2025



**alpha ventus**  
AC  
66 km · 62 MW  
Hagermarsch



**BorWin1**  
DC  
200 km · 400 MW  
Diele



**BorWin2**  
DC  
200 km · 800 MW  
Diele



**BorWin3**  
DC  
160 km · 900 MW  
Emden/Ost



**DolWin1**  
DC  
165 km · 800 MW  
Dörpen/West



**DolWin2**  
DC  
135 km · 916 MW  
Dörpen/West



**DolWin3**  
DC  
160 km · 900 MW  
Dörpen/West



**DolWin6**  
DC  
90 km · 900 MW  
Emden/Ost



**SyWin1**  
DC  
205 km · 864 MW  
Büttel



**HelWin1**  
DC  
130 km · 576 MW  
Büttel



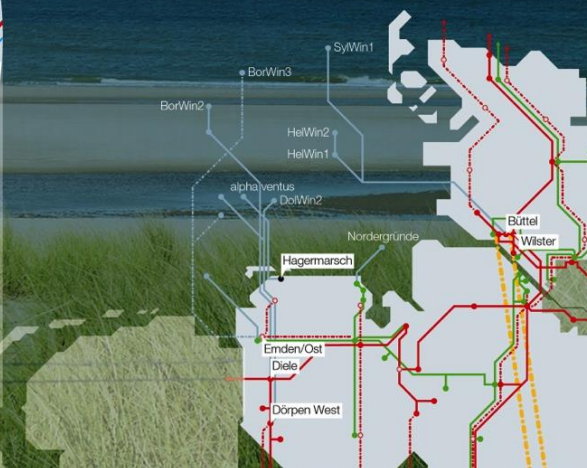
**HelWin2**  
DC  
130 km · 690 MW  
Büttel



**Riffgat**  
AC  
80 km · 113 MW  
Emden/Borssum



**Nordergründe**  
AC  
32 km · 111 MW  
Inhausen





# North Sea Vision

- New HVDC standard for larger scale further from shore
- Potential for bilateral offshore hybrid assets as stepping stone towards multilateral development
- Internationally coordinated large scale development

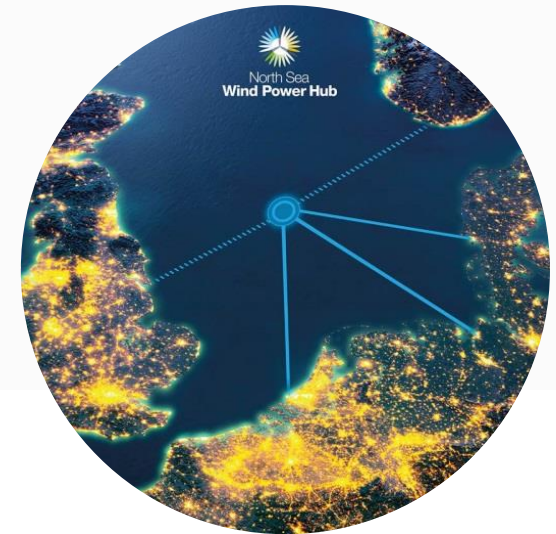


Roadmap 2030



WindConnectors

Requires international coordination and holistic integrated approach instead of radial development



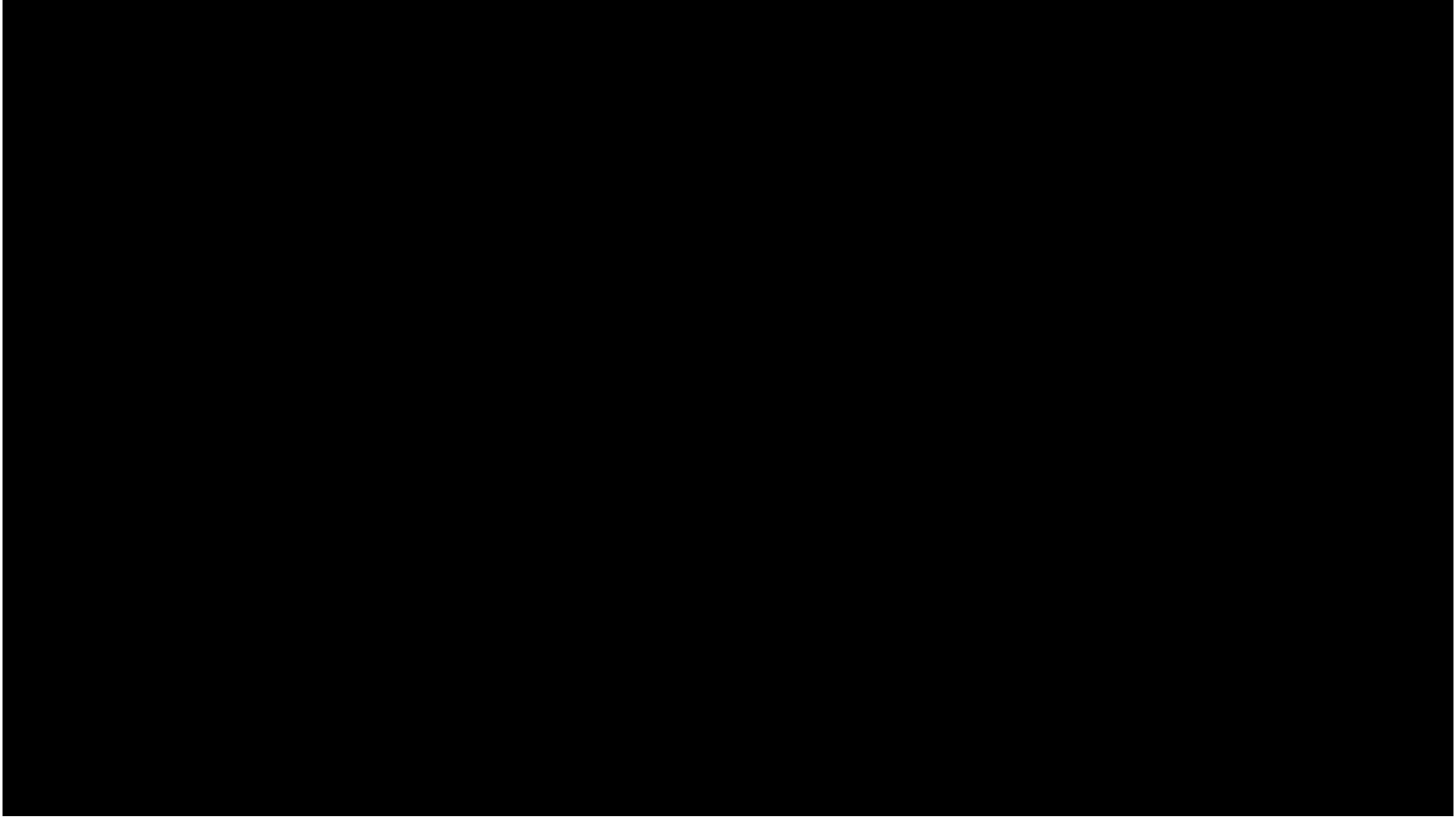
North Sea Wind Power Hub - post 2030

# Roadmap 2030



- Standardised systems
- 700 MW HVAC
- 2GW HVDC
- Integration onshore
- Electrification oil & gas platforms
- Hydrogen
- Wind Connector



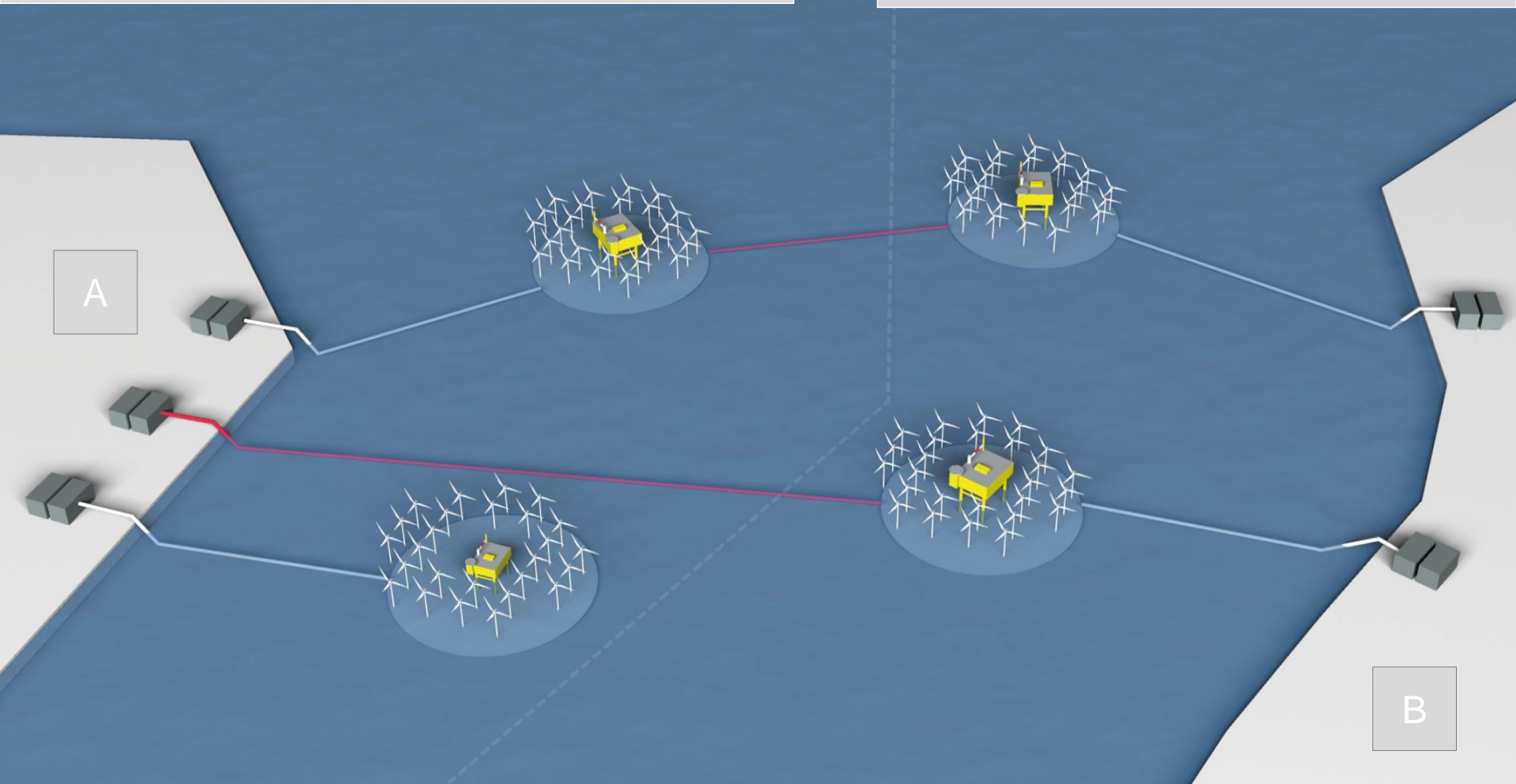




# WindConnector potential

- reduce interconnector investment costs
- Share onshore grid capacity
- increased utilisation of offshore wind infrastructure

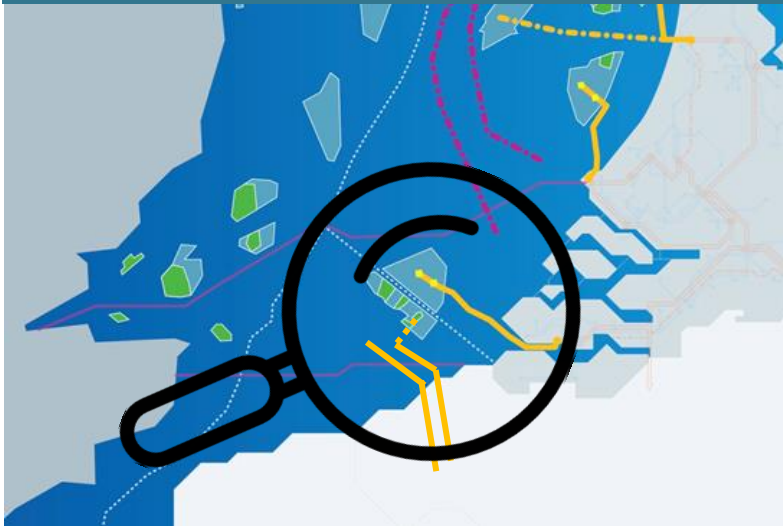
- Market integration (affordability)
- Security of supply (reliability)
- RES integration (sustainability)





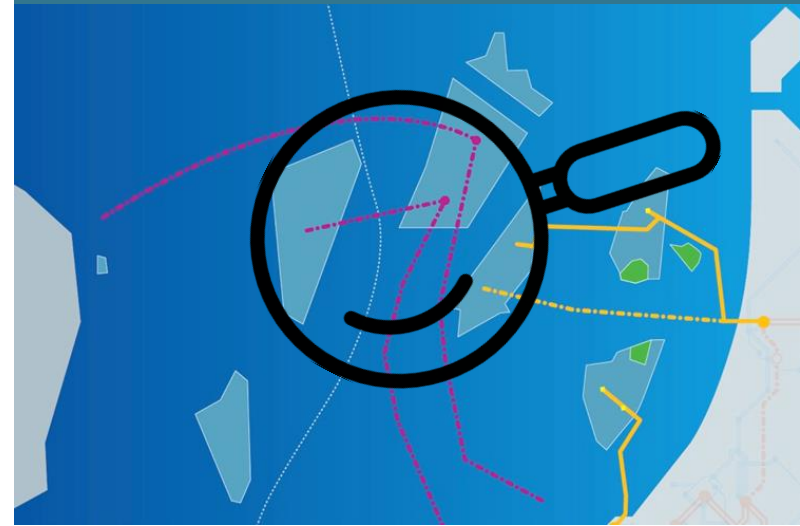
# Case by case consideration

WindConnector Borssele with BE  
(2019-2020)



- No good business case (onshore option)
- Uncertainty Belgian offshore TSO
- Different voltage levels
- No anticipatory spatial planning
- Operational challenges (loop flows)

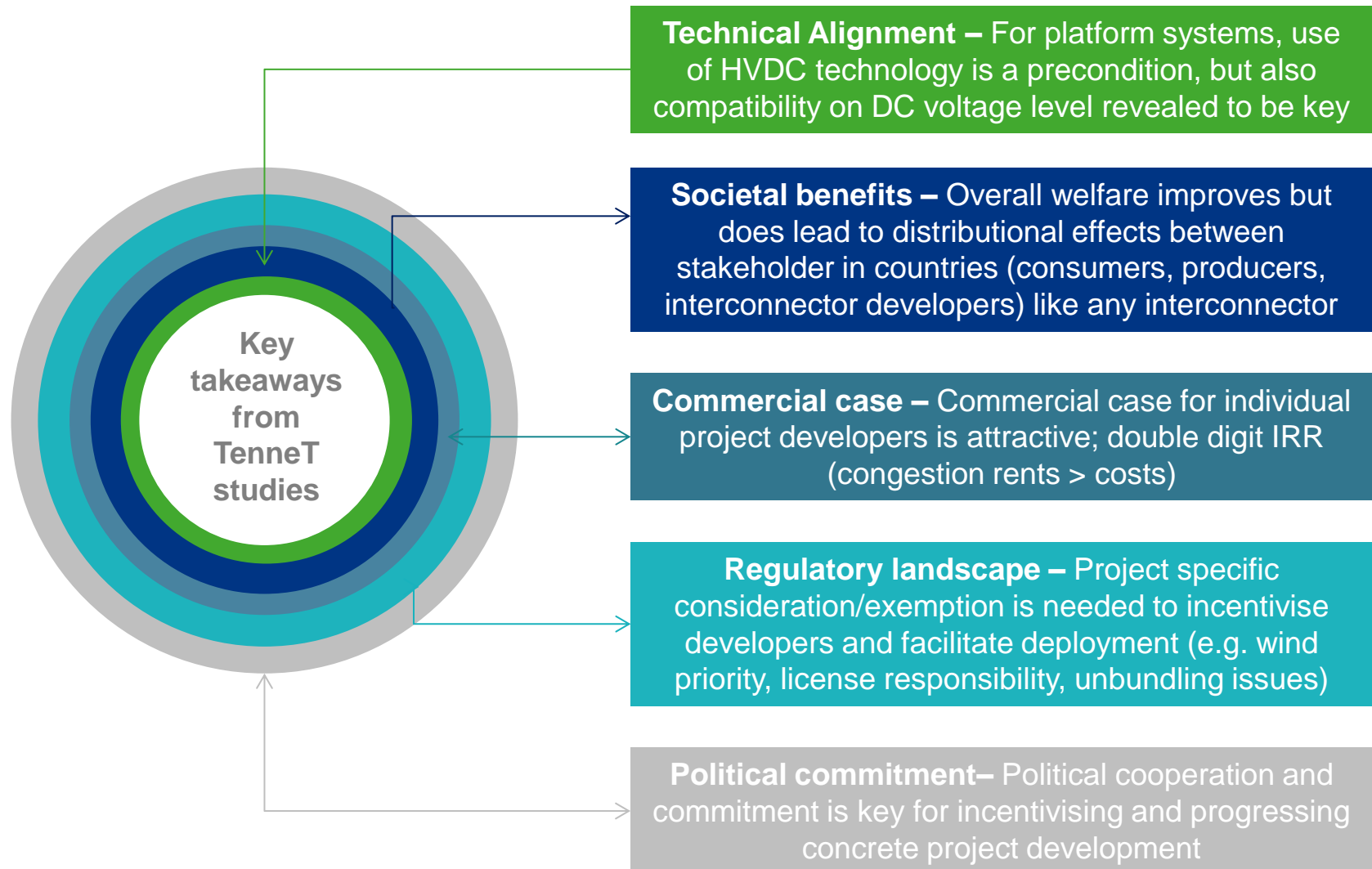
WindConnector IJmuidenVer with GB  
(2027-2030)



- Business case (no onshore option)
- Certainty potential partners
- close proximity & similar timelines
- technical alignment
- Regulatory challenges



# Other lessons learned



# Critical conditions for success



- Technical compatibility
- Internationally coordinated roll out
- Anticipatory investments

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