OCEANIC RENEWABLES SUMMIT

Possible options for the architecture of the offshore / on shore grid for the identified seabed areas

LISBOA – MUSEU DO ORIENTE

24.05.23

APREN

João Peças Lopes

FEUP & INESC TEC

Possible options for the architecture of the offshore / onshore grid for the identified seabed areas

U.PORTO
FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO
INESCTEC

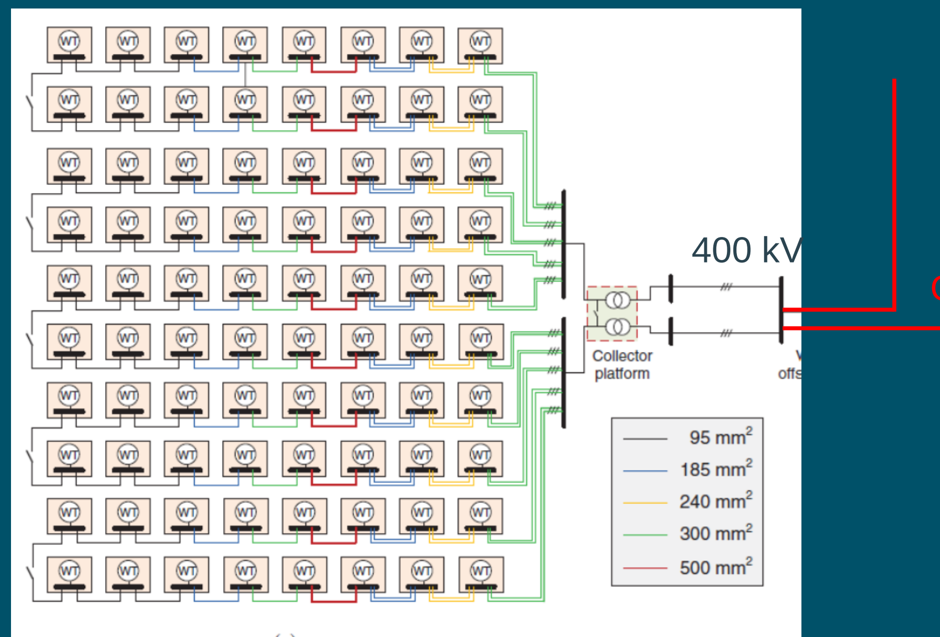
OCEANIC RENEWABLES SUMMIT

Connection of offshore wind parks to the onshore grid (1)

Standard solutions using generation blocks between 800 MW and 1 GW

15 MW – 18 MW per wind generator

63 kV

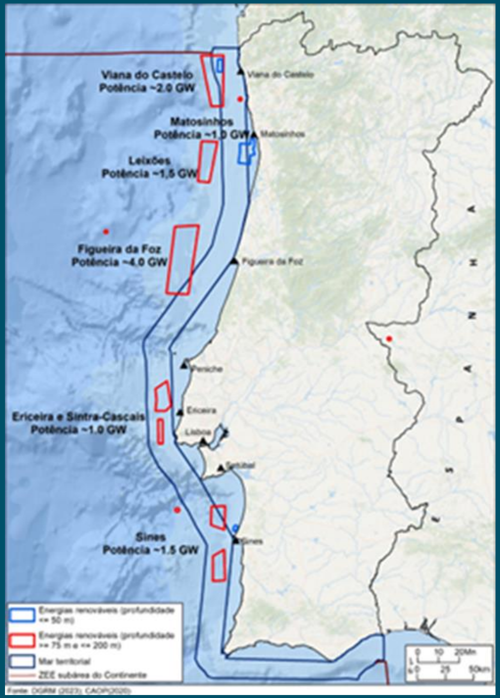


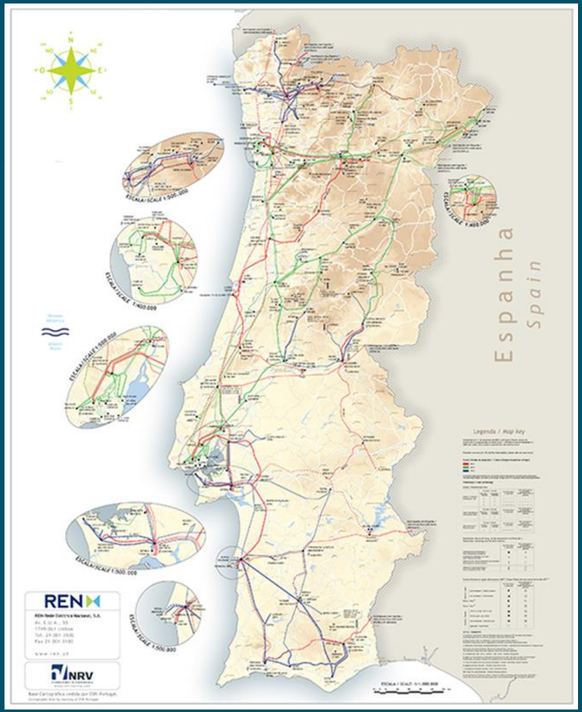
Onshore HVAC grid

Connecting wind offshore power to shore

It is mandatory to understand where the new consumptions will happen

It is necessary to build generation scenarios





Onshore Grid Development

Procedure:

Identify reinforcements (lines and transformers) of the onshore transmission grid that allow accommodating the production of offshore wind production using a dynamic and flexible management approach to the network, as suggested by DL 15/2022.

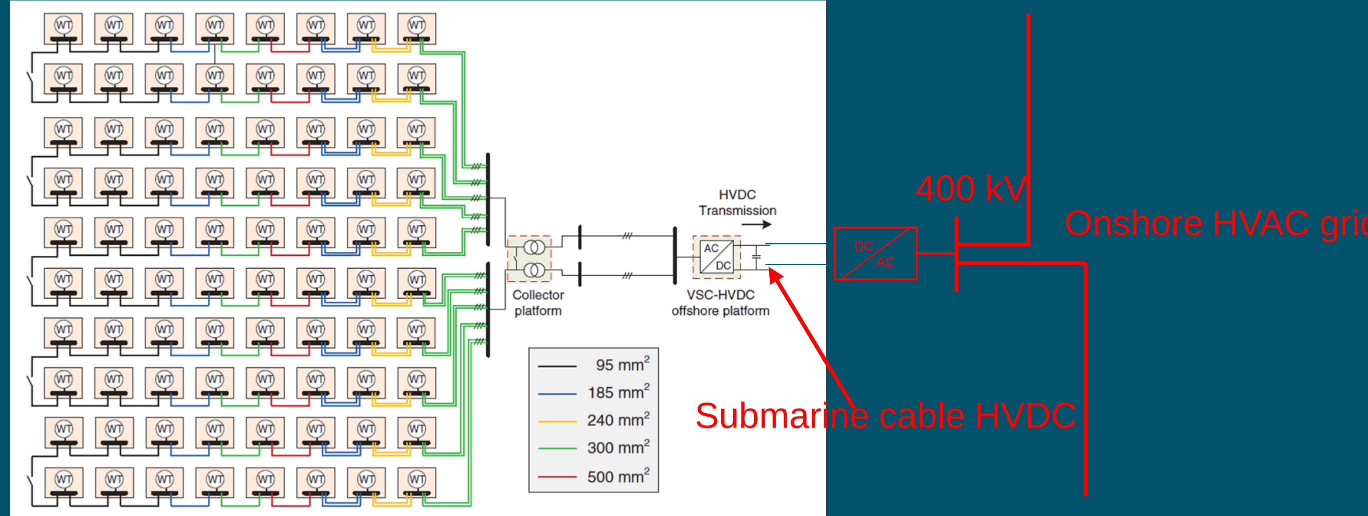
Resort to power flow studies with contingency analysis (N-1, N-1-1, N-2, etc.), with the powers to be injected into the network being subject to restrictions associated with contingencies that may limit these injections, as long as these restrictions do not restrict considerably the reception of offshore wind power…

Connection of offshore wind parks to the onshore grid (2)

The HVDC solution

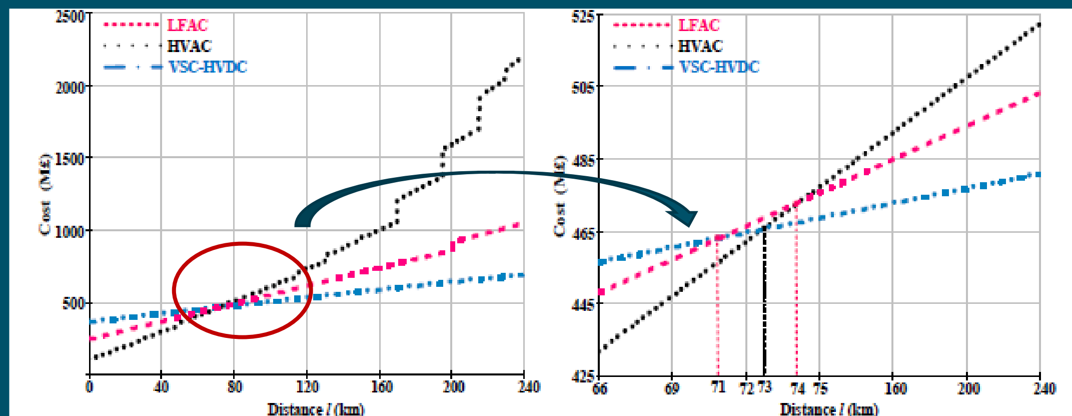
- For each block

63 kV



HVAC versus HVDC (VSC)

Comparative cost assessment for a capacity of 1,5 GW



Cost Analysis and Comparison of HVAC, LFAC and HVDC for Offshore Wind Power Connection

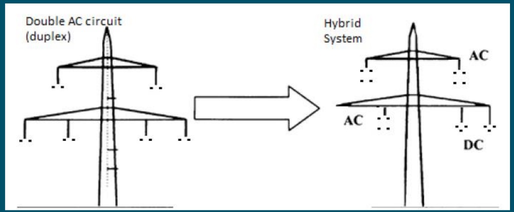
X. Xiang, M. M. C. Merlin, T. C. Green

OCEANIC RENEWABLES SUMMIT

The HVDC backbone solution

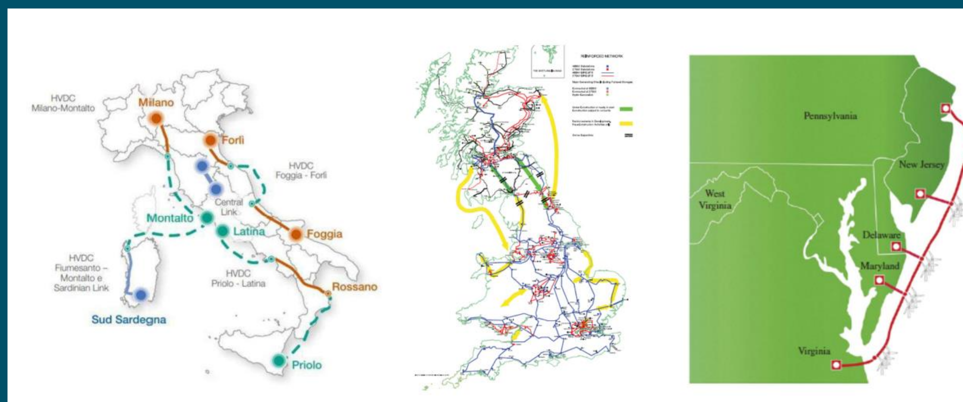
Build a HVDC backbone (multiport VSC):

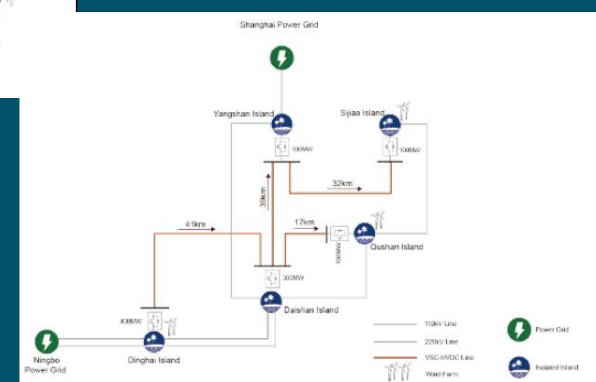
- Submarine cable;
- Hybrid overhead lines HVDC/HVAC using existing HVAC corridors



Connection of offshore wind parks to the onshore grid

HVDC Grids under development or already in operation





- Tennet
- 50 Hz
- Swissgrid
- TransnetBW GmbH

Conclusions

	HVAC	HVDC multiponto
Losses	• Transformers (<1%) • Skin effect • Losses due to reactive power flow (400 kV – 9 MVAr/ km) → compensation with reactances or SVC	Converters VSC (<2%)
Controllability	Reduced power flow controllability	+++ (P, Q in converter) Control of oscillations; Black start
Total costs	Reduced costs for L< 70 km	For L>80 km less costs
Maximum power flow	400 kV -->1,5 GW	+/- 500 kV –> 2,5 GW
Permits	Complex	
Environmental impacts	Larger, considering the needed reinforcements	Smaller

OCEANIC RENEWABLES SUMMIT

Obrigado!
Thank you!