Eolien Maritime
une industrie en plein essor

Centrale-Énergies

Centrale Métiers de la Mer

Conférence – 13 janvier 2021

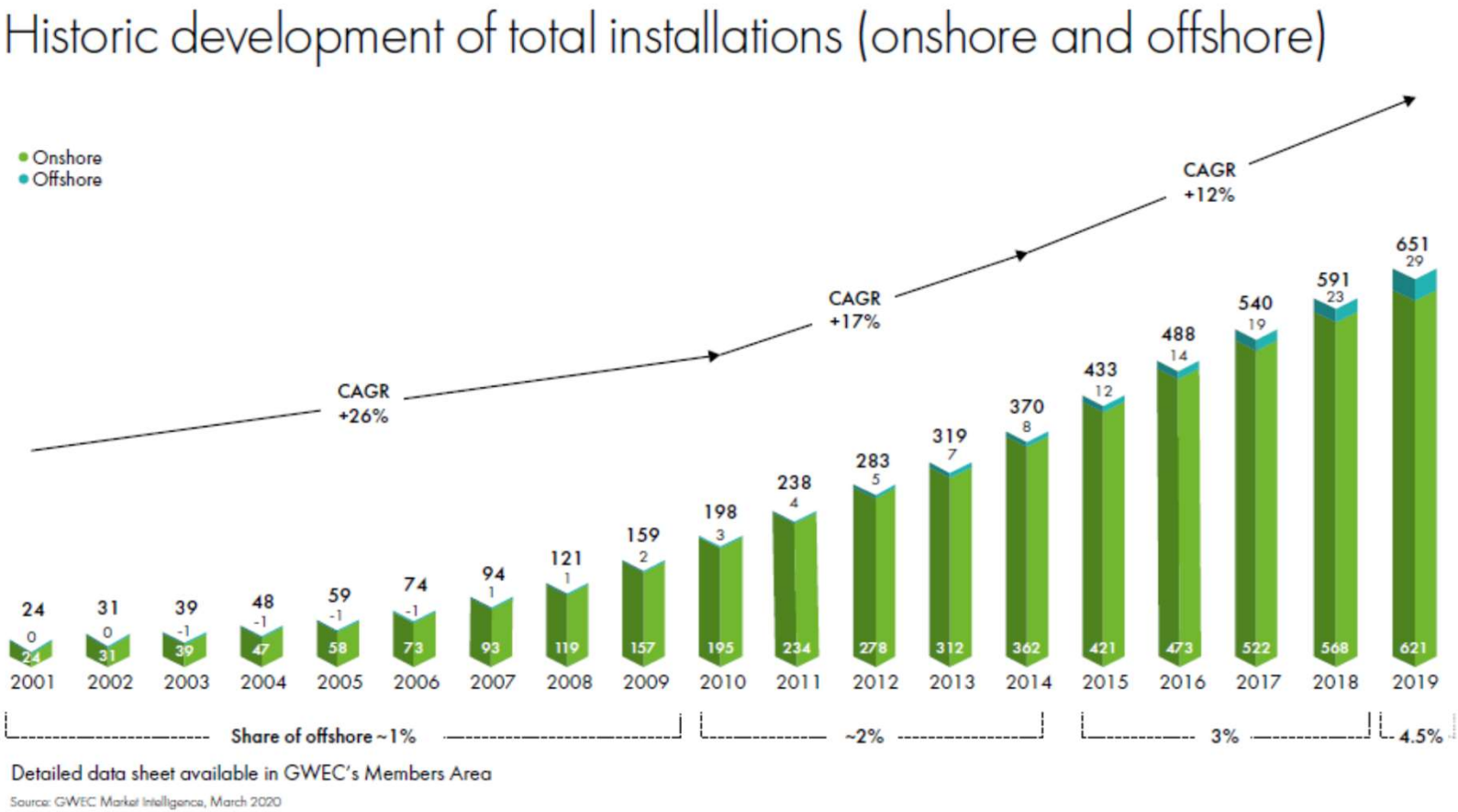
Eolien Maritime – Remarques liminaires

1. Repères Marché
2. Projet Type de Ferme Eolienne Maritime
3. Supply Chain

Eolien Maritime – Quelques repères marché

- 0,4% de la fourniture d'énergie mondiale (terrestre 5,4% - solaire 3,3%) – Fourniture totale = 27 800 TWh
- 29 GW installés (terrestre 621 GW)
  - 1ère installation: Vindeby, 1991, 11 x 450 kW – aujourd'hui 558 éoliennes marines (1,7 GW)
  - 2ème vague en Europe à partir de 2010
- Installations concentrées: GB (~10 GW), Allemagne (~7 GW), Chine (~7 GW), Danemark (1,7 GW)
- Investissements: 30 G$ à fin 2019 (terrestre 113 G$)
- Acteurs de développement dominants: le danois Oersted (ex DONG Energy) et l'allemand RWE AG
- Forte croissance:
  - Passé:
  - Future:
- 2 types d'éolien maritime:
  - Flottant ~0,5% (essentiellement des projets pilotes)
  - Fixe (posé) ~99,5%
- Eolien fixe de moins en moins subventionné et …
- De plus en plus compétitif

Eolien Maritime – Historique de développement



Eolien Maritime – Prévisions de croissance – 2030 - 2050

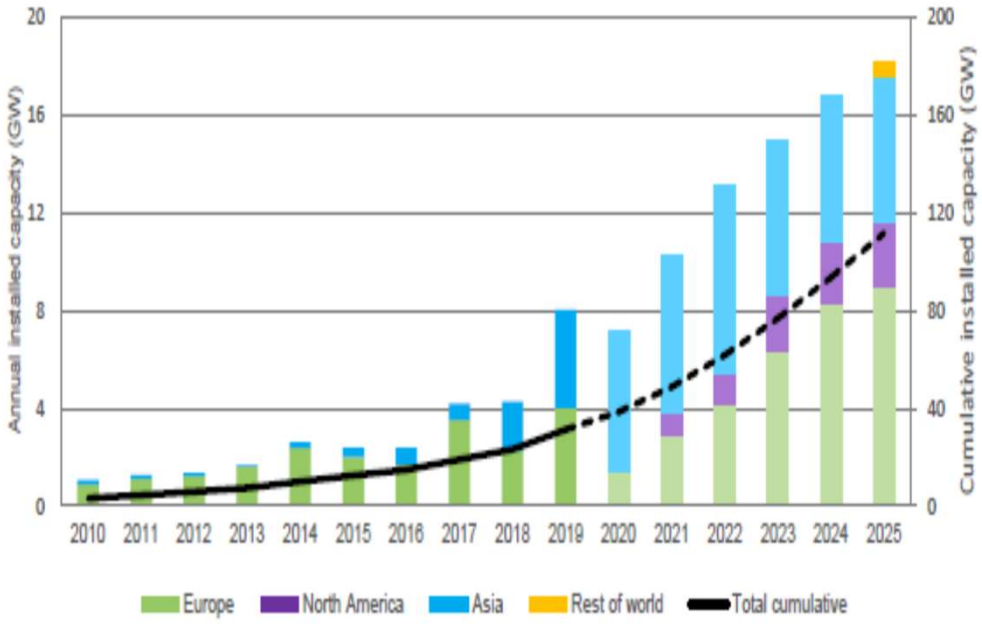


Figure 3 Offshore wind installation from 2010 to 2030. Source: GWEC

- **World** (1):
  - 29 GW existants → 1400 GW (2050)
- **UE** (2):
  - 12 GW existants → 60 GW (2030) → 300 GW (2050)
- **UK**(3):
  - 10 GW existants → 45 GW (2030) → 75 GW (2050)
- **France** (4):
  - 0 GW existants → 6 GW (2030) → 16 GW (2050)

Sources:

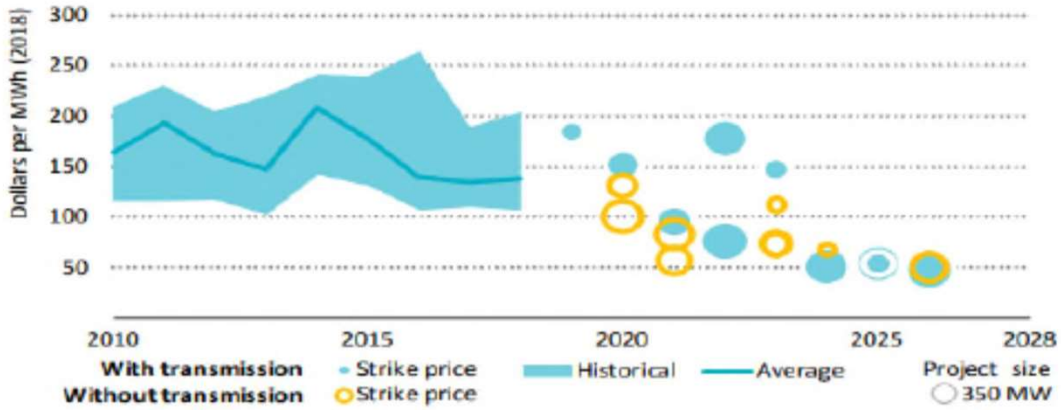
(1) OREAC (Ocean Renewables Energy Action Coalition) – Vision dec. 2020

(2) Stratégie UE-27 – Nov 2020

(3) ORE Catapult UK – June 2019

(4) PPE

Eolien Maritime – LCOE futur



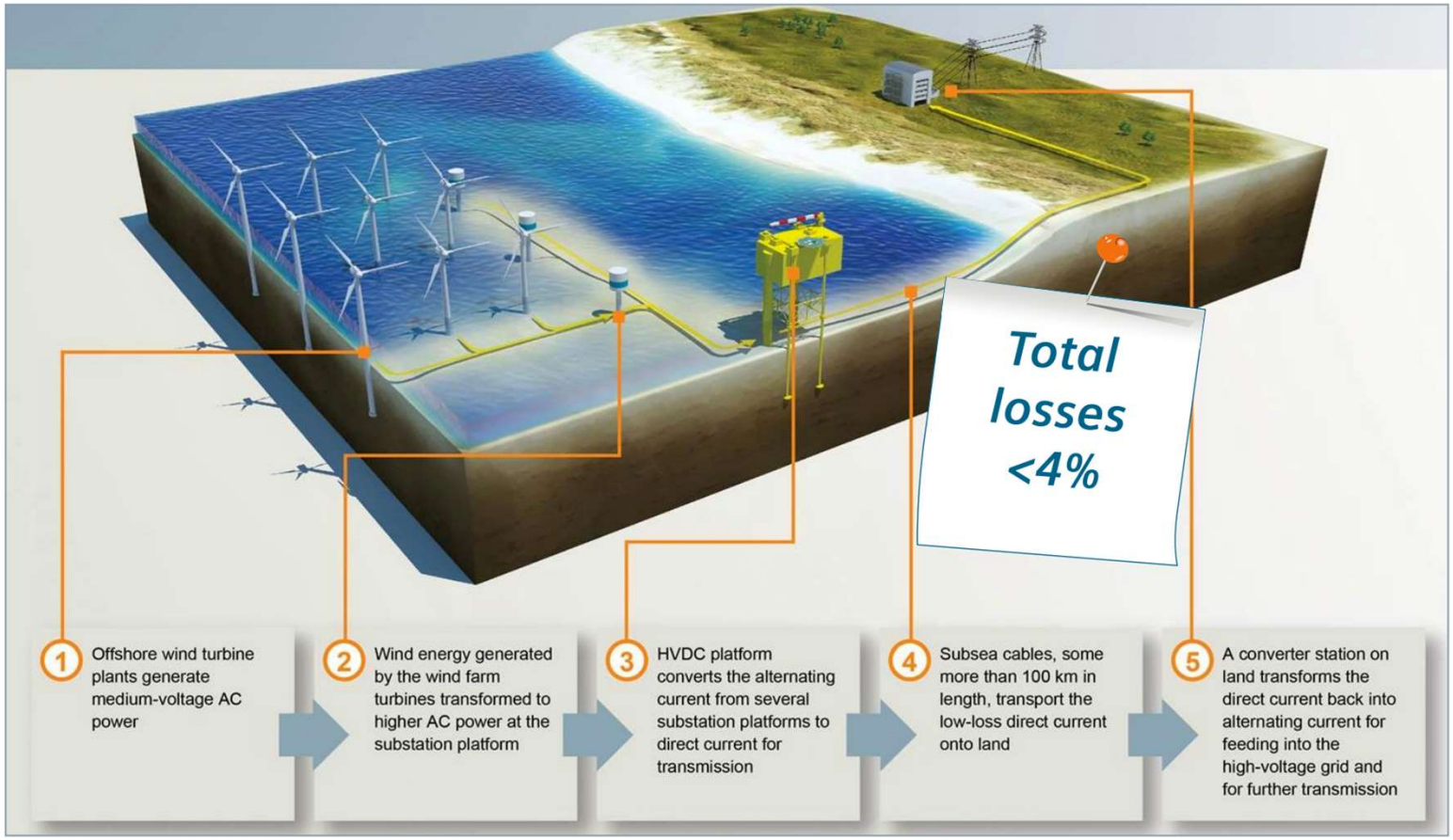
With transmission			Without transmission		
Project	Strike price ($/MWh)	Expected COD	Project	Strike price ($/MWh)	Expected COD
United Kingdom			**Germany**		
Beatrice	185	2019	Baltic Eagle	74	2023
East Anglia 1	152	2020	Gode wind 3	68	2024
Triton Knoll	95	2021	Gode wind 4	112	2023
Moray East	73	2022	**Netherlands**		
Hornsea 1	178	2022	Borssele I/II	83	2020
Hornsea 2	76	2022	Borssele III/IV	62	2021
Neart na Gaoithe	148	2023	**Denmark**		
Cr. Beck A Dogger Bank	51	2024	Horns Rev 3	118	2020
Cr. Beck B Dogger Bank	54	2025	Kriegers Flak	57	2021
Dogger Bank Teeside A	54	2025	Vesterhav Nord/Syd	73	2023
Seagreen	54	2025			
Muaitheabhal	51	2025	**France**		
Sofia	47	2026	Dunkirk	50	2026

Source: IEA report 'Offshore Wind Outlook 2019

Eolien Maritime - Projet typique de ferme éolienne

- *400 MW*
- *50 éoliennes fixes*
- *~35m d'eau*
- *~50 km*
- *~1,7 G€*
- *7 – 10 ans développement*

~300,000 homes
~600,000 t/y CO2
~13,000 t/y SO2



Eolien Maritime – Supply Chain

5 – 10 ans
PROMOTION AND PROJECT
Vincent

- Wind farm development
- Socio-economic analysis of potential locations
- Environmental impact evaluation
- Technical support studies
- Basic design of offshore wind farms
- Civil works engineering project
- Project management and processing
- Logistical planning for wind farm construction

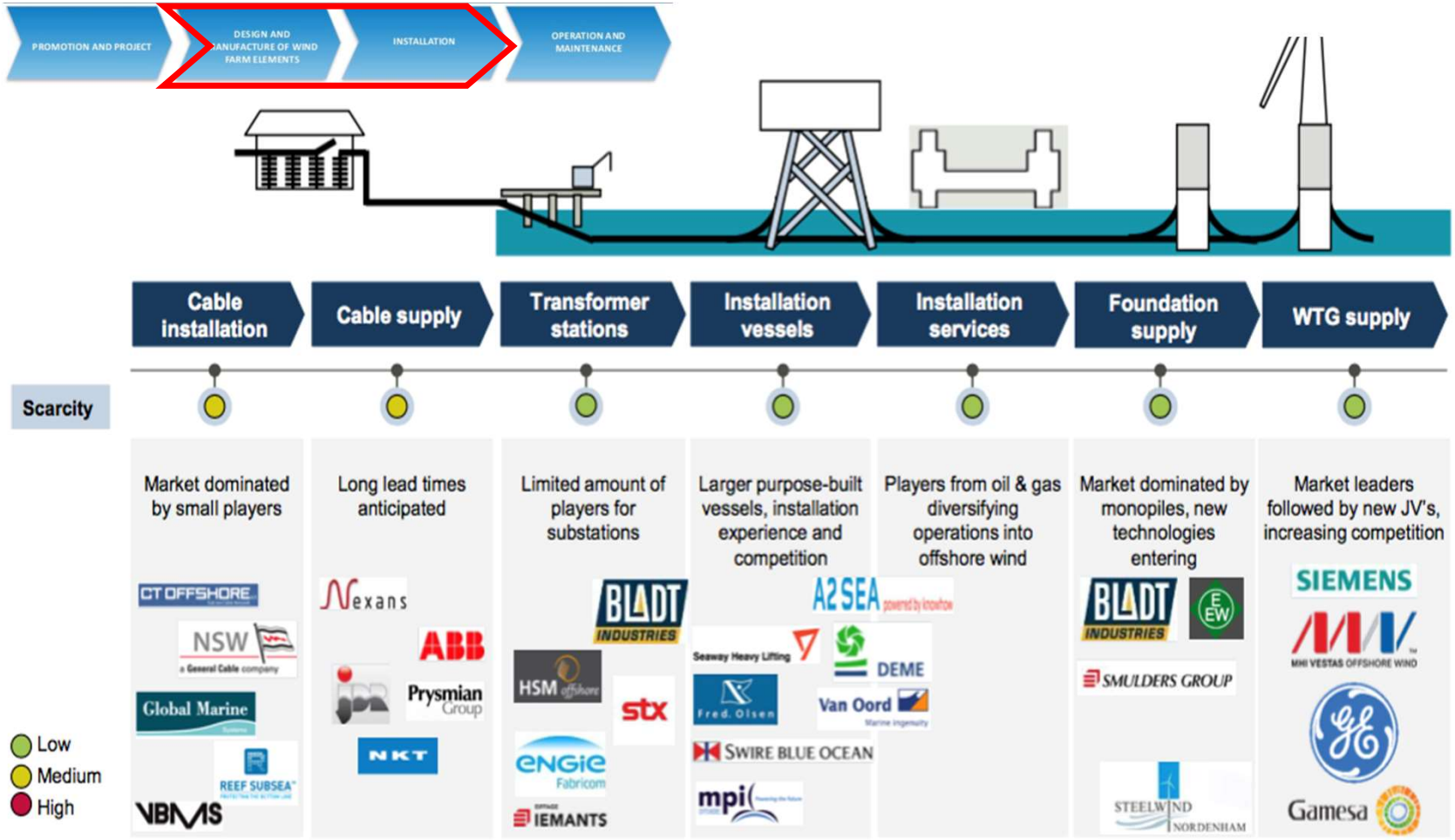
2 - 4 ans
DESIGN AND MANUFACTURE OF WIND FARM ELEMENTS
Maxime

- Turbine
- Foundation
- Electrical grid connection
- Offshore substation
- Telemetry and control systems

INSTALLATION
Frederic

- Design and construction of vessels for cable, turbine and foundation installation , and other auxiliary vessels (jack-up barges, platforms etc.)
- Services for transport and installation of submarine cable
- Services of transport and installation of turbine and foundation
- Offshore substation installation
- Offshore civil work
- Auxiliary services for the facilities (transport, handling equipment, maritime safety, etc.)

25– 30 ans
OPERATION AND MAINTENANCE
Vincent - Maxime

- Design and construction of vessels for offshore wind farm maintenance
- Services for wind farm operation and control
- Meteorological services
- Maintenance and repairs (electrical and mechanical)
- Auxiliary services for operational and maintenance activities (transport of material and personnel)
- Recycling and disassembly

Eolien Maritime – Supply Chain