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# FLOATING WIND Introduction

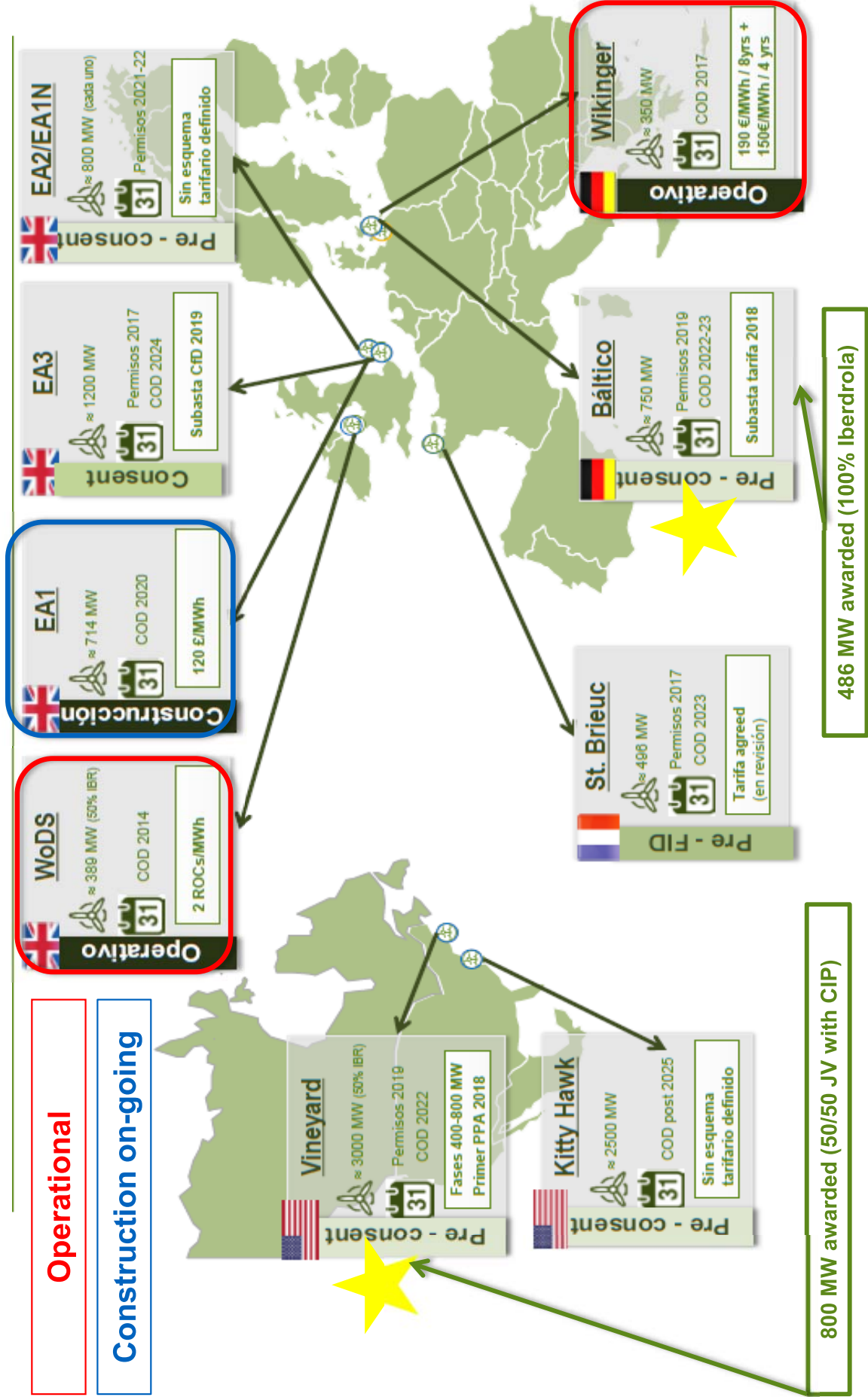
Juan Amate López

# Iberdrola Offshore Projects Pipeline



Recent Developments (auction success)

- Operational
- Construction on-going



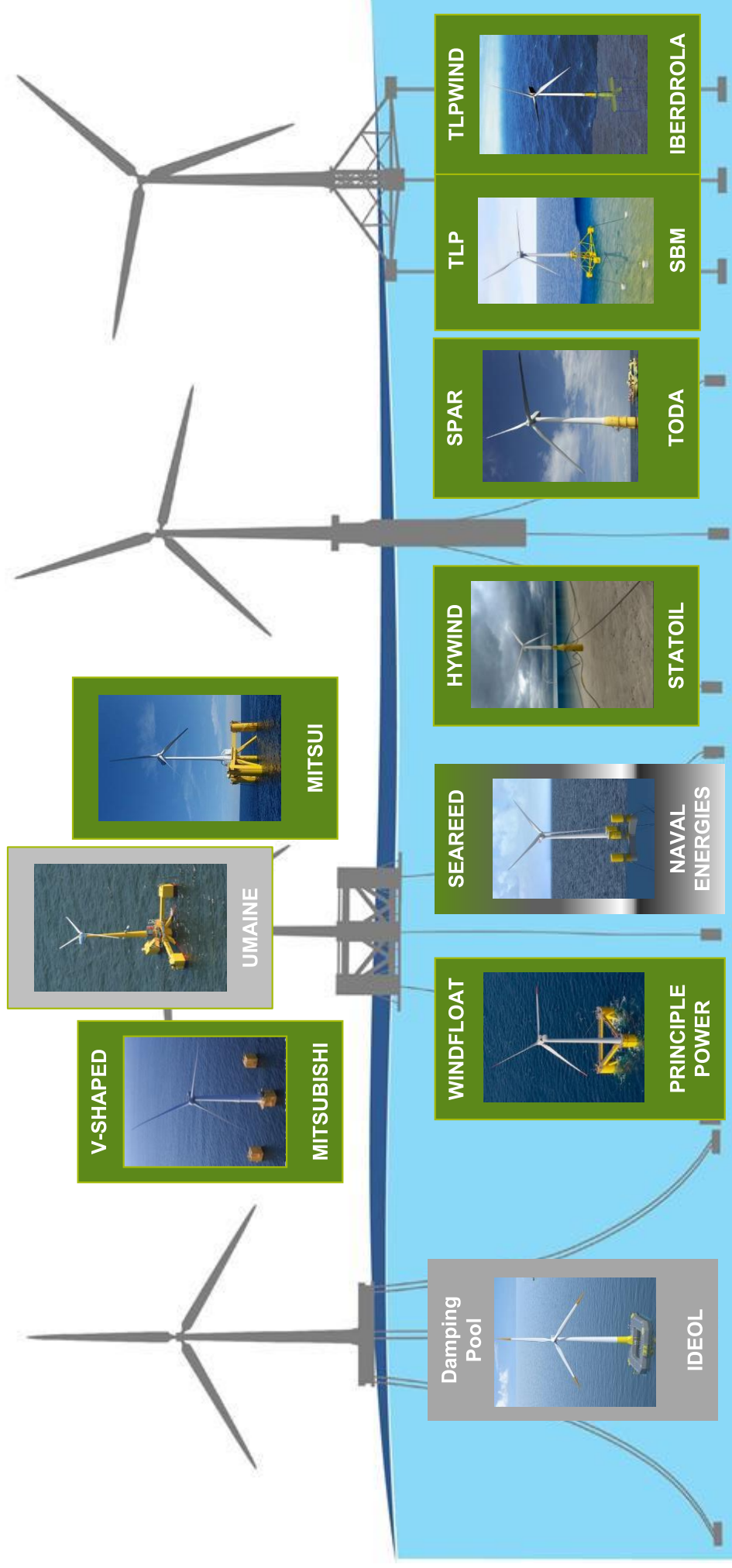
# Floating Wind technologies Introduction

**Barge**

**SEMI**

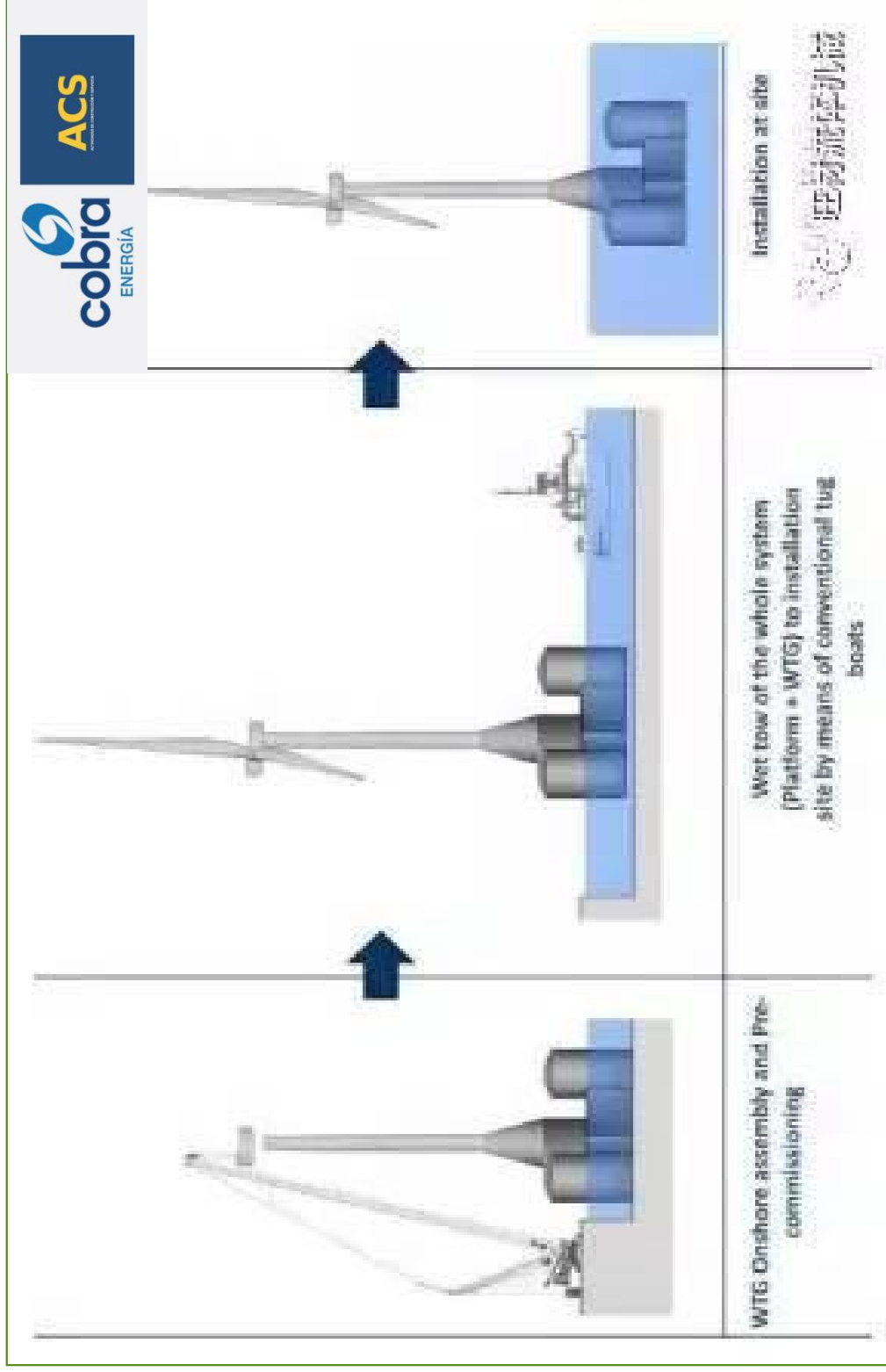
**SPAR**

**TLP**



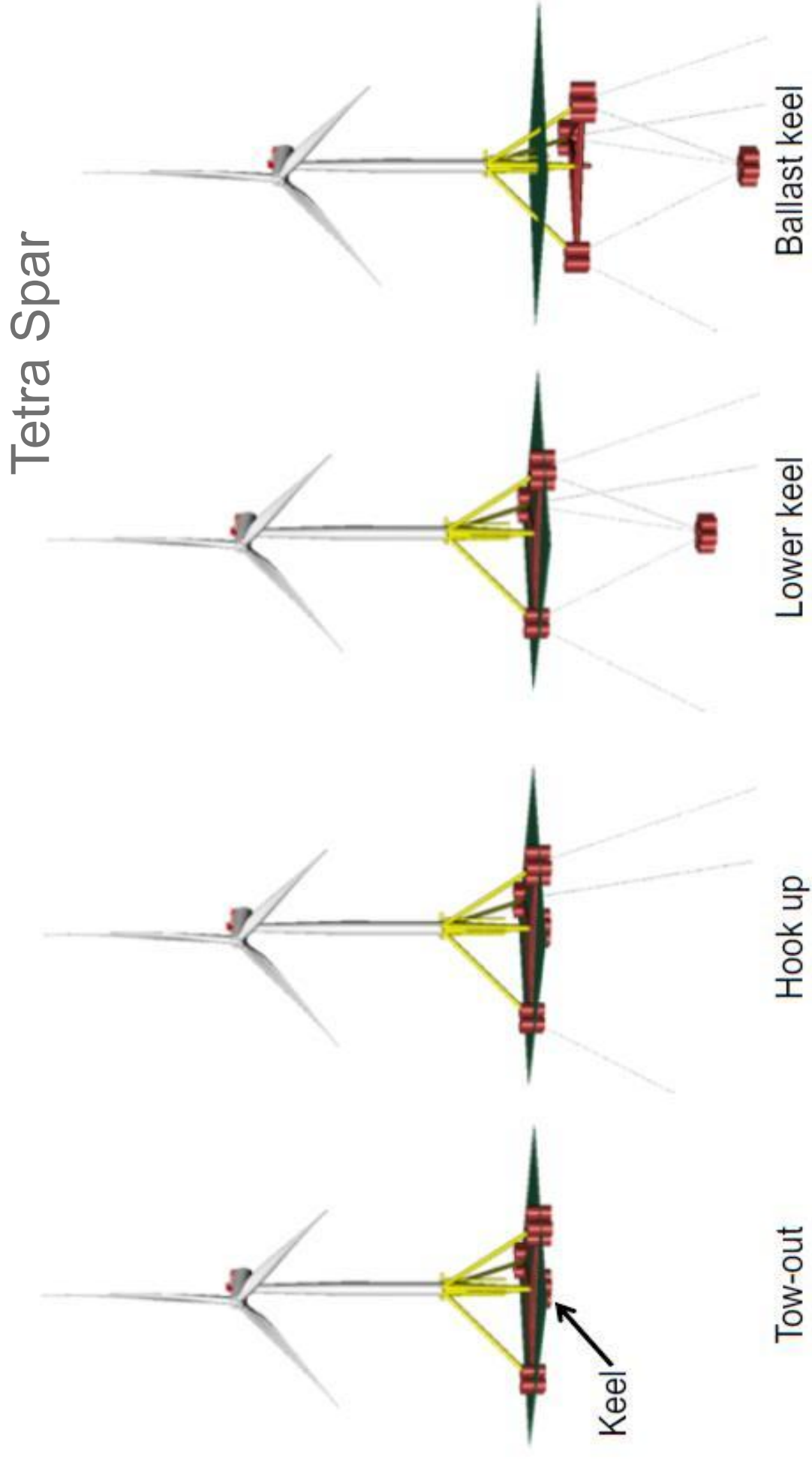
# Floating Wind technologies Introduction

## SEMI-SPAR



# Floating Wind technologies Introduction

## SEMI-SPAR

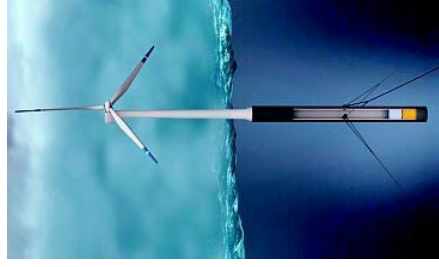
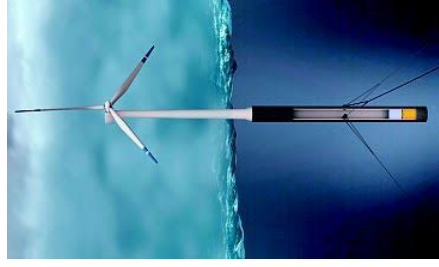
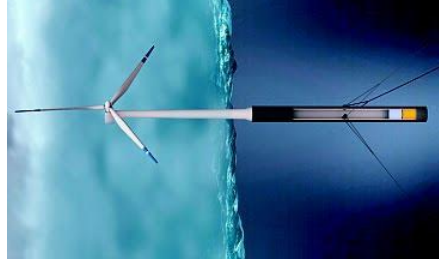
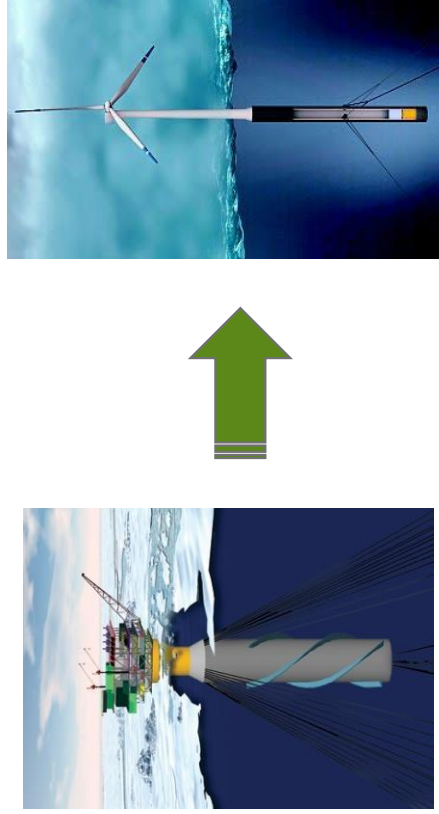


# Floating Wind technologies Introduction



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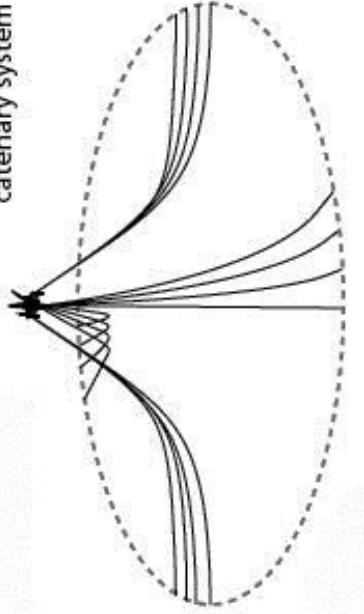
## ► Spar



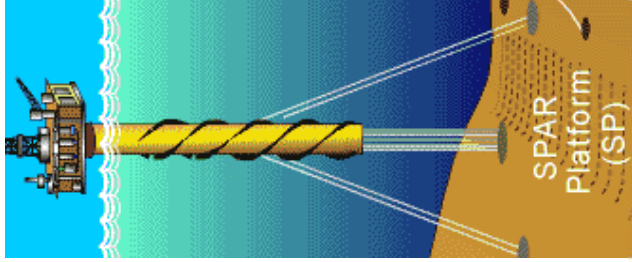
# Floating Wind technologies Introduction

## Slack Catenary moorings

catenary system



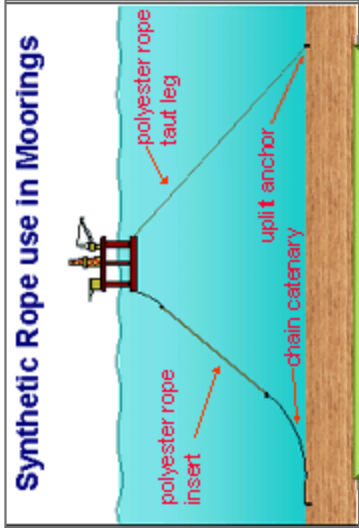
Slack Catenary moorings



## Semi - Taut moorings

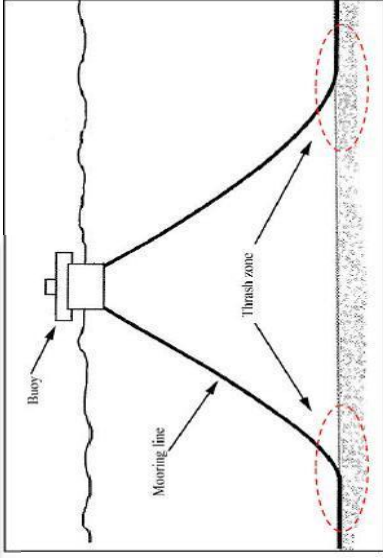
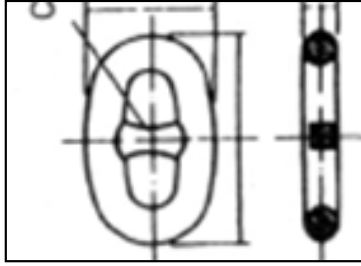


## Taut moorings

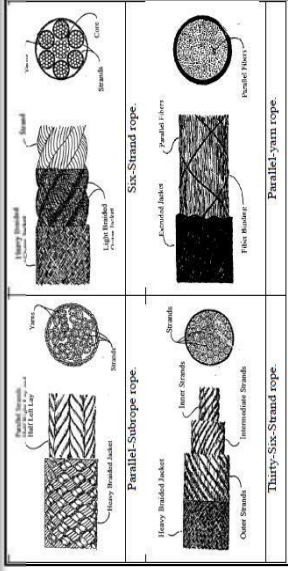


## Hybrid Synthetic-Chain moorings

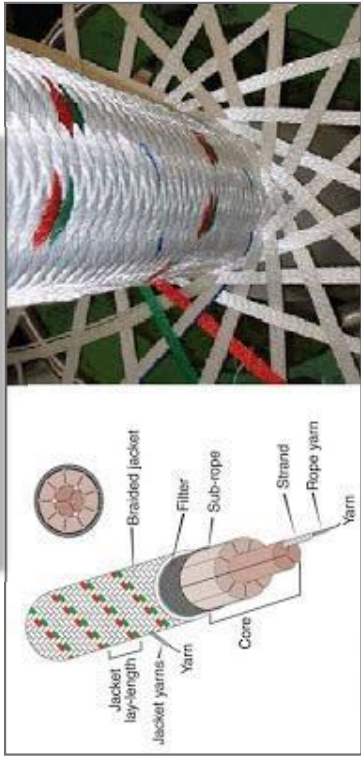
## Chains



## Steel wires (SWR) & tubes

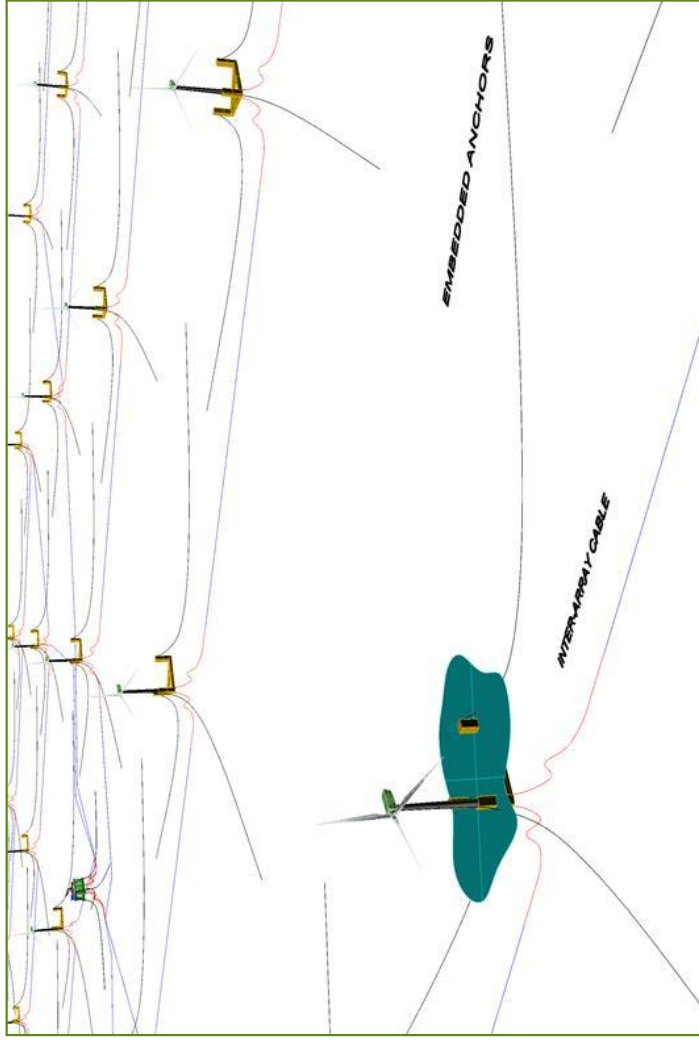
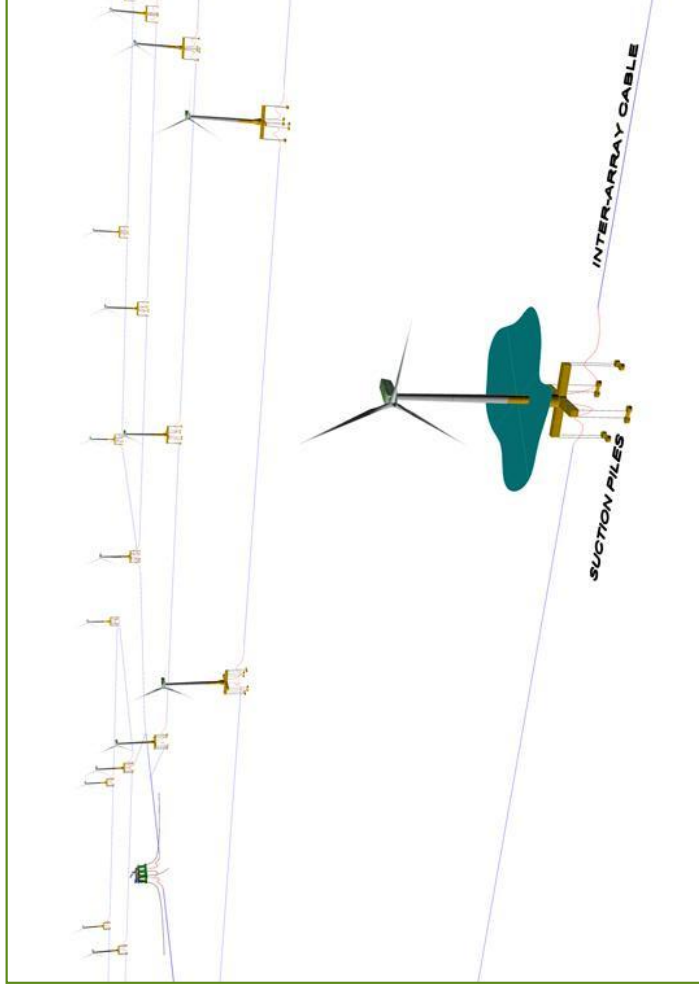


## Synthetic wires



# Floating Wind technologies Introduction

## Moorings: Taut vs Slack



**Slack Moorings** Technologies would need some extra separation than Optimal Wind Layout due to mooring interferences at deeper waters (<150 m) unless slack moorings are highly optimized

**Slack Moorings** would have a much bigger seabed footprint and much more Environmental Issues when sanctioning/permitting the project

# Floating Wind technologies Introduction

## Anchor/Foundation Systems

► Gravity Anchors

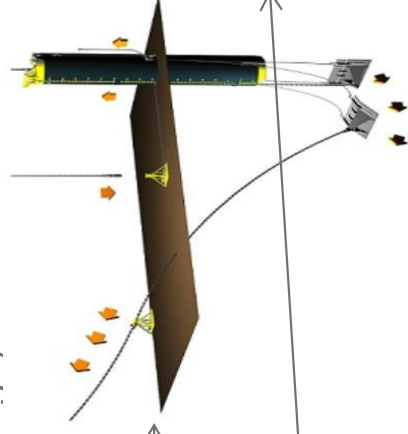
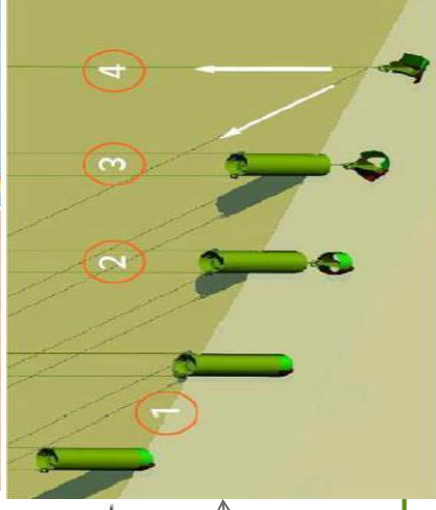
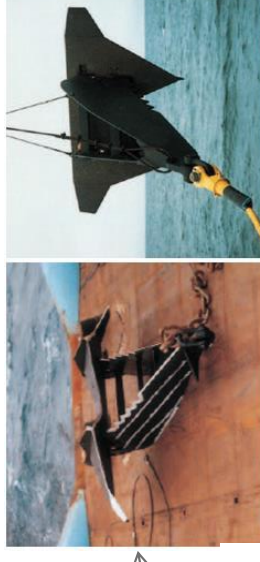
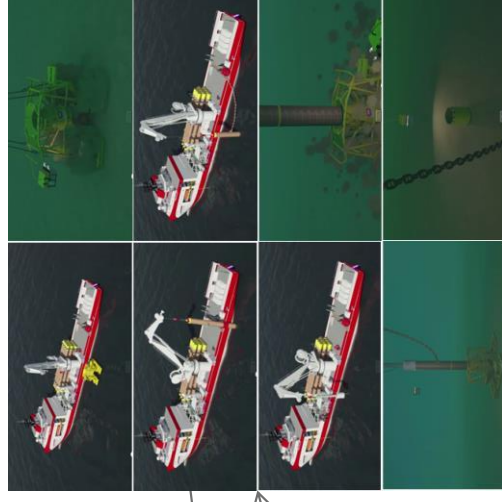
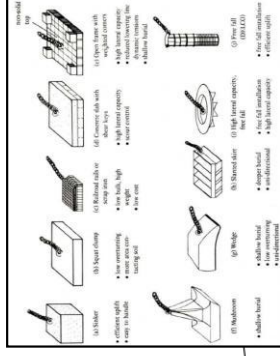
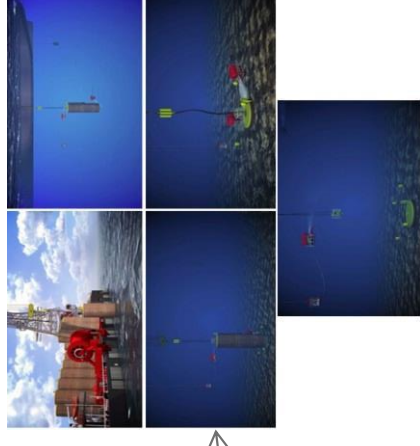
► Suction piles

► Driven & Drilled Piles

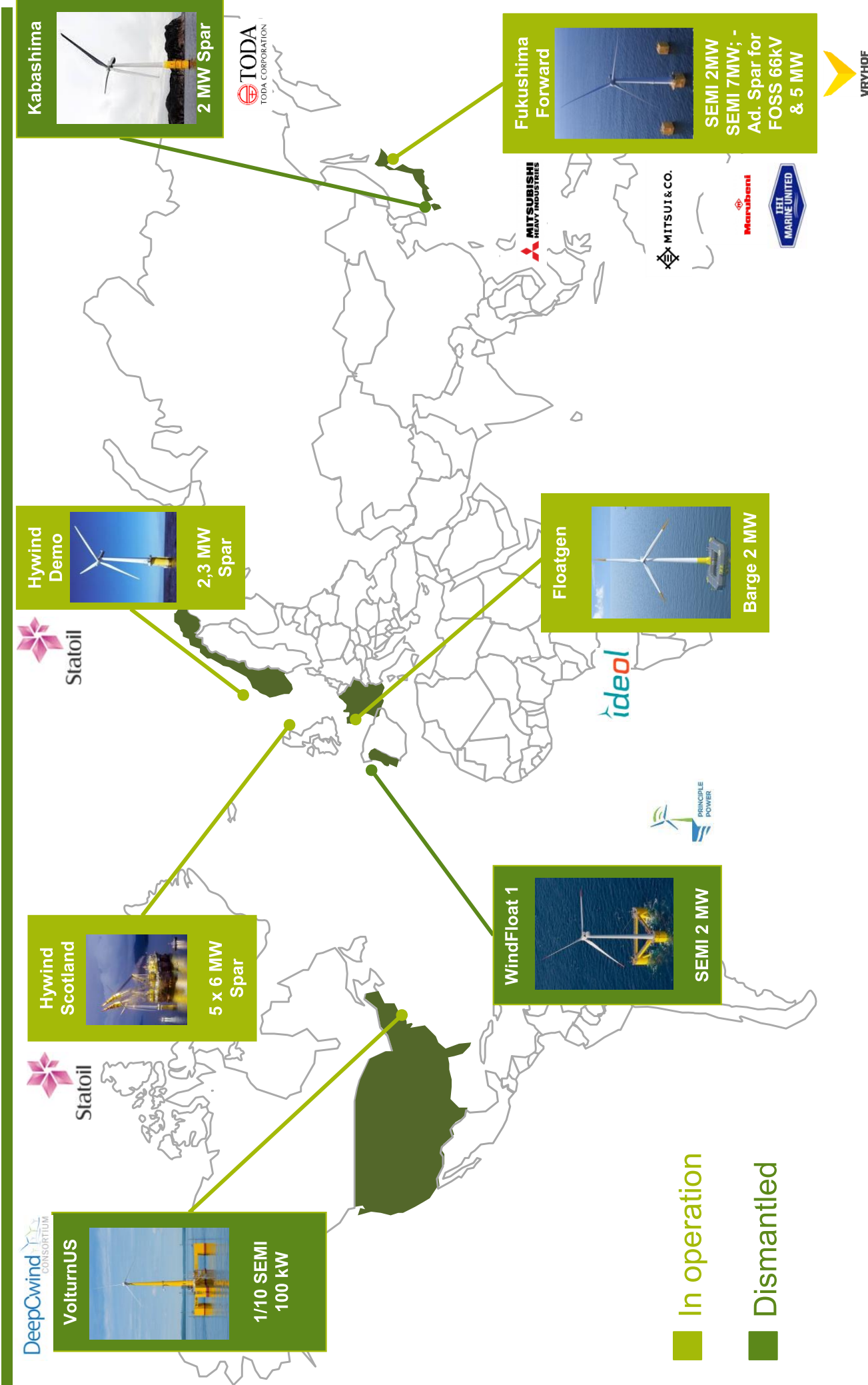
► Dredging anchors (normally only for slack moorings)

► Suction Embedded Plate Anchor (SEPLA)

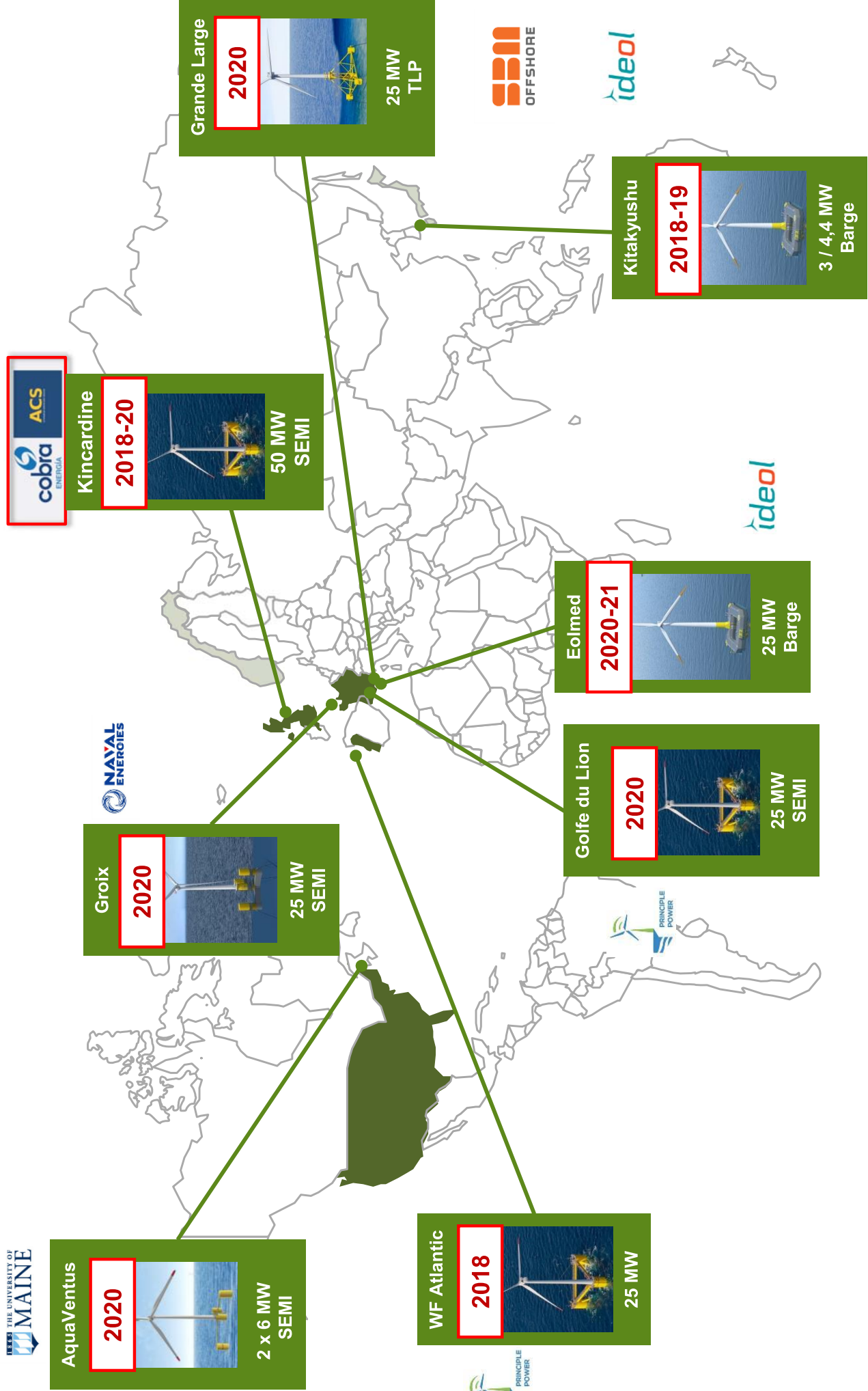
► Suction Embedded Anchor



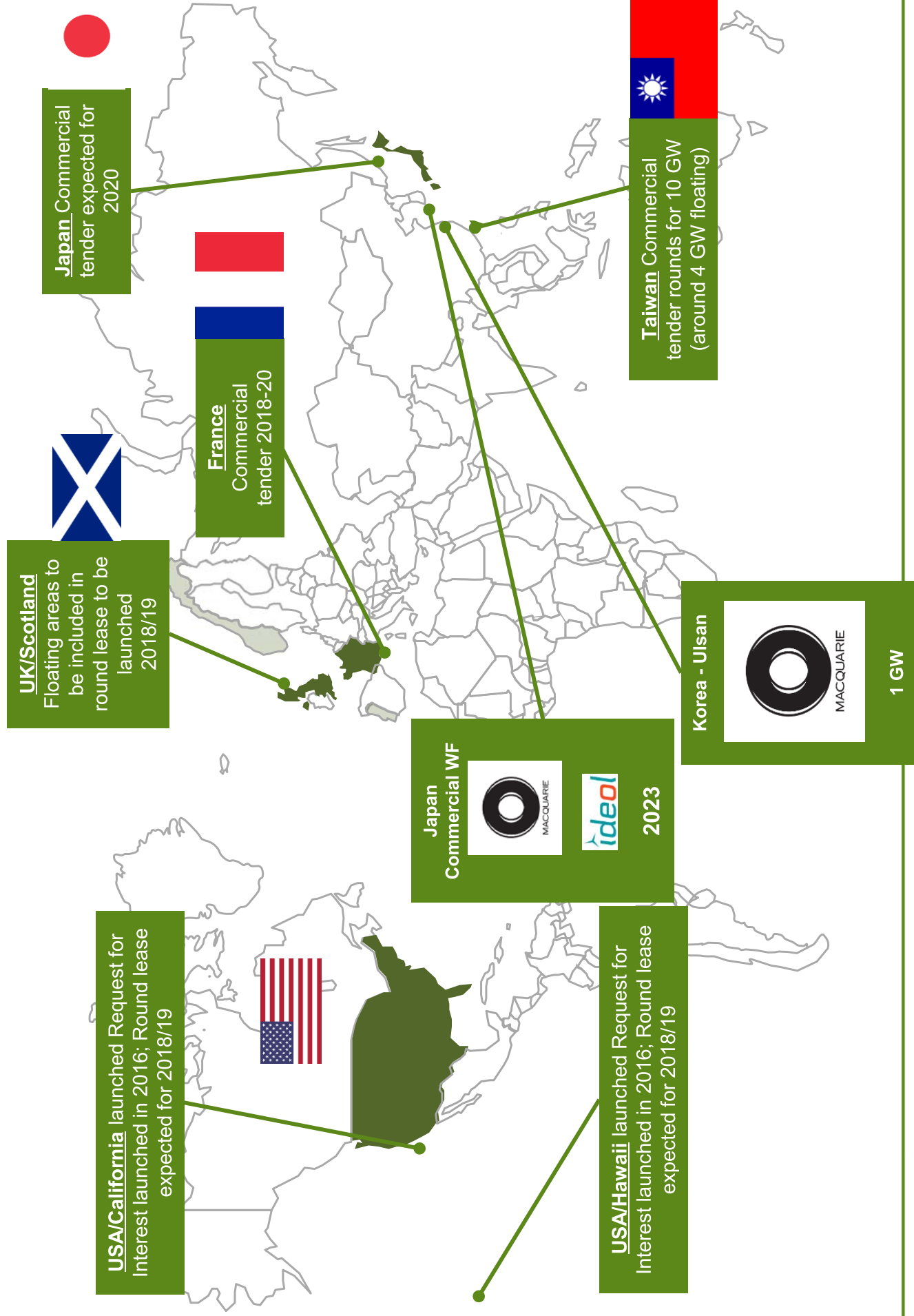
# Operational Floating Offshore Wind projects (2009-on going):



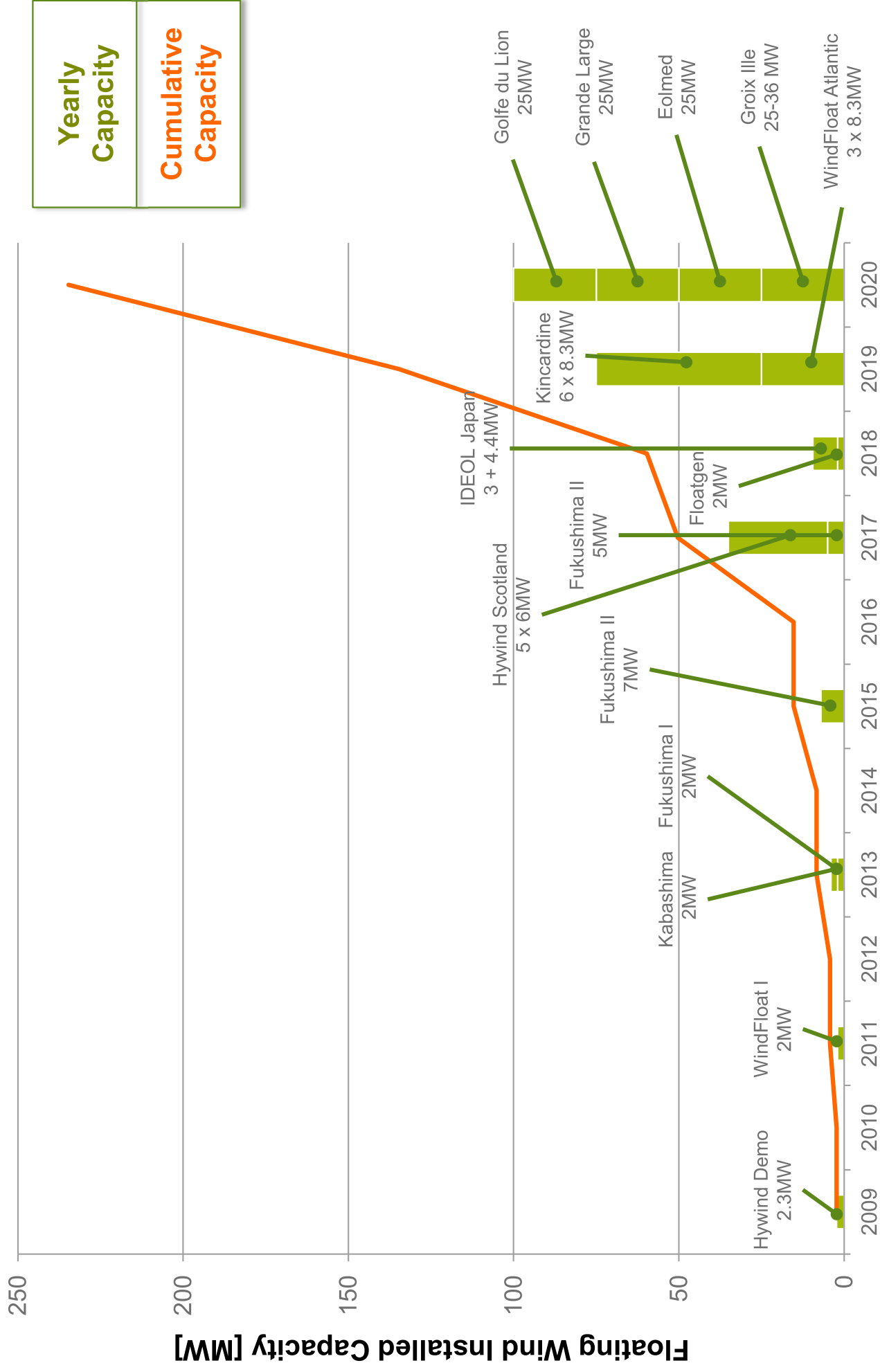
# On-Development Floating Offshore Wind projects (2018-2021)



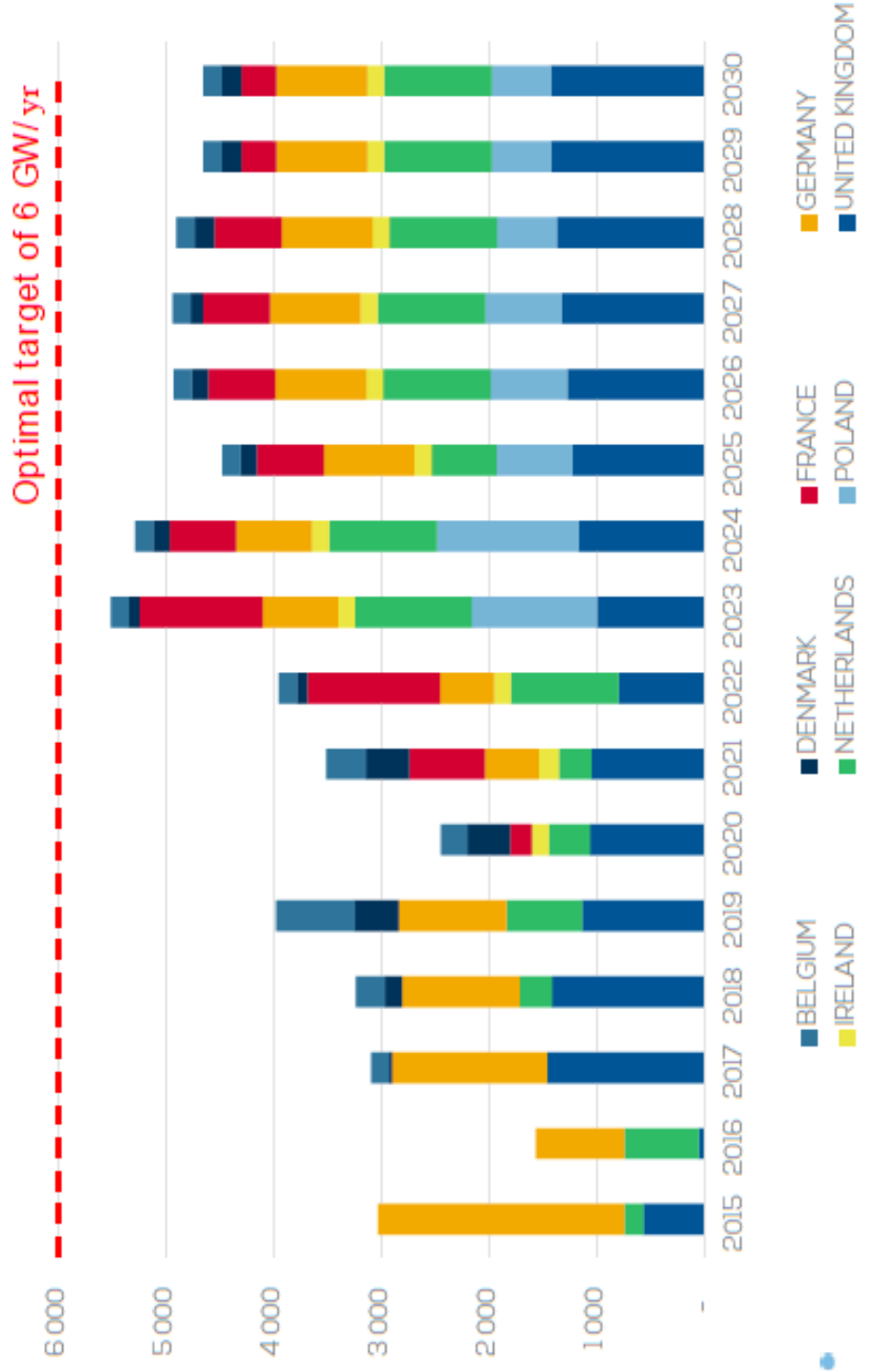
# Commercial Floating Offshore Wind tenders/leases (from 2018)



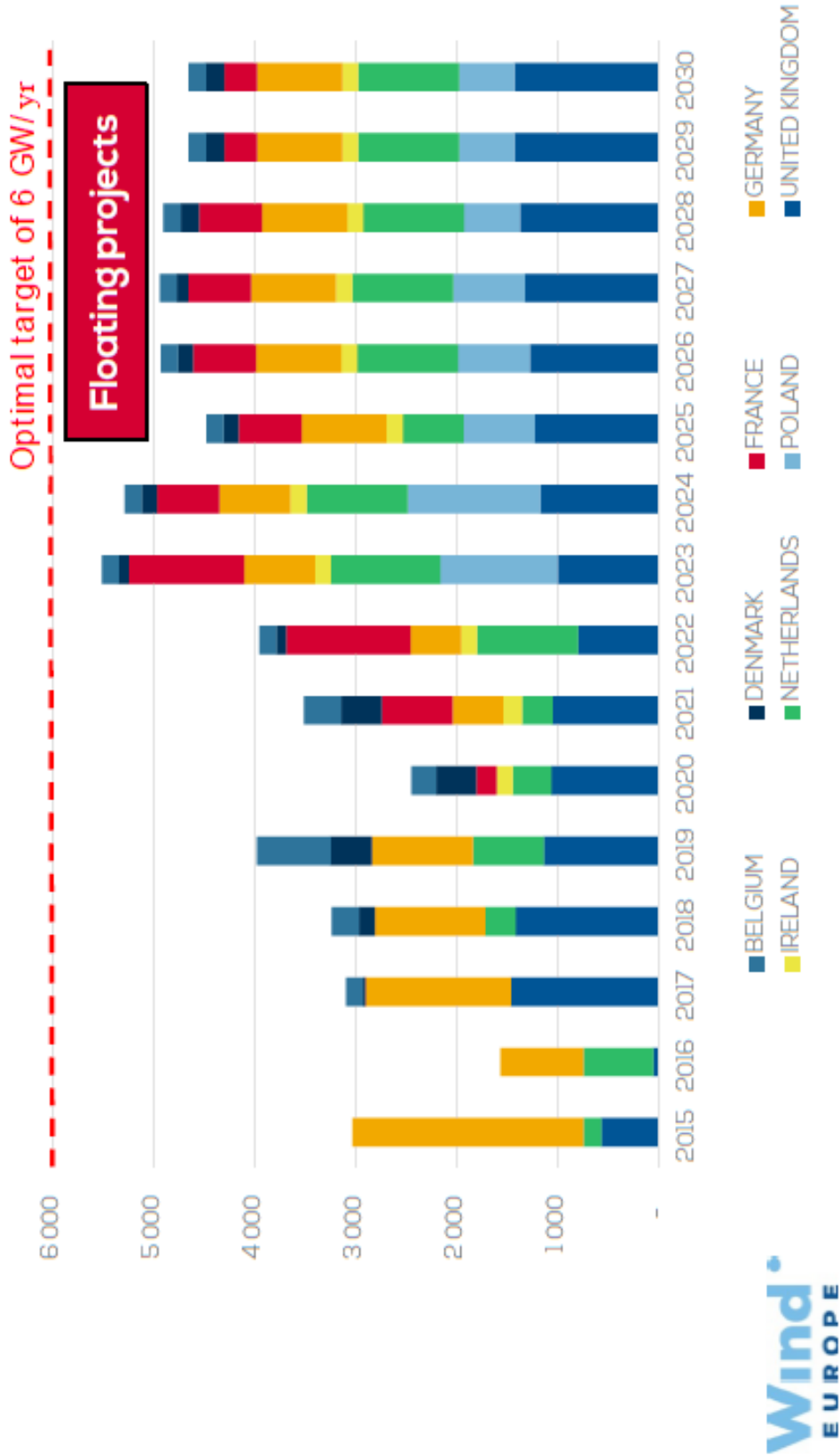
# Status of the market – Installed capacity until 2020



# Outlook to 2030

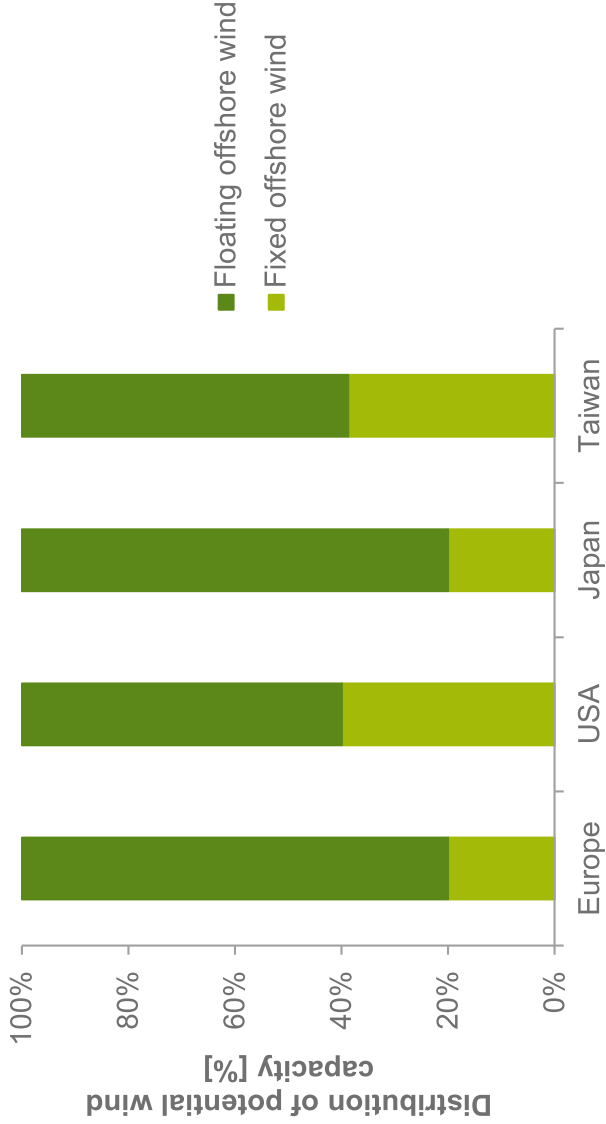


# Outlook to 2030



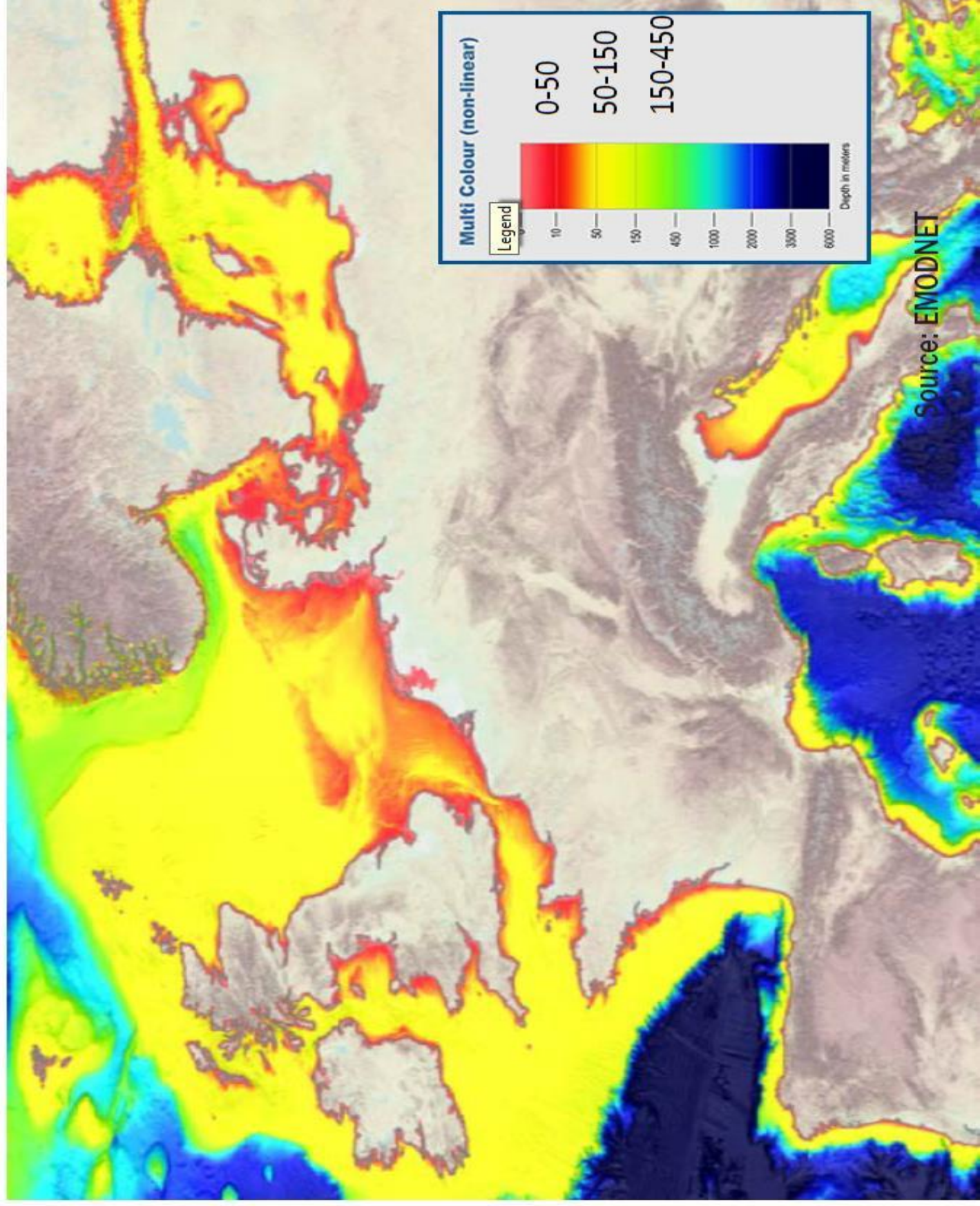
## Floating Wind gross potential

Country / Region	Potential offshore wind capacity	Potential for floating wind capacity (60m+ water depth)
Europe France Scotland	5.000 GW 80 GW 1.250 GW	4.000 GW (80%) - 1.000 GW (80%)
USA	4.100 GW	60 %
Japan	625 GW	80 %
Taiwan	147 GW	60 %



Floating adjusted strike price of  
**40-60€/MWh** by 2025-30  
(based on **Statoil** and **Principle** Power forecast)

# A reminder of the potential



# Capacity factors

**22.5%**

2017 average onshore  
wind CF

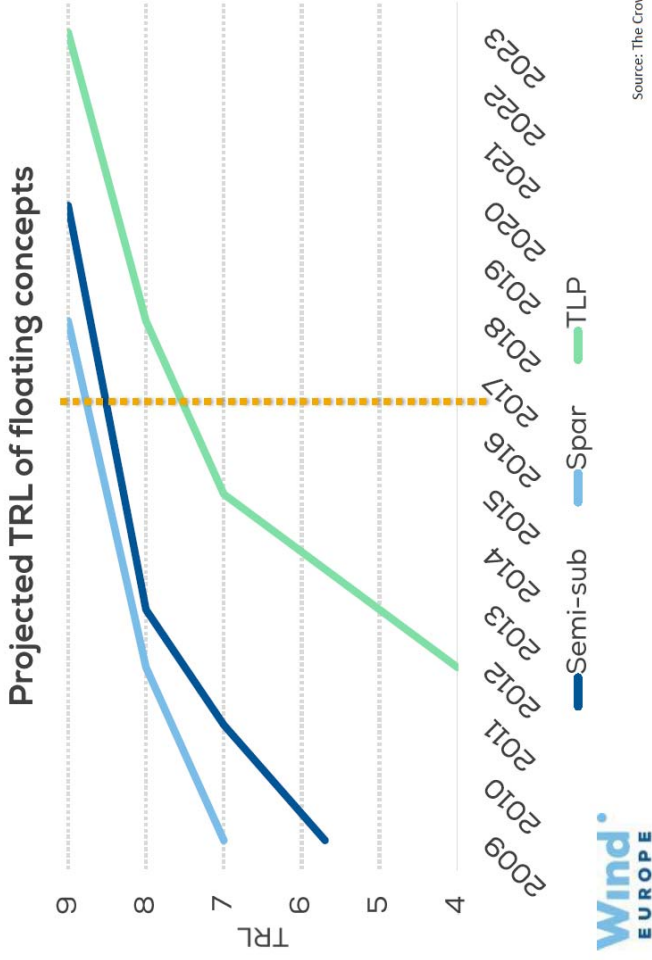
**41.7%**

2017 average offshore  
wind CF

**65.1%**

Last 3 months of 2017 average  
Hywind Scotland

# No longer an R&D exercise



# A reminder of the potential

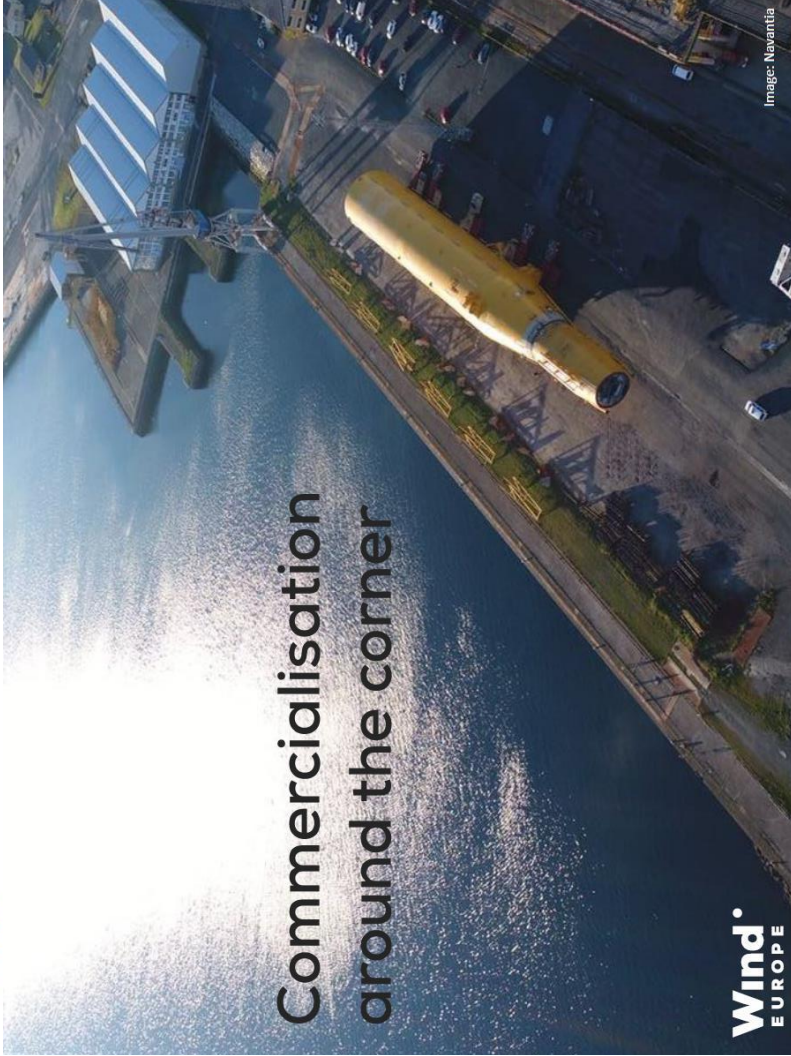
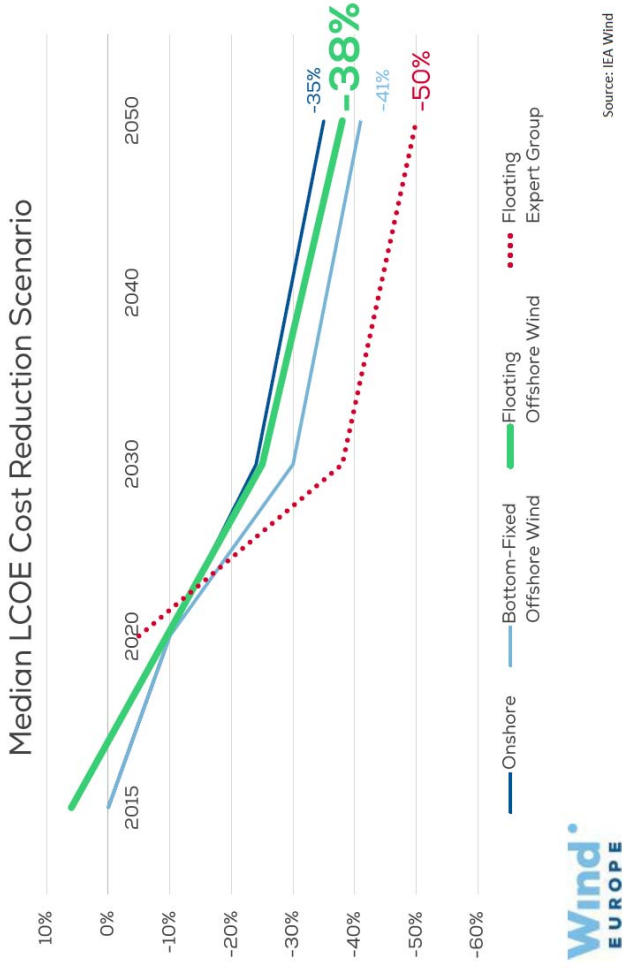
Country/Region	Share of offshore wind resource in +60m depth	Potential for floating wind capacity
Europe	80%	4,000 GW
USA	60%	2,450 GW
Japan	80%	500 GW
Taiwan	-	90 GW

Scotland 1,000 GW

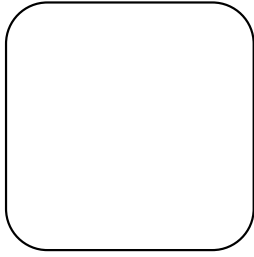
Wind EUROPE

Source: Carbon Trust, MOFA

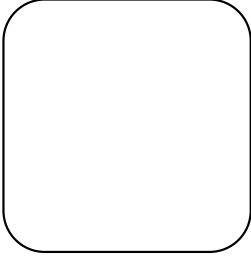
# The cost reduction pathway



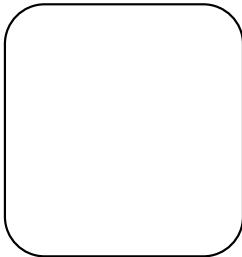
# Why Floating?



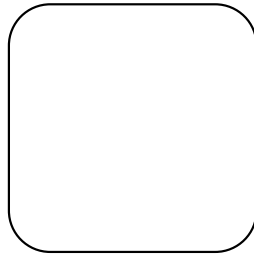
Highest Wind Resource areas are located in deeper waters where bottom fixed technologies are not feasible → Power Production has the biggest weight in LCoE → **Floating Wind** has the **potential to deliver one of the lowest LCoE in the whole Offshore Wind industry**



Lower dependence on **WTG loads** than current bottom fixed structures → **Lighter structures** helping the Offshore Wind market to drive the **LCoE** down; **Next generation WTGs (12/13 MW)** installation demands are already covered (3,000/5,000 ton capacity onshore cranes) and thus there is no need of developing **new WTG installation means**



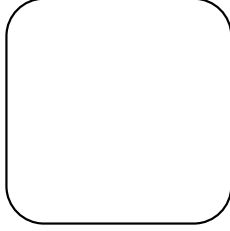
Easy to adapt **larger and wider payloads** than bottom fixed technologies → Capacity to adapt the design to hybrid solutions like Siemens OTM or Equipment to perform O&M major corrective actions; Feasible **life extension** (like MODUs) and **upgrade** for future larger WTGs



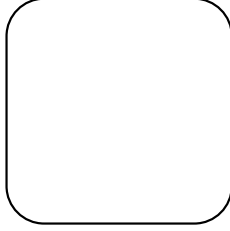
**Lean Design** → Much lower design variations from site to site than bottom fixed technologies  
Soil dependence >>> Weather Dependence → Floater could be **Type Certificate** granted (like WTGs) → lower development Time and **Risk** (lower LCoE uncertainty when developing a site from scratch)

# Why Floating?

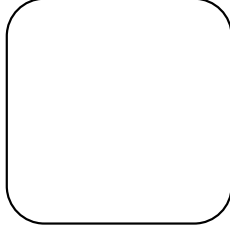
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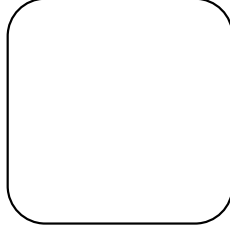
Minimizing overall Project Risks by performing most of the actions onshore → less Offshore operations → less weather dependence & hazards → **Lower overall project's Risk Profile than currently** → **Lower insurance rates & improved project finance** are expected when market is fully developed



**Offshore Installation & Commissioning times** for an OWF could be reduced up to 50%; Simpler & Reduced offshore Installation spread → Lower Marine coordination complexity



**Equal structures per project** → **Higher manufacturing standardization potential** → attracting new Supply Chain players → enhancing Market Competitiveness → driving down **LCoE**



**Potential to Maximize Local content** by maximizing **Onshore operations** like the OWTG assembly & commissioning → **New project contracts structure & Scope of Works** → lower Risk to assume for supply chain companies (WTGs)

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# Thank You!!