

Concrete Floating Offshore Wind Turbine Foundations

Naveed Iqbal

R&D Engineer, Vattenfall

Why use floating offshore wind foundations?

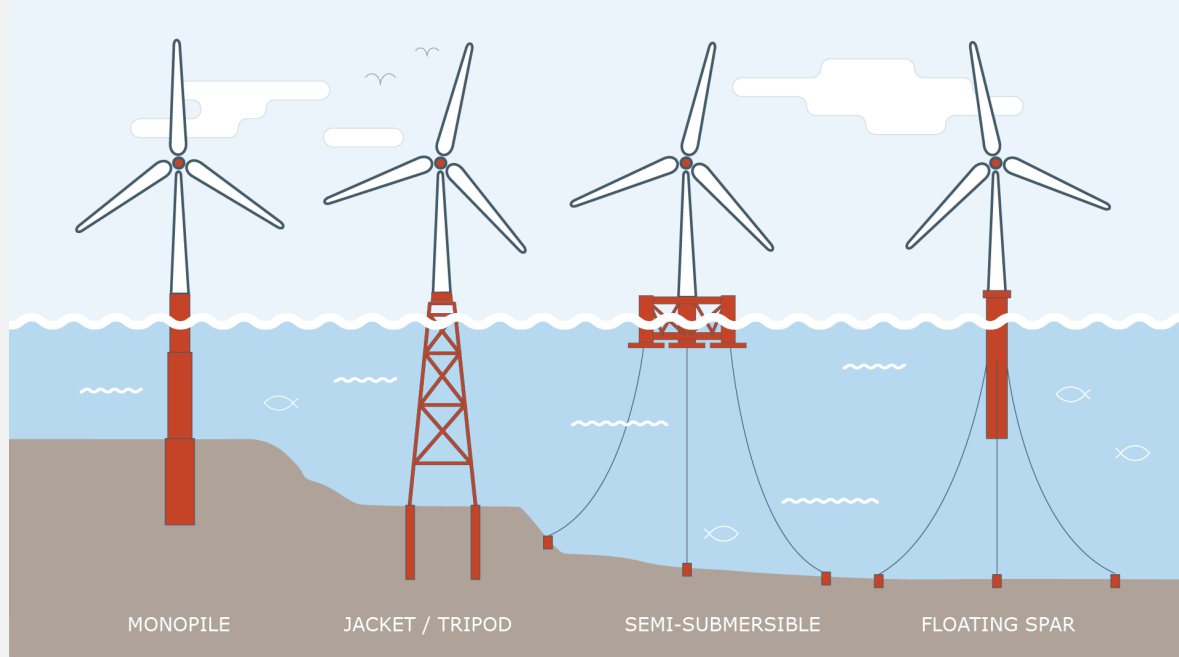


image: [cowi](https://www.cowi.com)

- Depth constraints of present offshore WTG's
- Allows access to deeper waters: depths > 50 meters
- Offers large areas with stronger winds
- Expands offshore wind market
- Less environmentally invasive to the seafloor

Typical floater concepts



Image: National Renewable Energy lab ([NREL](#))

- Main components of a floating foundation
 - Platform structure
 - Buoyancy system
 - Mooring cables/chains
 - Anchor system

- Spar buoy

- Barge floater

- Semi-submersible

- Tension-leg platform

Leveraging the oil & gas industry's offshore experience



- Offshore drilling platforms
- Floating production systems (FPS) and storage facilities
- Extensive concrete used in Gravity based structures (GBS)

- Leveraging Oil & Gas extensive experience:
 - Design principles and methodologies
 - Mooring systems
 - Logistics and operations
 - Transportation and installation
 - Regulatory framework
 - Impact on environment

Image:(upper-right) [marineinsight](#); (left): [acteon](#); (lower-right): [zmescience](#)

Concrete based floating wind foundation concepts



- Various concepts at different stages of development, testing commercialization
- Several concepts utilize concrete as hull material
- Based on floating concepts described earlier:
 - Barge floater
 - Semi-submersible
 - Vertical pontoons/columns
 - Structural Caissons
- Many in the pilot project stage

Image: (Upper-left): [BW-Ideol](#); (Lower-left): [OO-star](#); (Upper-right): [Voturn US. Univ. Of Maine](#); (Lower-right): [Crown buoy. Brezo energy](#)

Advantages of concrete floating wind foundations

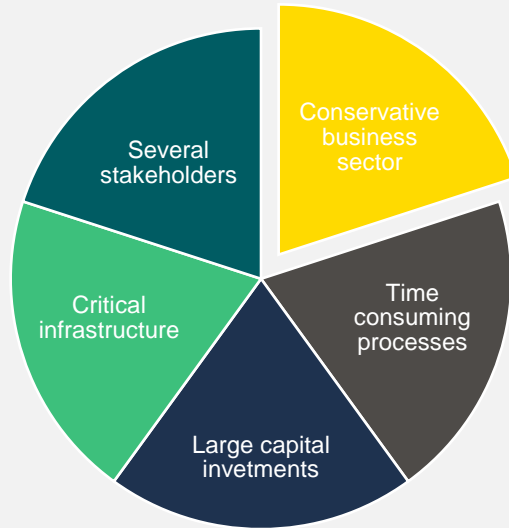


- Stability in rough seas
- Durability
- Cost effective
- Local production
- Environmental benefits
 - Green concrete
 - Artificial coral reefs

Images: (upper-left): [NREL](#) ; (upper-right): [offshore drill platform](#); (lower-right) [artificial coral reefs](#)

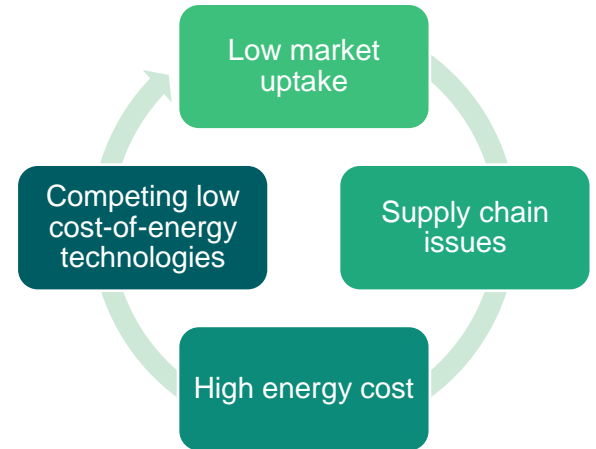
Challenges...

Commercial challenges



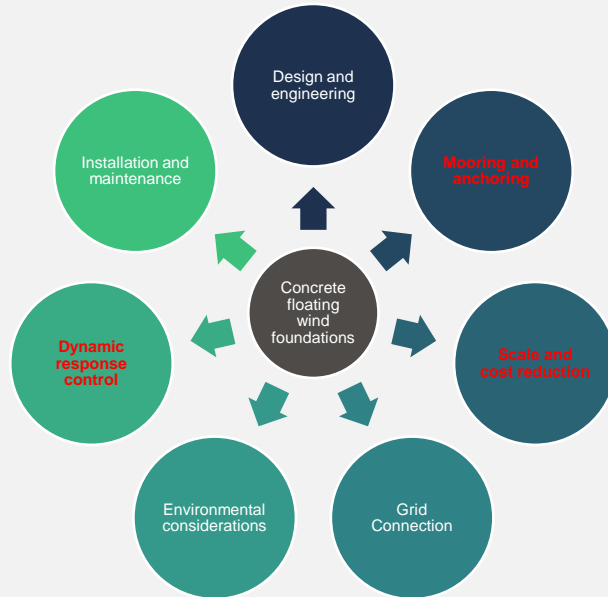
Source: IRENA

Price of energy from FOW must be competitive!



Challenges

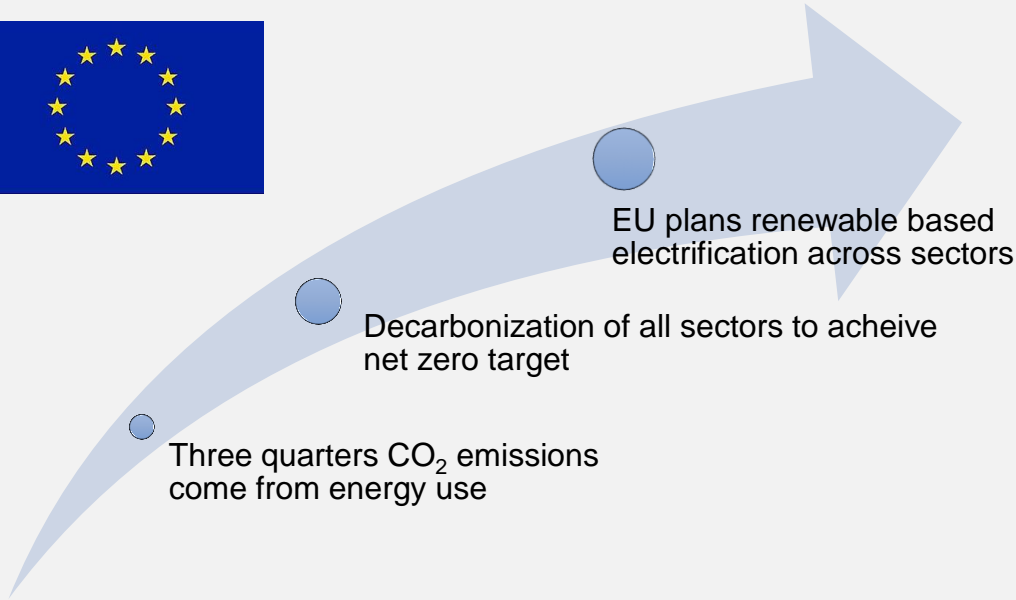
Technical challenges



- Continued research and development
- Collaboration between industry stakeholders, government and research institutes
- Promoting education of offshore floating wind technology

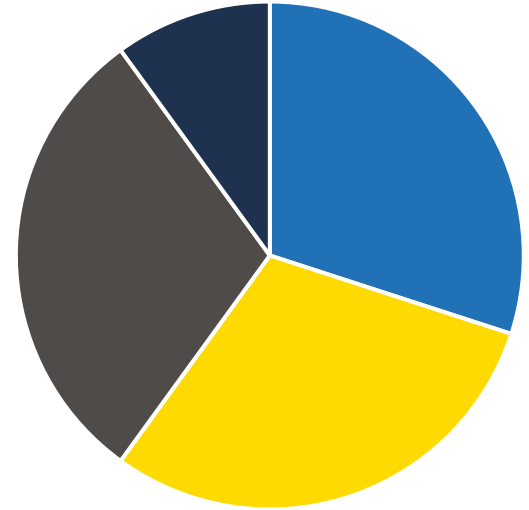
Towards Net-zero emissions by 2050

EU's Pledge to achieve Net-zero CO₂ emissions by 2050



Source: Windeurope.org

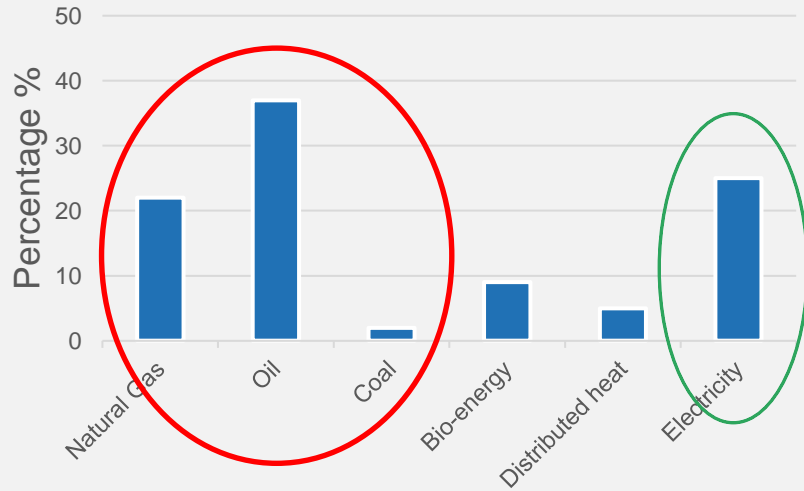
Energy related CO₂ emissions by sectors



- Industry
- Buildings
- Transport
- Others

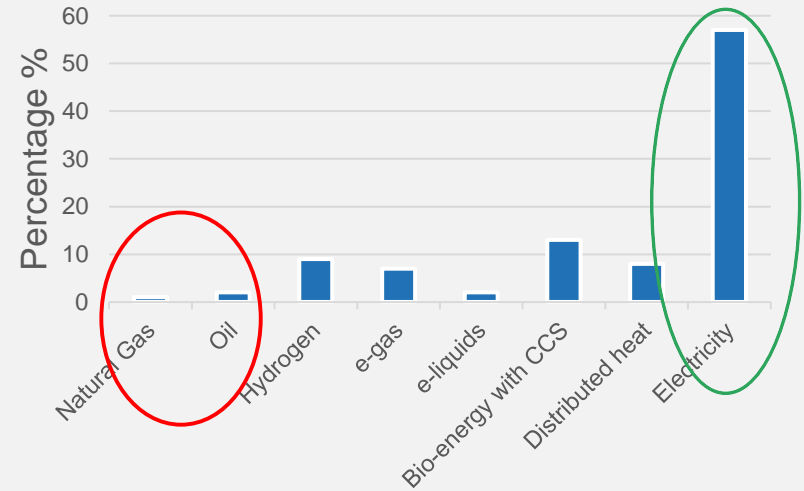
Energy demand per energy carrier

2019



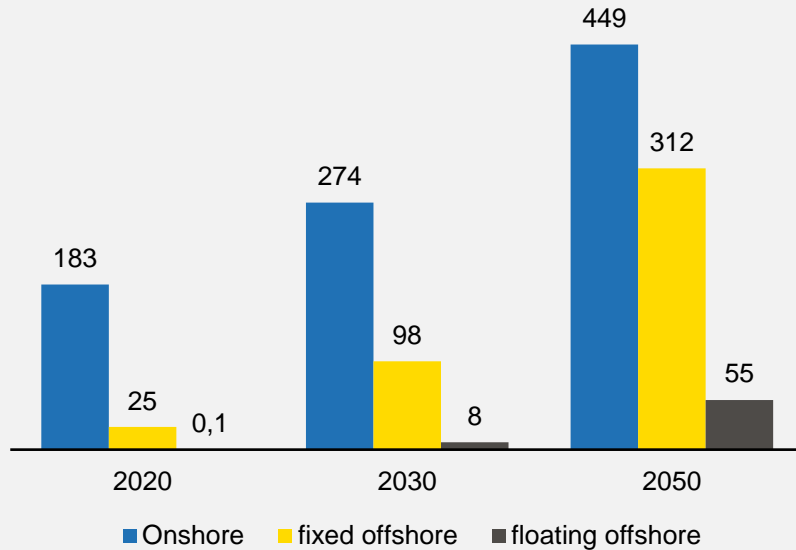
Source: Windeurope.org

2050



EU's Wind energy outlook

Installed wind capacity (GW)



Source: [DNV](#)

- Floating Offshore Wind represents a significant growth market
- FOW has therefore a Crucial role to play in achieving the net-zero target by 2050



Thank you!