FLASC

Renewable Energy Storage

Utility-Scale Subsea Energy Storage

MDES 2024

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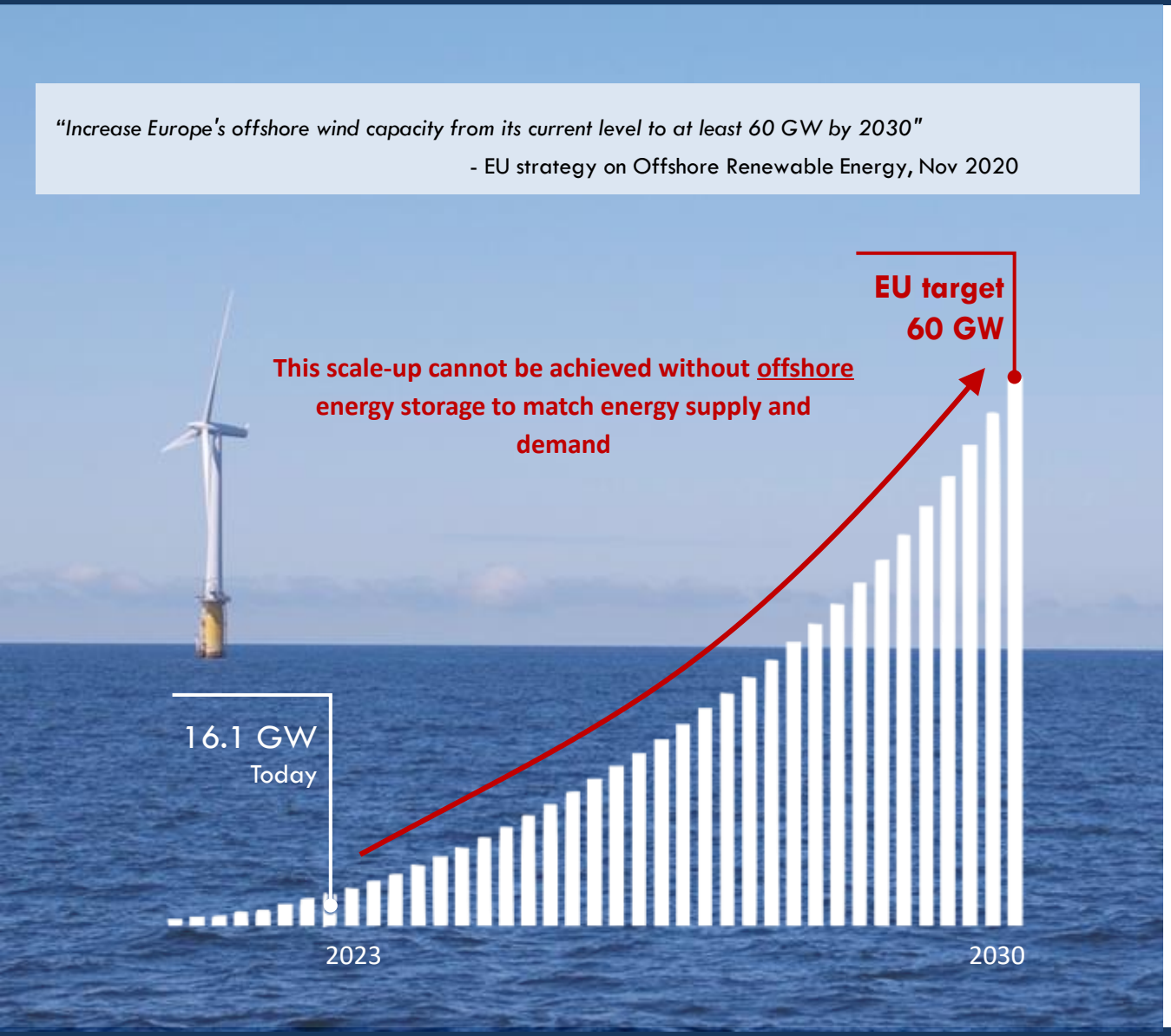
The Challenge

- Power available for a specific site needs to be evaluated using resource measurements (eg. wind data). These are typically available already for sites being considered for project development.
- An important attribute is the Capacity Factor: percentage of time the Renewables Energy System (RES) is delivering the rated output.
- Offshore wind has the highest capacity factor of all renewables: 40 – 50% (even 60% has been reported from floating demos).
- This implies significant periods of (fixed) rated power delivery, but intermittency occurs on shorter time-scales when compared to solar PV.
- Detailed Energy Storage System (ESS) system sizing must also consider demand-side data.
- **Important to establish the storage capacity “sweet-spot” for a project to be viable.**

The Challenge

"Increase Europe's offshore wind capacity from its current level to at least 60 GW by 2030"

- EU strategy on Offshore Renewable Energy, Nov 2020



Temporal Mismatch

- Offshore wind generation is intermittent and can only be used when there is immediate demand.

Spatial Mismatch

- When the onshore grid is constrained, offshore power cannot be delivered where needed and ends up being wasted.

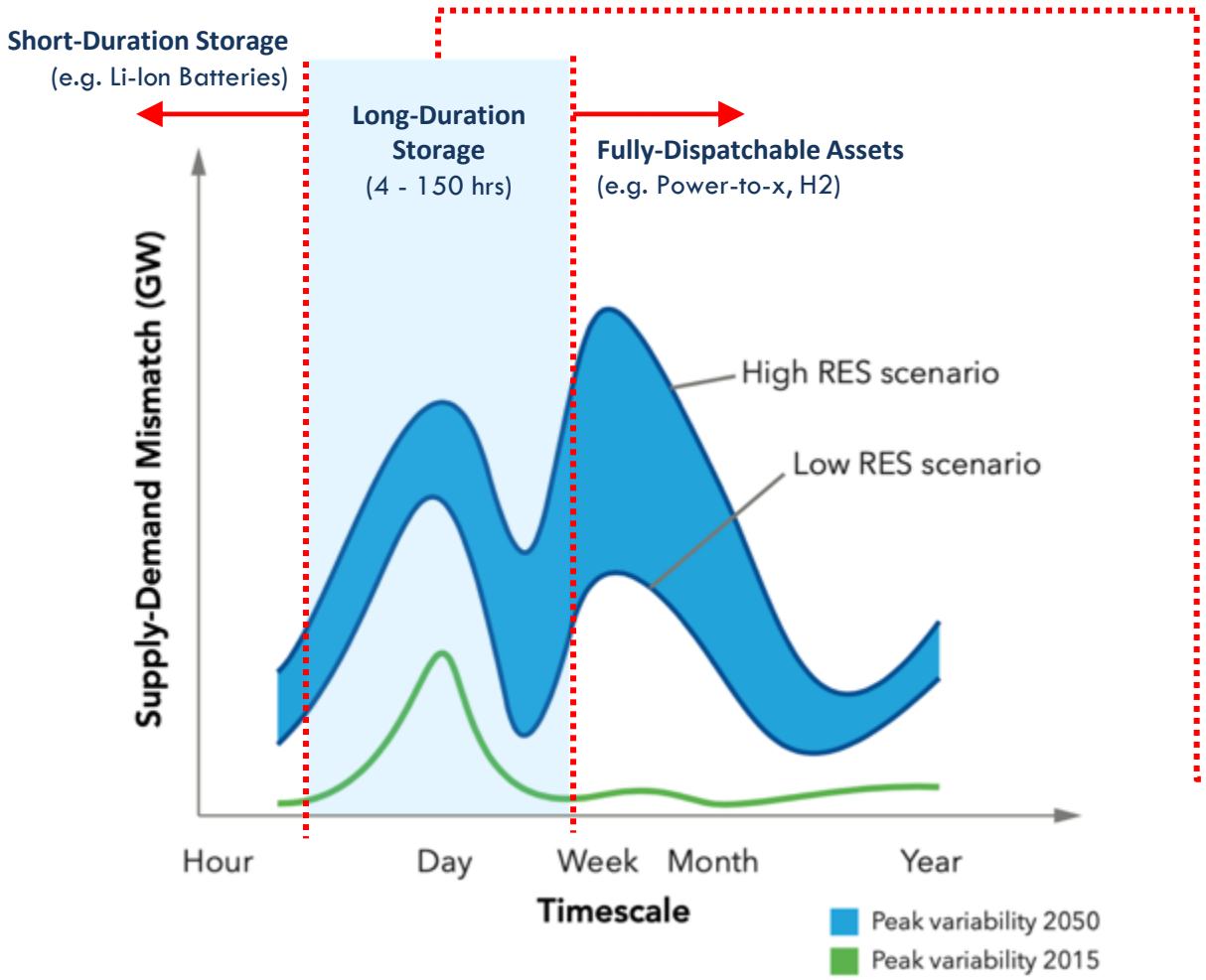
Market-Specific Pain Points

Grid-Connected Offshore Wind

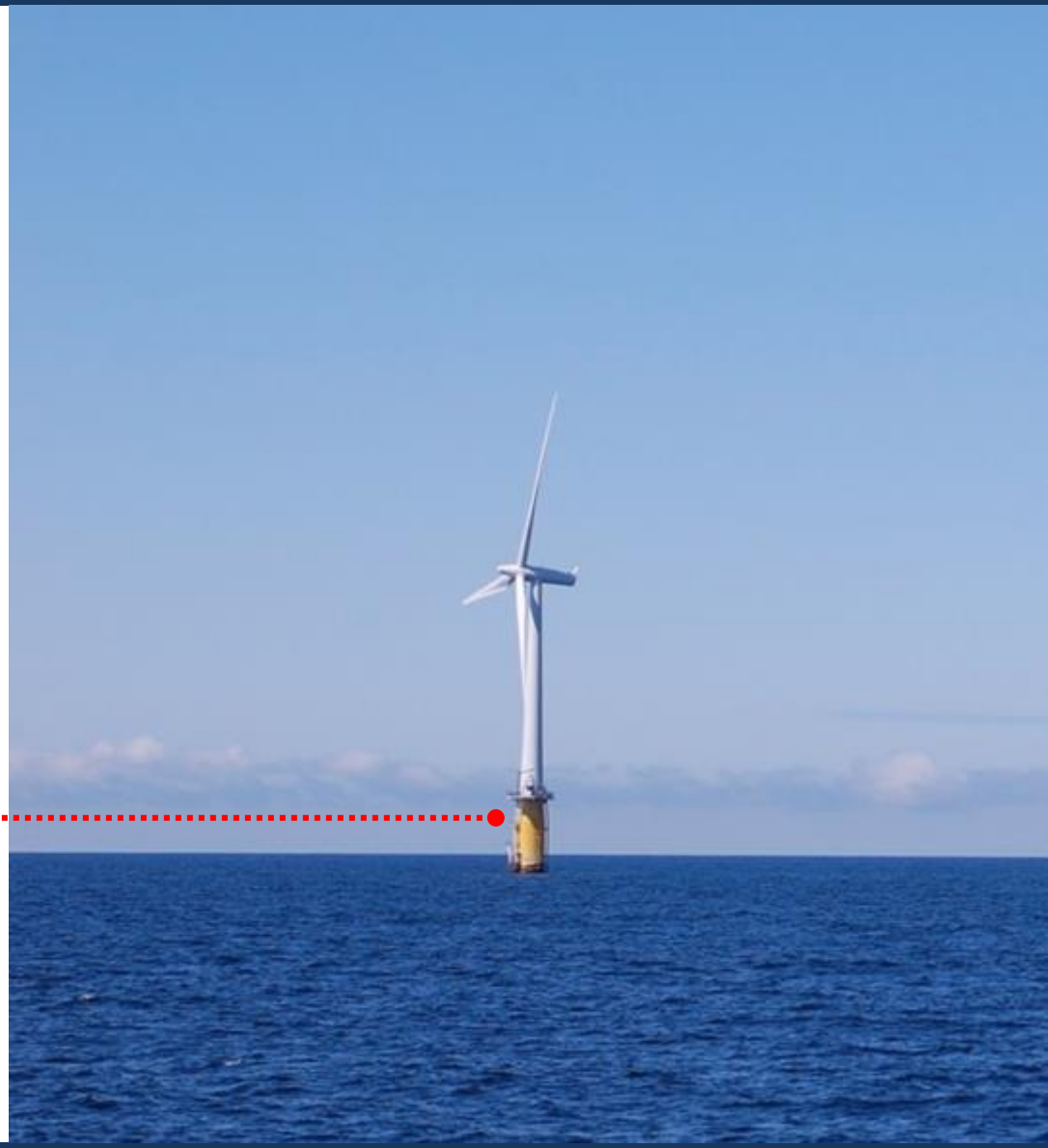
Decarbonisation of Oil & Gas

Small-Islands & Sensitive Regions

An Ocean of **Opportunity**



Peak variability of residual load at different time scales in a European electricity grid (*modified from DNV*)

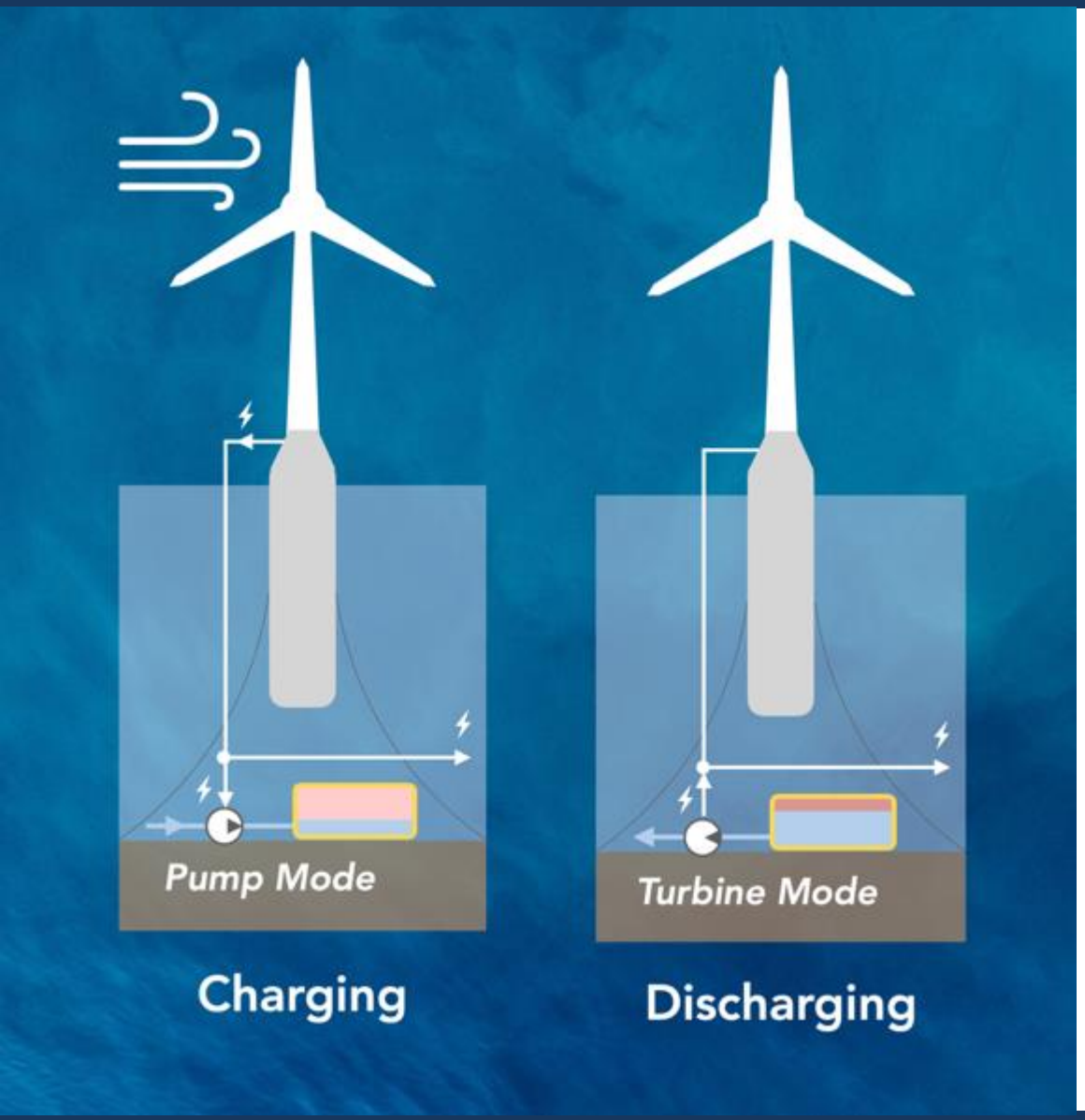


Delivering Value

by storing energy at sea

1. **New Generation + Storage Projects**
2. **Decarbonisation of Oil & Gas**
3. **Green Hydrogen Production**
4. **Small-Islands and Sensitive Regions**
5. **Repurposing Existing Infrastructure**

Hydro-Pneumatic Energy Storage



Combining pressurised **seawater** and **compressed air**

Patented Innovations:

Pneumatic Pre-Charging
→ Shallow-Water Energy Density

Ocean as a Natural Heatsink
→ High Thermal Efficiency

Scalability: **>100 MWh**

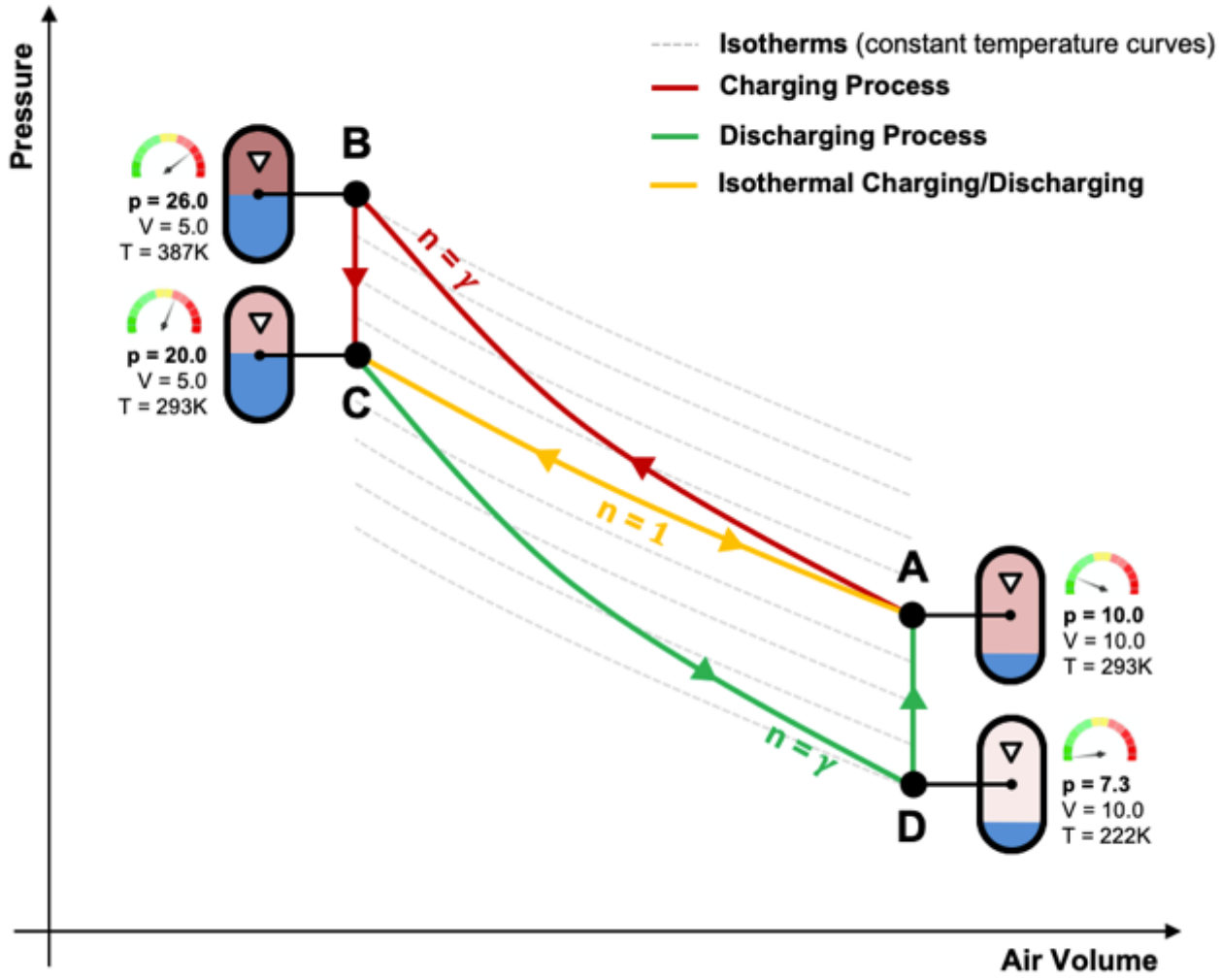
Roundtrip Efficiency: **70-75%**

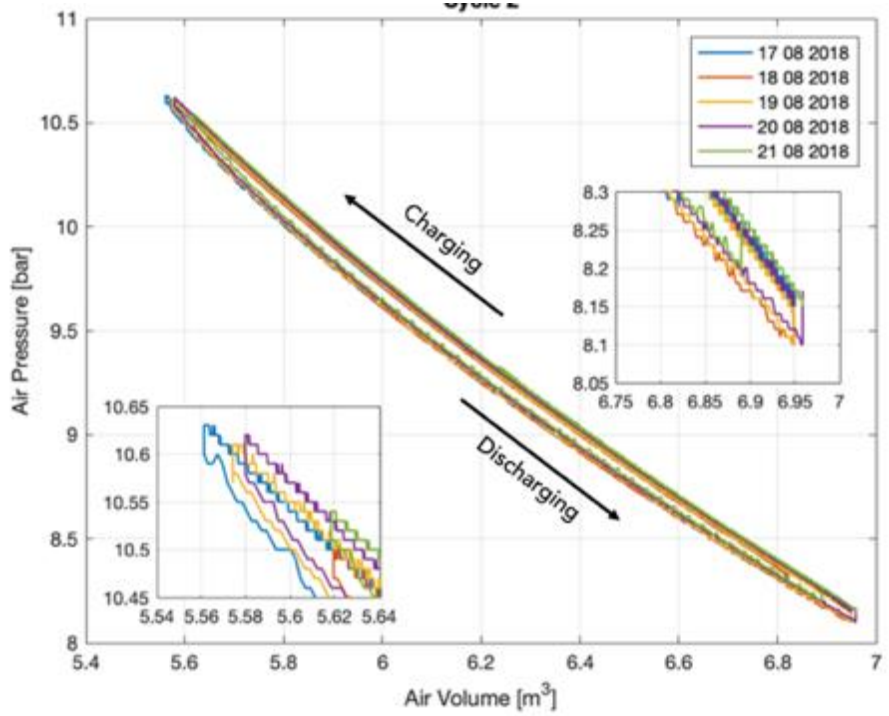
Storage Duration: **4-12 hours**

Operational Lifetime: **+30 years**

The Ocean as our Ally

- Near-Isothermal compression/expansion process by using the **ocean as a natural heatsink**





▲ **Charging cycles from the FLASC Small-Scale Prototype**
(source: https://doi.org/10.1016/j.est.2019.100774)

- Measured Thermal Efficiency: +96%
- Established Hydraulic Machines: 85-90%
- → Estimated Roundtrip Efficiency: **70-75%**

Prototype & Field Tests

▲ First Prototype (2018)
Grand Harbour, Malta

+400
Charging Cycles

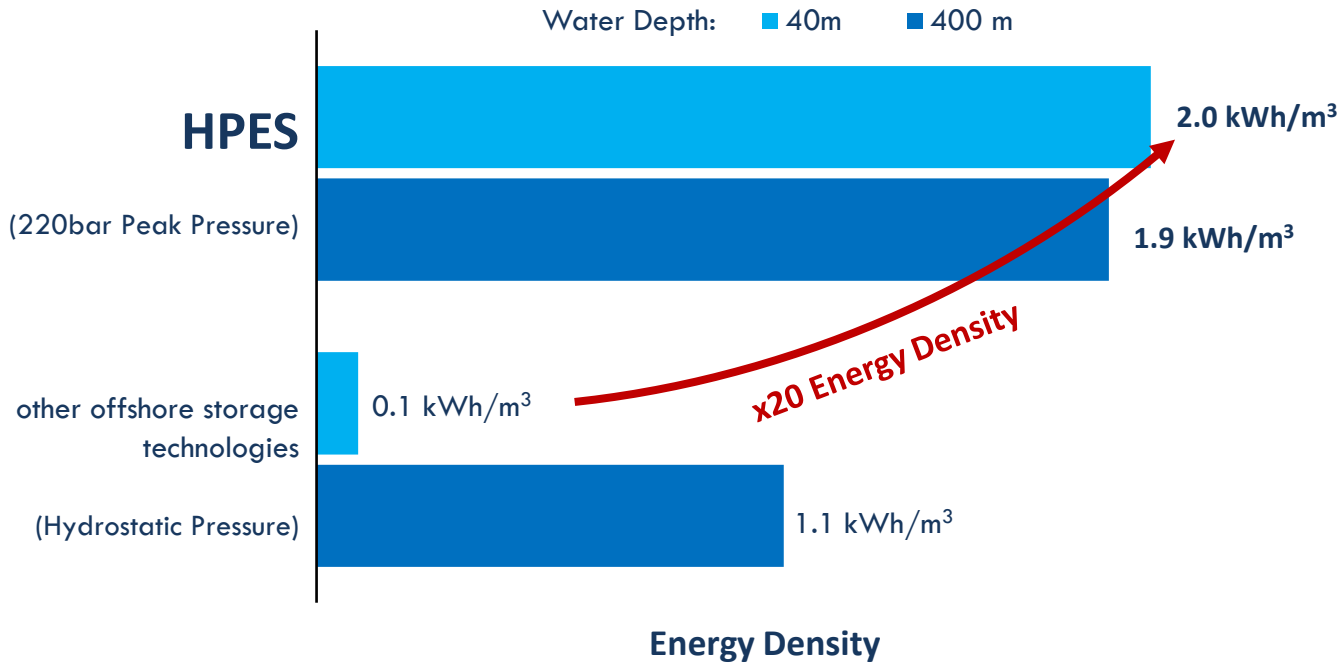
+15 Months
Continuous Operation

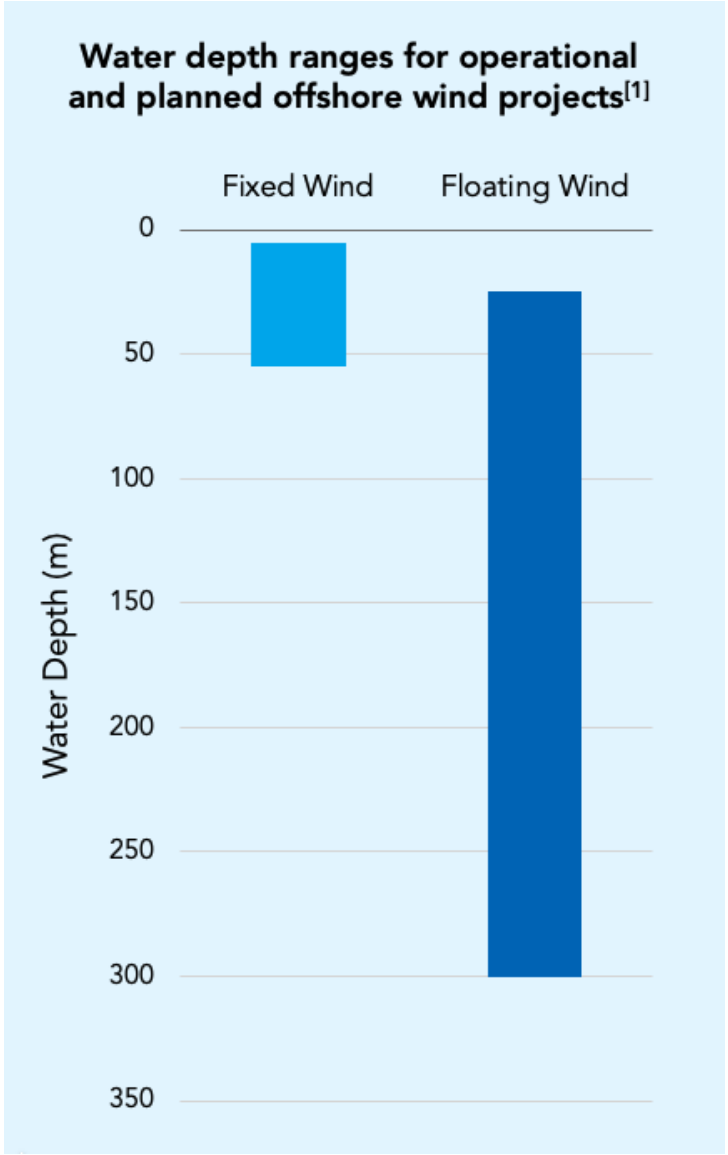
> 96%
Thermal Efficiency

> 98%
System Availability

Energy Density & Water Depth

- Market research shows that upcoming offshore wind projects will be in shallower waters (<300m)[1]
- The FLASC HPES technology is specifically targeting these water depths:



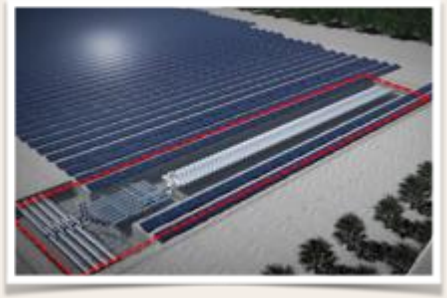


[1] Offshore Wind Market Report 2021 Edition: Global offshore wind energy projects by depth, country, and project size (US Dept of Energy)

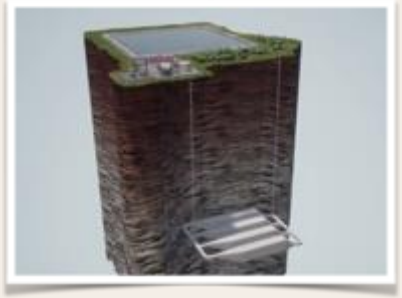
Offshore problems require Offshore Solutions

Onshore Long-Duration Energy Storage

- Large-scale infrastructure with significant topographical constraints
- Does not adequately address spatial mismatch for offshore wind



▲ Land-based HPES (Augwind)



▲ CAES (Hydrostor)

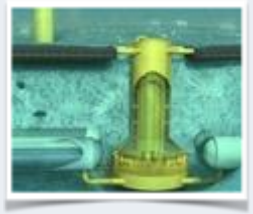
▲ Gravity Storage (Energy Vault)

▲ LAES (Highview Power)

Offshore Energy Storage

- Solutions using hydrostatic pressure require deep water
- Several solutions under development

▲ StEnSea (Fraunhofer)

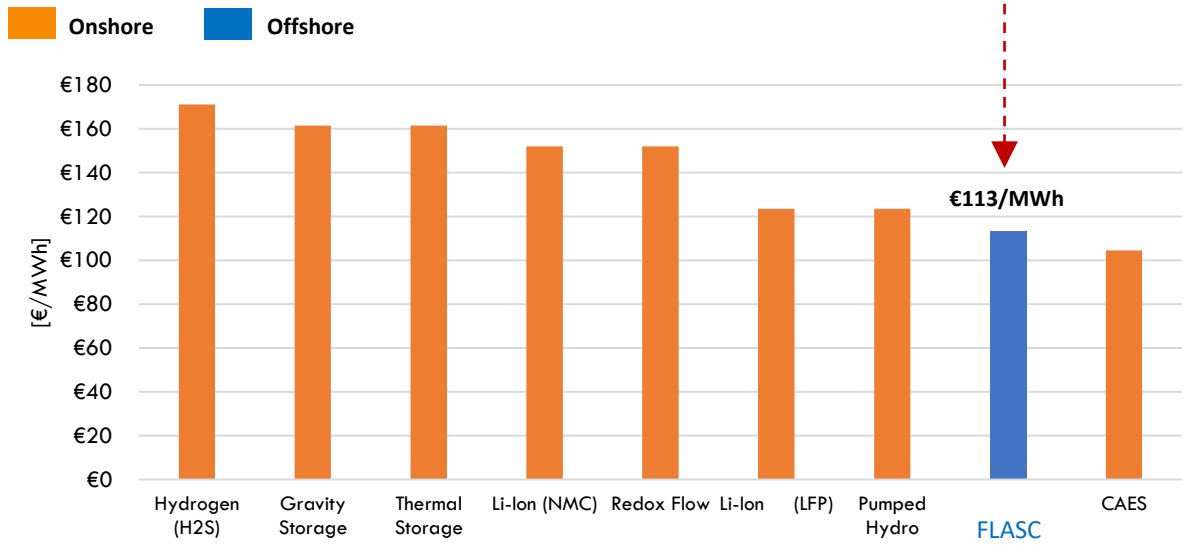


▲ Ocean Grazer

FLASC
Renewable Energy Storage

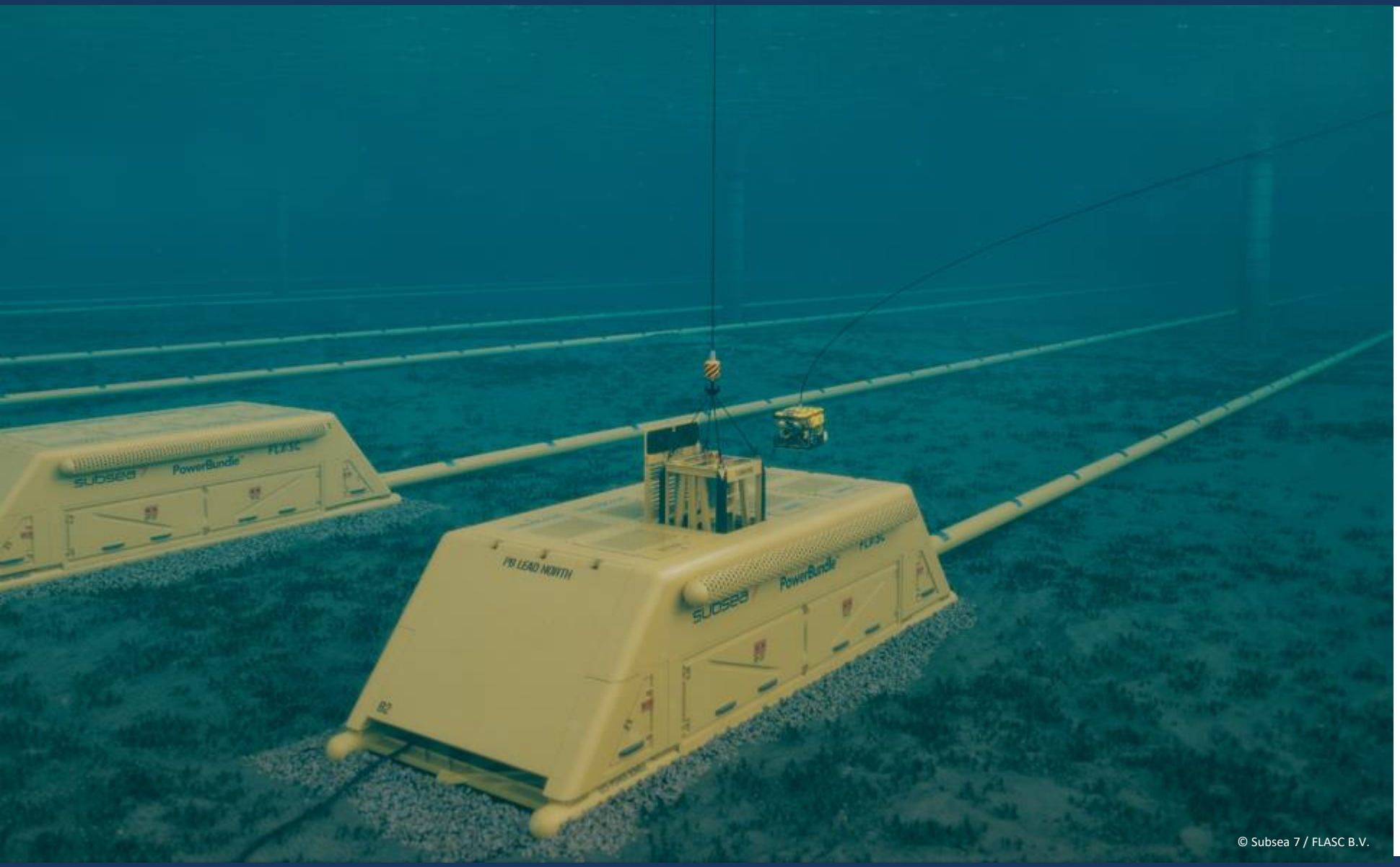
- FLASC is specifically positioned to address temporal and spatial mismatch in offshore wind applications
- Energy density up to x100 greater than existing offshore solutions
- Levelised cost that is competitive with the cheapest land-based storage

2030 Levelised Cost of Storage (LCOS)[1]



[1] 2022 Grid Energy Storage Technology Cost and Performance Assessment (US Dept of Energy) (+100MW / 10-hr Duration)

The PowerBundle: Long-Duration Energy Storage for Offshore Applications



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- **Large-Scale Offshore Wind**
- **Decarbonisation Of Oil & Gas**
- **Offshore Green H_2 Production**
- **Small-Islands & Sensitive Regions**
- **Repurposing Oil & Gas Pipelines**

ANIMATION

Current Status

<2019

- **Proof-of-Concept** [TRL5]
- **DNV Statement of Feasibility**

2020-2022

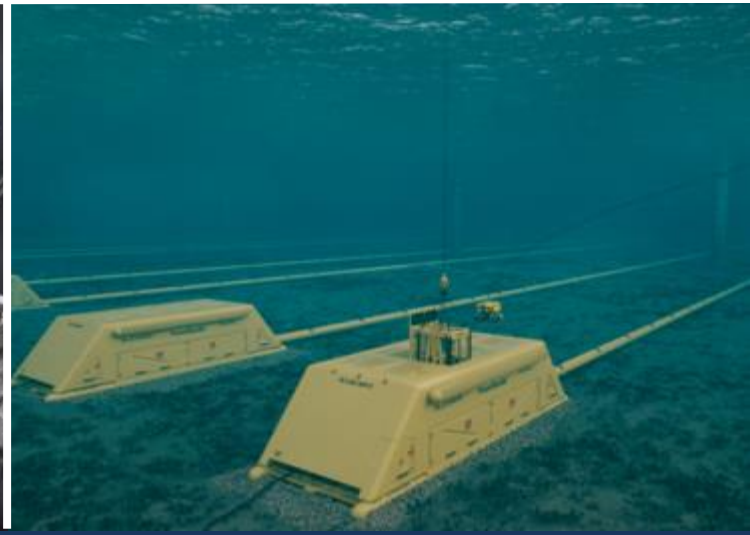
- **Subsea7 Strategic Collaboration**
- **Floating Wind Demo** [TRL7]

2023 -2025

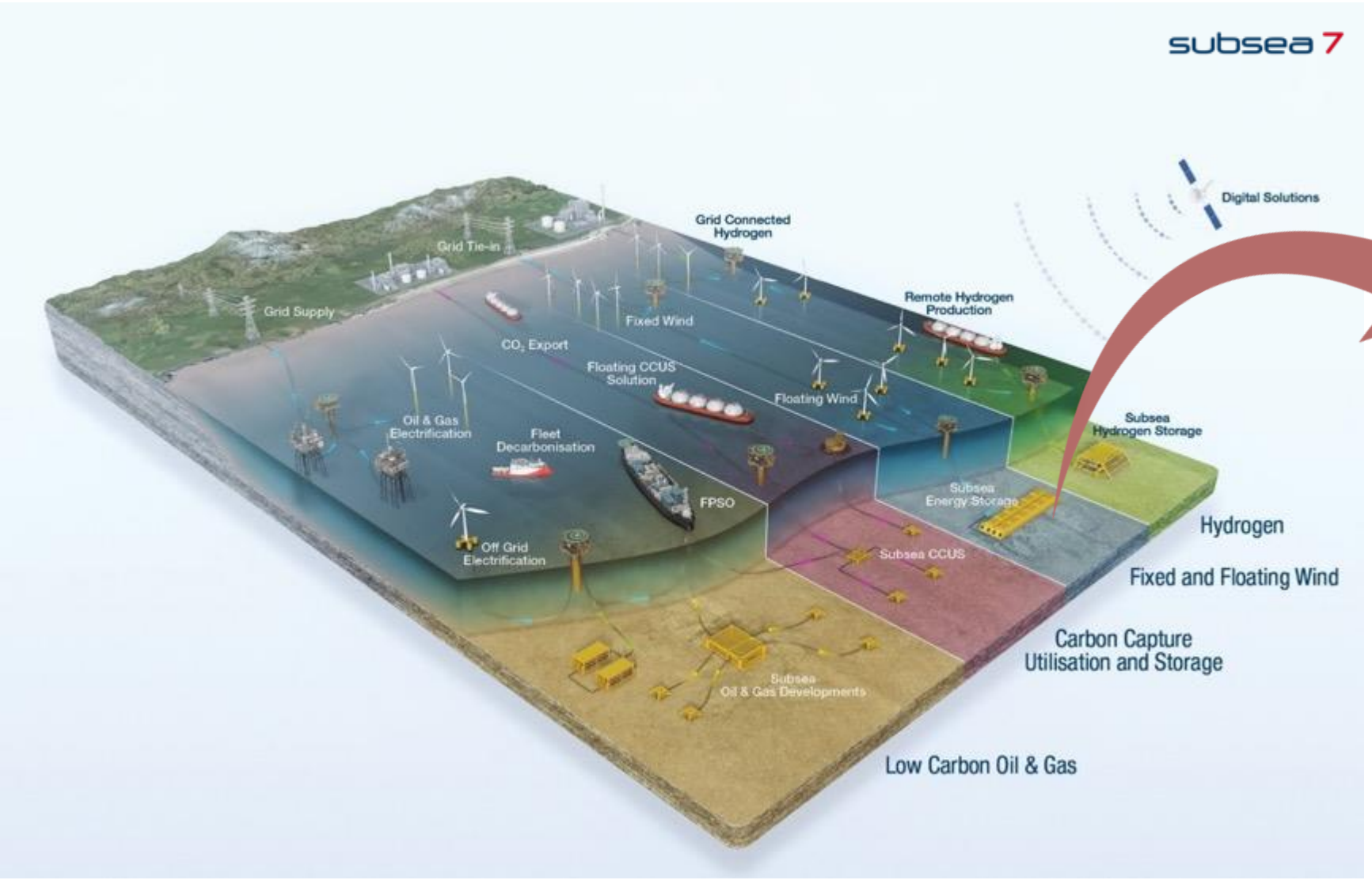
- **Digital Twin** (Offshore for Sure)
- **Final Technology Certification** [TRL8]

2026

- **Wind-Farm Pilot**



The Energy Transition Landscape



- **First-movers in offshore energy storage**
- **Leveraging decades of technology development and execution track-record**
- **Offshore energy storage is an enabling solution for the energy transition**

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