

Ocean Battery

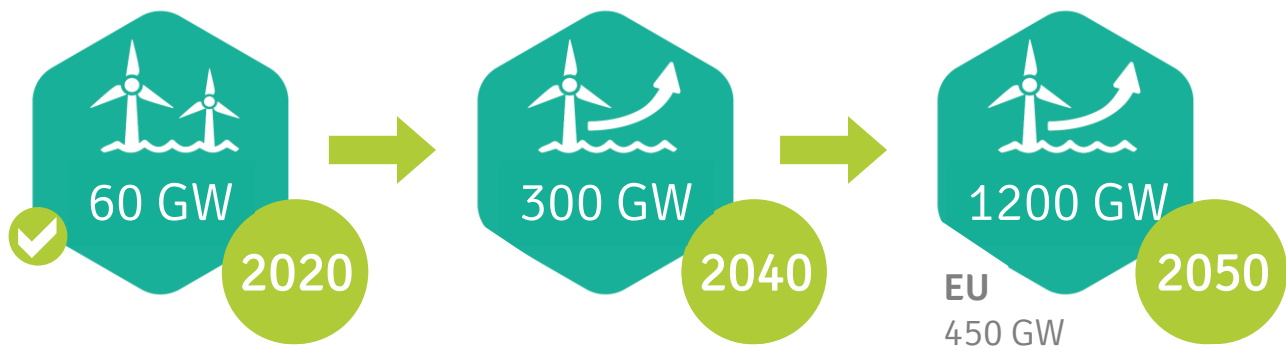
Unlocking the Full Potential of
Offshore Renewable Energy

KIVI Webinar – Februari 16th, 2022



Target Market

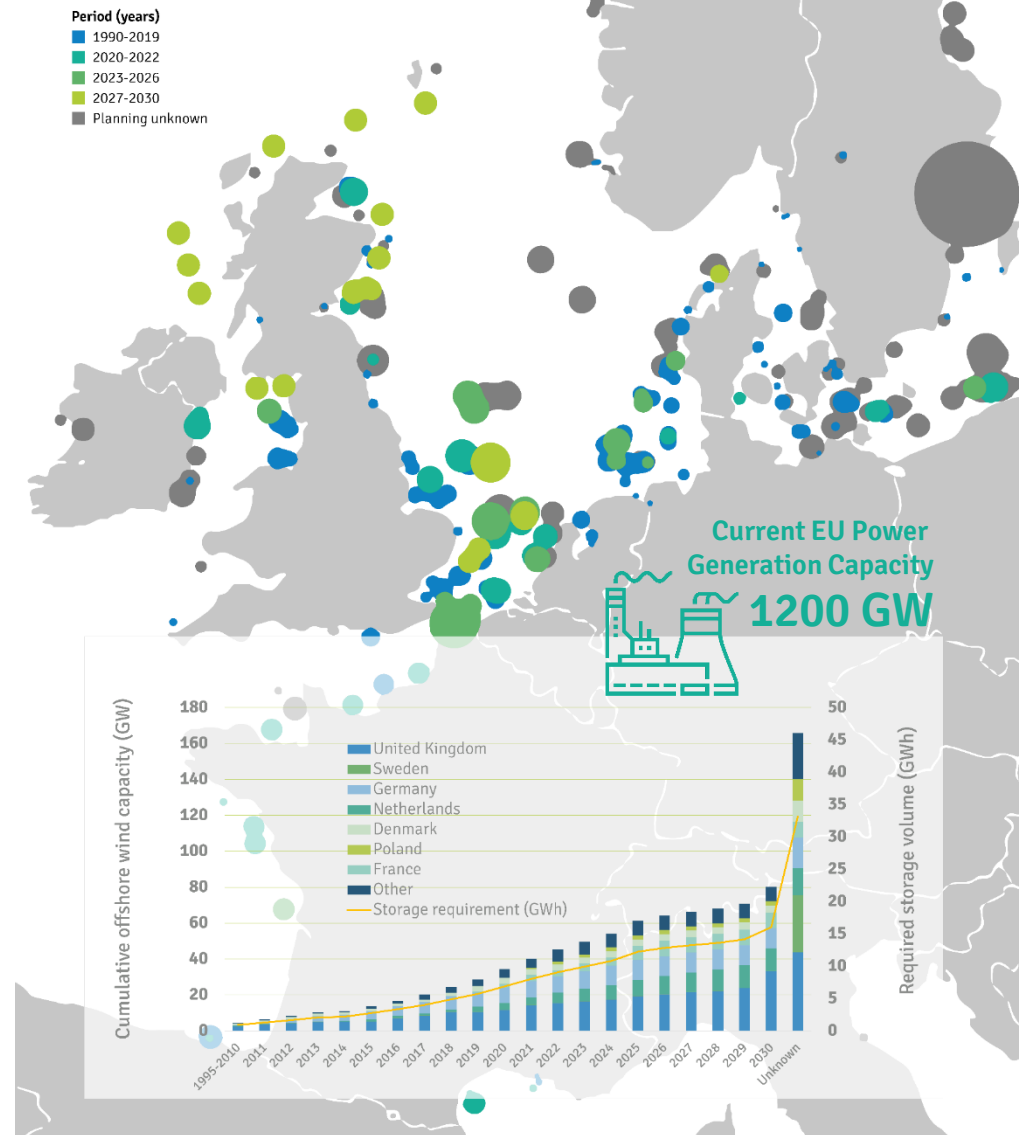
The Offshore Wind Market



The main challenges for grid integration are:

- 1) Preparing the system for 100% of renewables
- 2) Flexibility at the heart of a 100% renewable system

EU Market Development



Need for Storage Innovations

The highest priority for wind branche

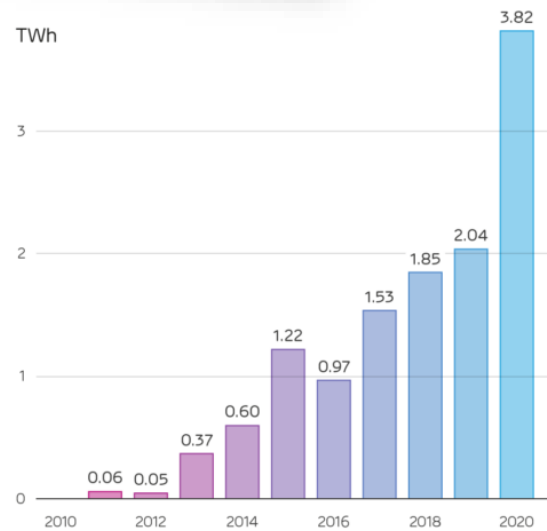
Enough wind power was curtailed in 2020 to power a million homes for a year

A new report suggests an additional 20GWh of battery storage could see the amount of wind power wasted annually reduced by up to 50%

UK Struggles With Sagging Power Demand and Surging Renewables

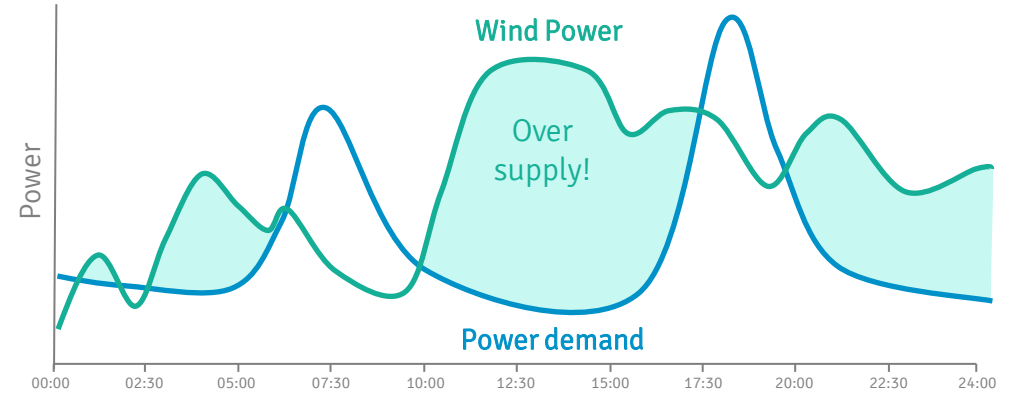
Curtailed of U.K. wind farms surged as COVID-19 lockdowns depressed power demand. More batteries on the grid would help, but how?

JOHN PARNELL | JUNE 10, 2020

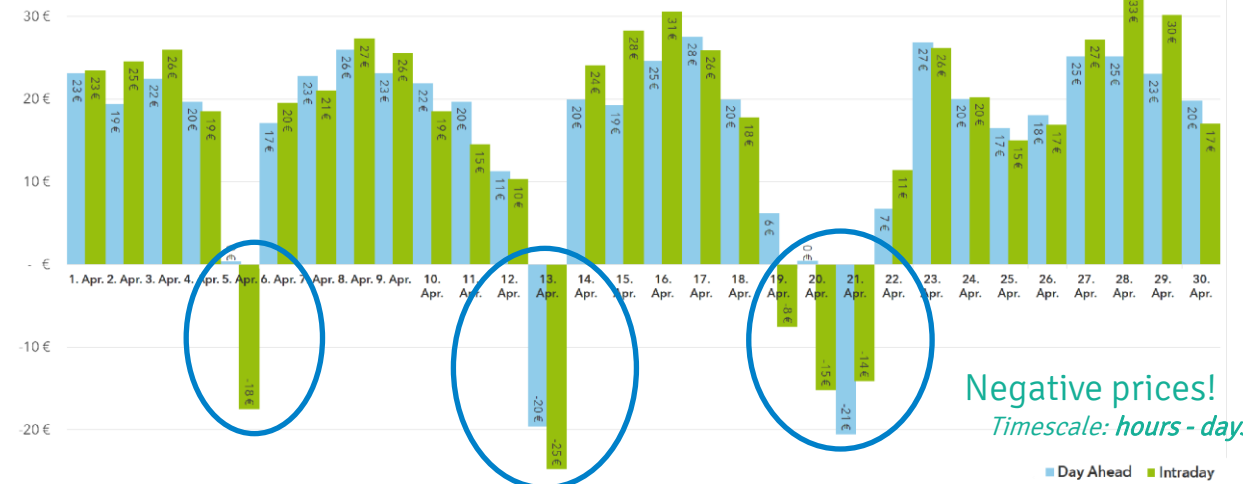


6% of Britain's wind output had to be curtailed in 2020

Annual curtailment of wind energy in Britain over the last decade. <https://reports.electricinsights.co.uk/q4-2020/record-wind-output-and-curtailment/>



Power Prices April 2020 (Day-Ahead-Auction & Intradaymarket)



Negative prices!
Timescale: hours - days

Nobody wants to sell at negative prices!
They have a huge impact on the profitability of offshore wind farms

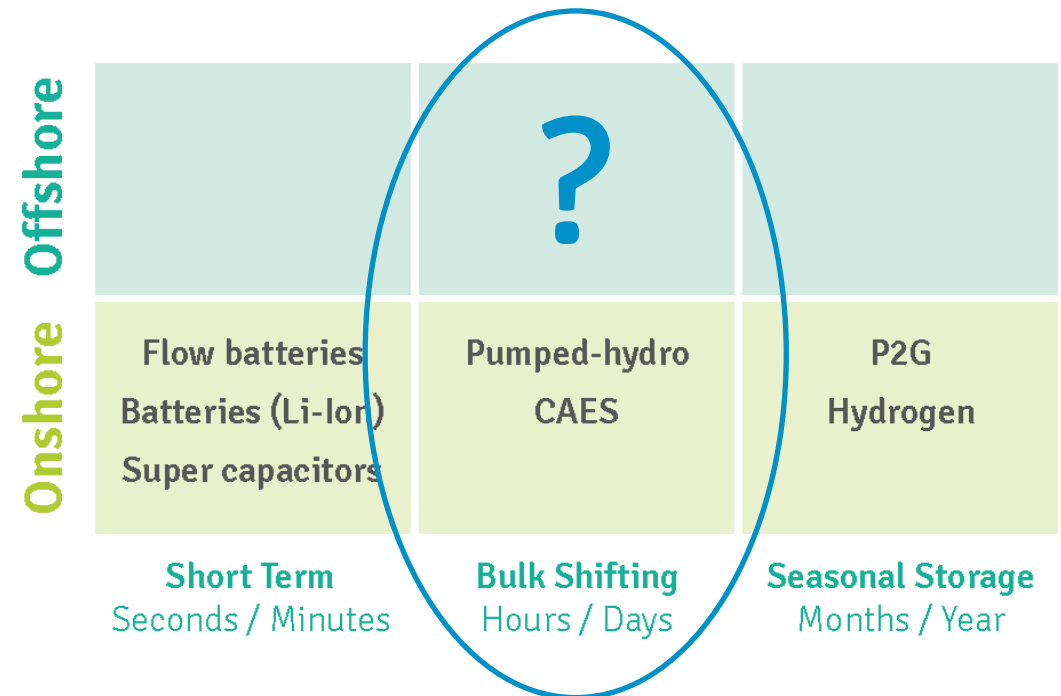
Source: EPEX Spot via Fraunhofer ISE

Large-scale Offshore Energy Storage

Solve the problem at the source!

Offshore energy storage needed to:

1. No longer sell **wind power** at **negative prices**.
2. Increase **energy yield** per km² by **overplanting** turbine **capacity**
3. Stop **curtailment** of **wind power** generation
4. Prevent **imbalance penalties**
5. Capex intensive **grid expansions** no longer necessary



No suitable offshore storage solution available!

How can this be resolved?

Offshore Market

95% of the offshore windfarms build in shallow waters

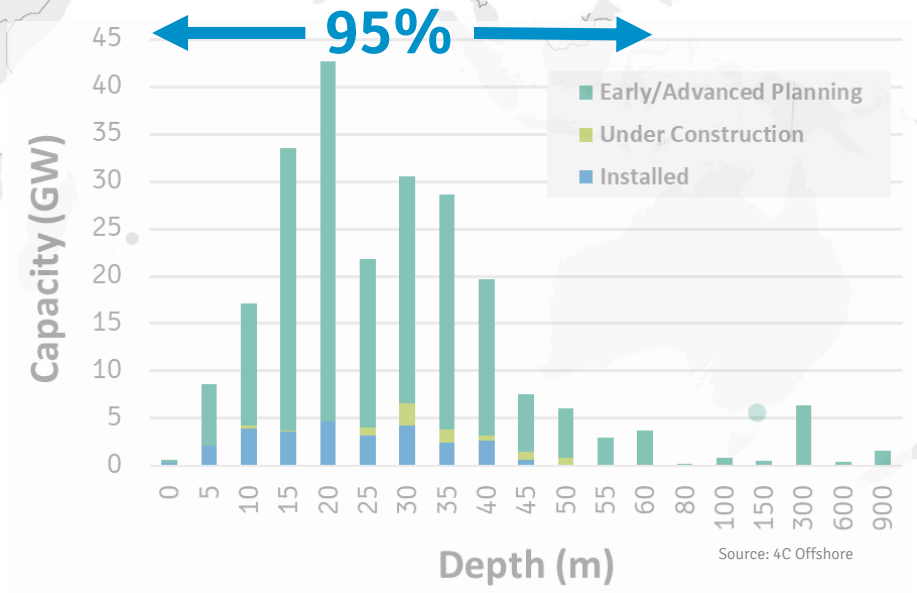
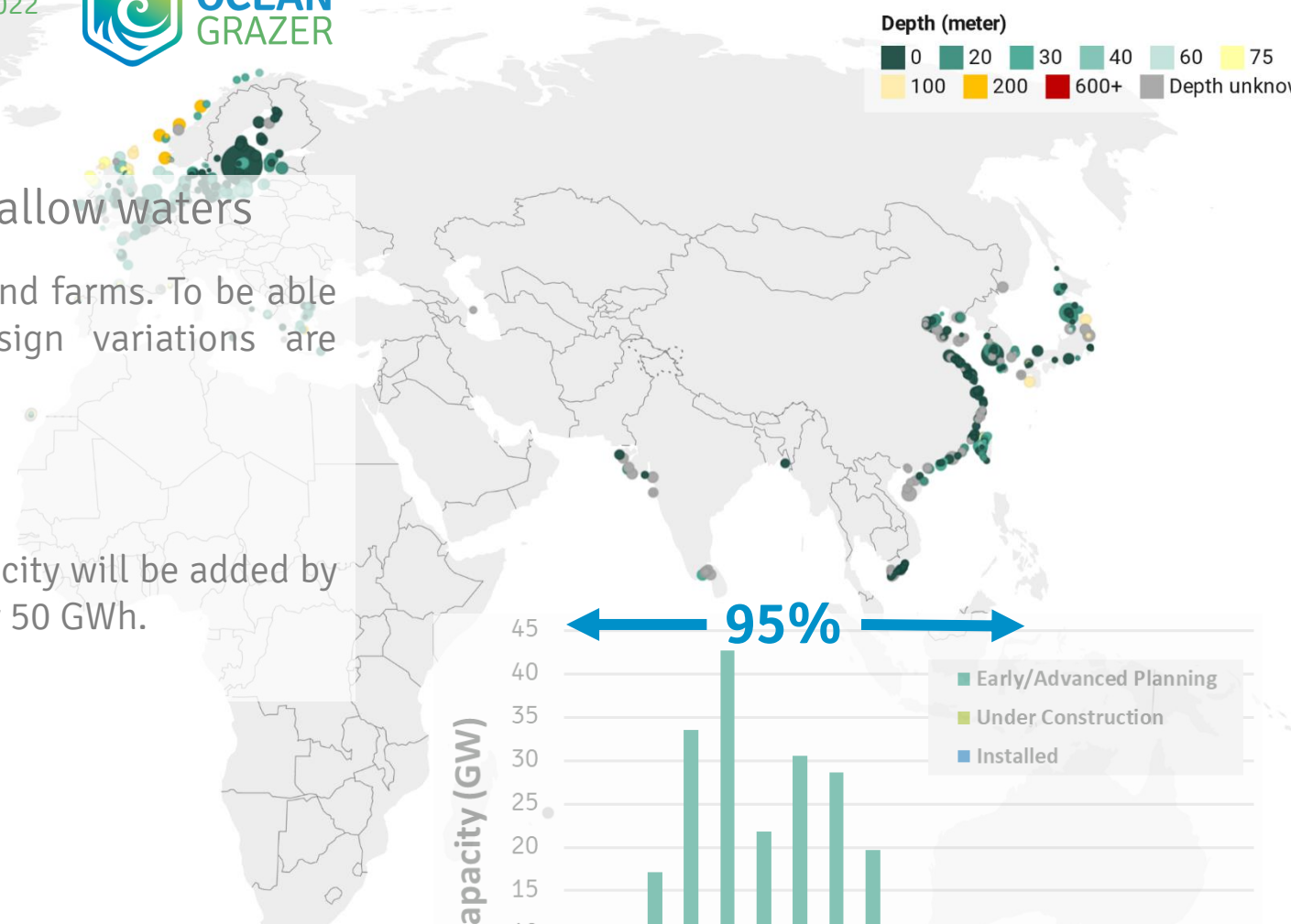
The focus market for Ocean Battery are offshore wind farms. To be able address the complete offshore market two design variations are developed (slide 19):

- Buried system
- Deepwater system

Globally more than 250 GW of wind generation capacity will be added by 2030 resulting in a storage demand of approximately 50 GWh.

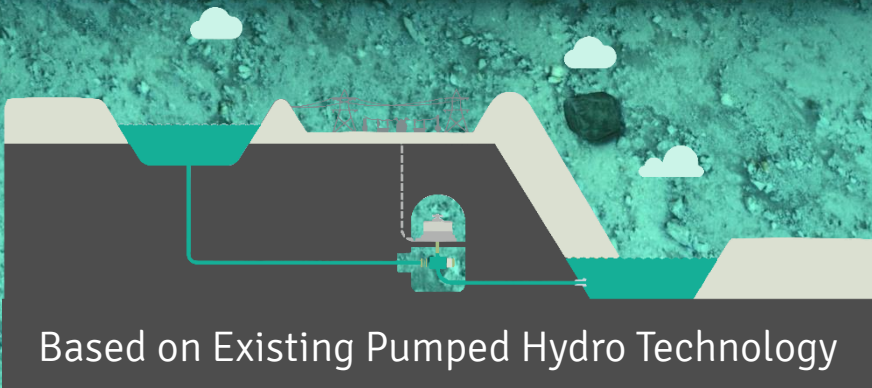
References & relevant background material

- [EU strategy on offshore renewable energy](#) COM(2020)741 on 19 November 2020
- [European Green Deal 2019 – 2024](#)
- [2050 Long Term Strategy](#)
- [EU strategy on energy system integration](#)



Ocean Battery

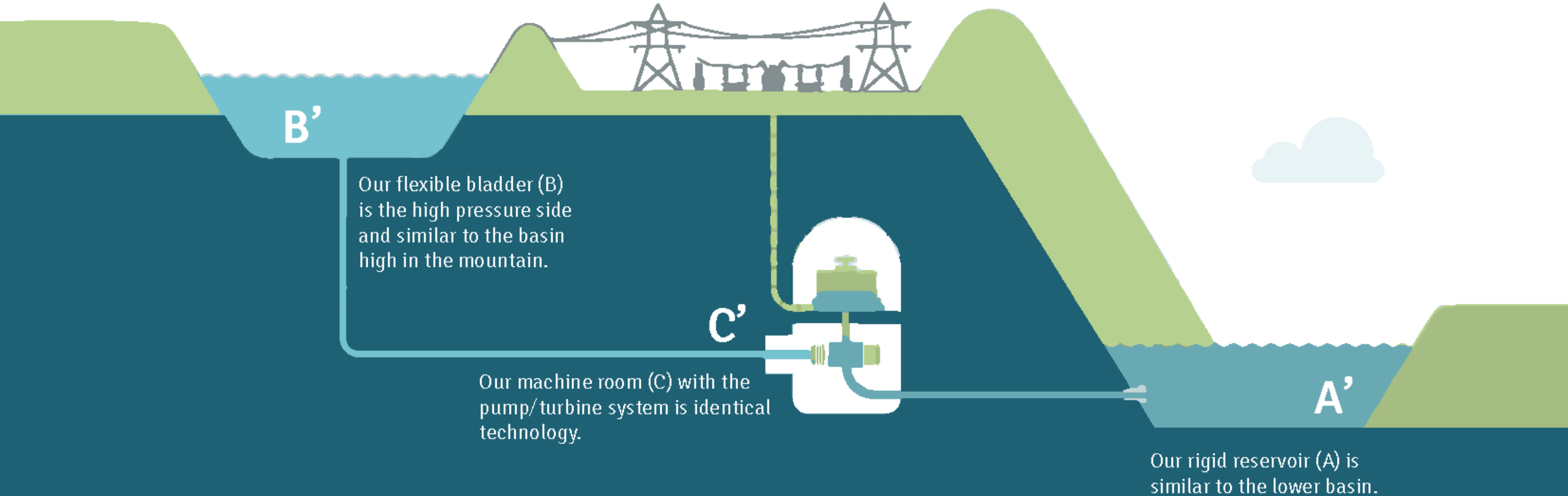
Flexible Reservoirs



Rigid Reservoirs

Pumps and Turbines

Pumped Hydro Storage Comparison



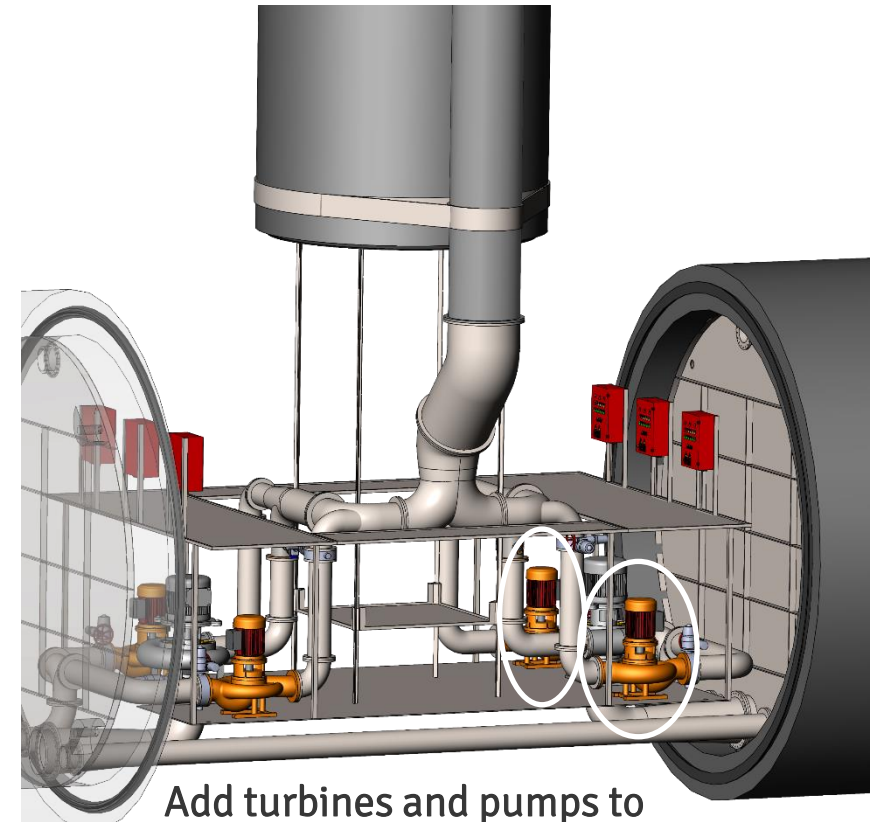
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- **Adaptable and Scalable**
 - **No rare earth materials**
 - **Ecofriendly**

Modular & Scalable

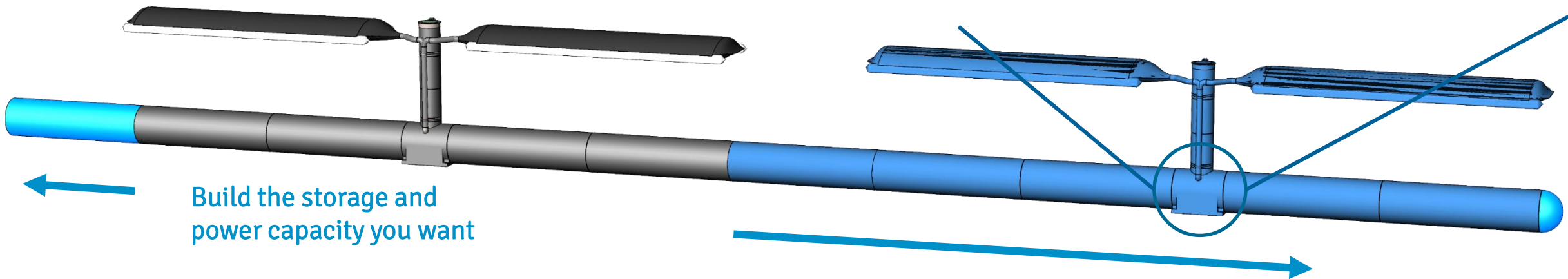
Adaptable design to your needs

Our storage solution is based on a modular design that allows to couple multiple storage reservoirs to a machineroom.

The modular design allows to easily scale the storage volume (MWh) to the size of a wind farm and adapt the capacity (MW) to the application of the storage operator. For example bulk shifting requires a large storage volume with respect to the capacity, but for frequency control a large capacity is needed compared to the storage volume to allow rapid injection of power to stabilize the power system.



Add turbines and pumps to scale the power capacity



Build the storage and power capacity you want

Eco Friendly

Conditioned water as working fluid

Ocean Battery will have a positive impact on the marine life at sea. The dredging activities to install the buried version of Ocean Battery will have a temporary negative effect on the environment.

But to stabilize the construction on the seabed scour protection is needed which will provide a stable environment for marine life to grow on. The utilization of special concrete enhances this growth process providing opportunities to enrich the marine life. The net effect will be very positive.

Chances of pollution of the environment by utilization of harmful materials is zero since conditioned water is used as the working fluid for Ocean Battery.

References & relevant background material

- Source: Ocean Battery design



Eco Friendly

No use of scarce materials

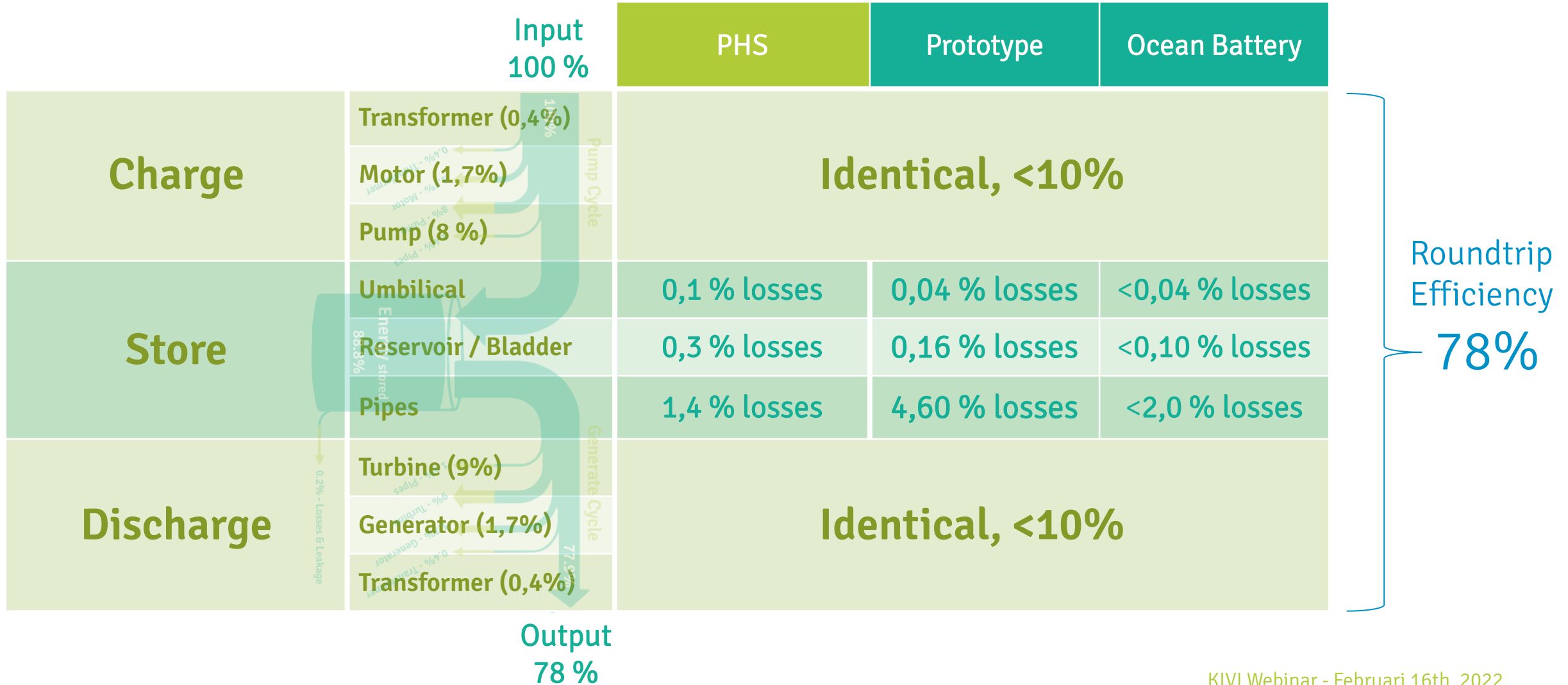
To facilitate the energy transition the EU recognized its dependency on scarce raw material. To ensure that the EU achieves it becomes energy neutral first in 2050 it wants to be independent of scarce materials and encourages:

- Reduce dependency on critical materials
- Minimise environmental impact of batteries
- “Close the loop”

References & relevant background material

- EU Action plan on Critical Raw Materials
- EU Batteries Regulation





Timeline

Start R&D at University of Groningen



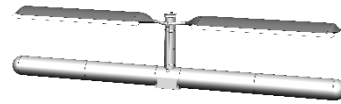
university of groningen

1st Patent: integrated system

2nd Patent: underwater storage



Start of Prototype building



Improved Design



Launch of Harbor Prototype



3rd Patent: buried system



1st Investment: Seed investor

Founded Ocean Grazer BV startup

Winner of the Offshore Wind Challenge competition

Tender with Ørsted

EU Seal of Excellence

Winner of the 1st 'Ben Feringa Impact Award'



2nd Investment: Angel investor

CES Best of Innovation: Sustainability, Eco-Design & Smart Energy

CES Honoree: Sustainability, Eco-Design & Smart Energy

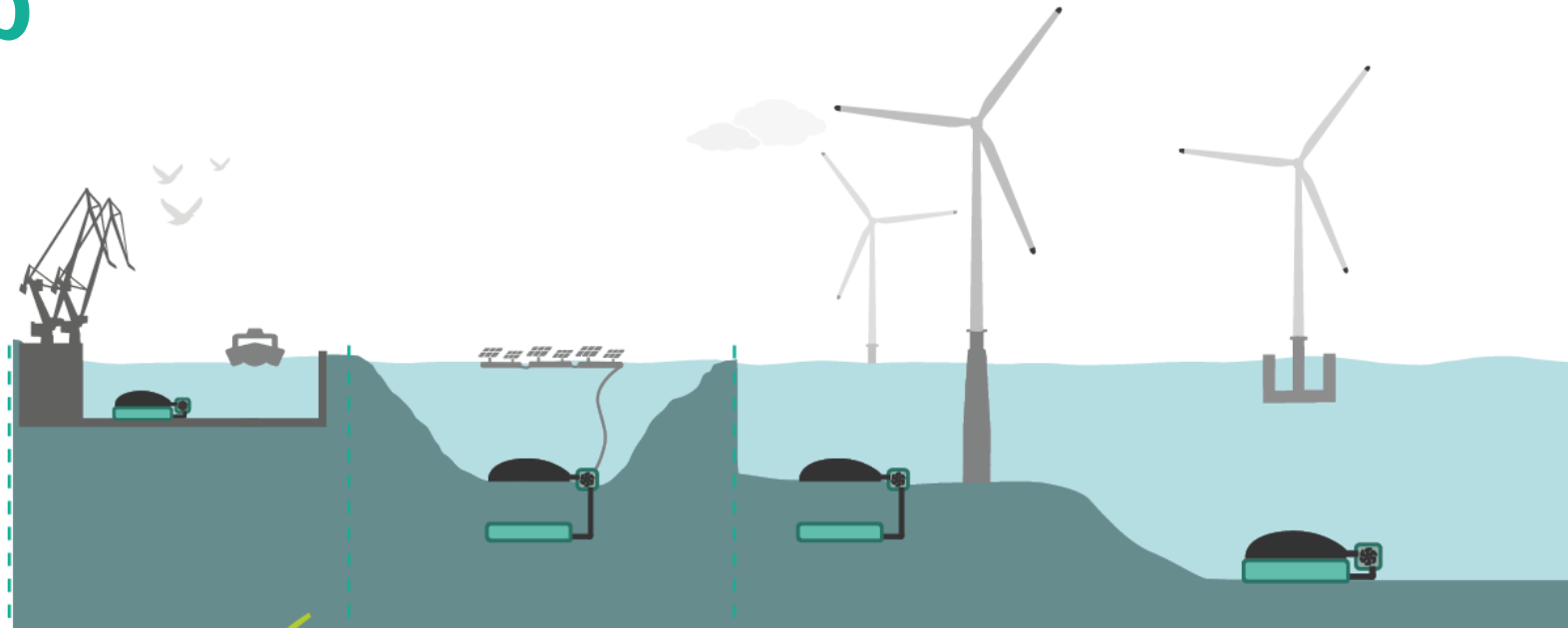



Sand Excavation Lake - Sellingeren

Sand Pit Owner: Kremer
Floating PV developer: Groenleven



Roadmap



	Prototype Step 2  Completed	Inland Demonstrator Step 3	Offshore Demonstrator -> Deep Sea System Step 4	
Location	Groningen Seaports / Eemshaven. Labs MARIN and Deltares (internal validation tests)	Sand Excavation Lakes Northern Netherlands	North Sea / Shallow Water (< 100 m)	Global
Planning	2020 - 2021	2022 - 2024	2024 - 2026	2026 - beyond
Objective	Demonstration & Verification of Ocean Battery under realistic conditions	Demonstration & Verification of Ocean Battery for onshore and offshore application	Offshore Demo for Wind Farms (depth < 100m)	Offshore Demo for Wind Farms (depth > 100m)



Vote for Marijn via [this link](#) if you think he should win the prince Friso Award



Questions?

Thank you for your attention

