



Green energy out of the blue: Renewables for Subsea Power (RSP)

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Renewables for Subsea Power

RSP is a **Net Zero Technology Centre** flagship project:

- “First-of-a-kind” commercial **full-scale system** to provide renewable power & communications offshore
- Combined system deployed, connected & operational as of February 2023

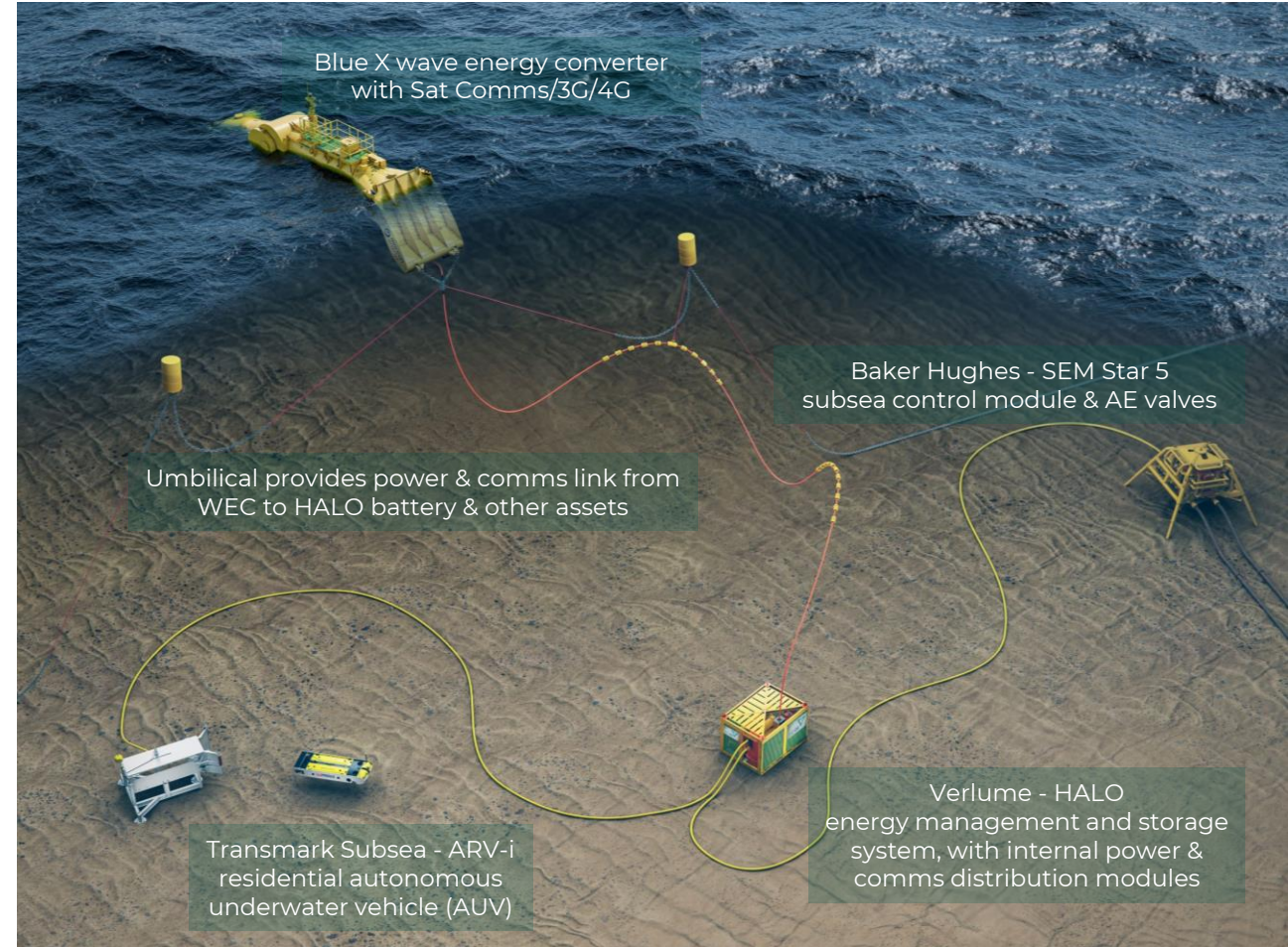
Demonstration via 12-month deployment:

- 3.5 nautical miles east of Orkney mainland; 50-53m water depth
- Remote comms, control & monitoring

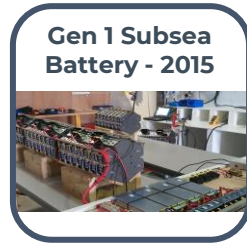
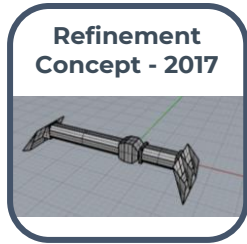
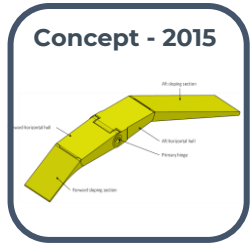
Qualification to a system TRL 6-7 (API):

actual system completed & qualified via test and demo

- **Boost industry confidence in the proposed solution**
- **Pave the way to wider carbon mitigation via systems scalable in size and number across off-grid subsea power applications**



RSP - Qualification



Technical Specification & System Integration

Transmark – ARV-i

Battery Capacity	600 Wh charged via WiSub pinless connection
Endurance	14 hrs
Machine Vision	Up to 6 HD cameras
Camera	4K uncompressed video, suitable for photogrammetry
ARV-i Drone Dims	0.61 m (L) x 0.4 m (W) x 0.36 m (H)
ARV-i Doc Dims	1.2 m (L) x 1.25 m (W) x 0.7 m (H)

Baker Hughes – SEM Star 5

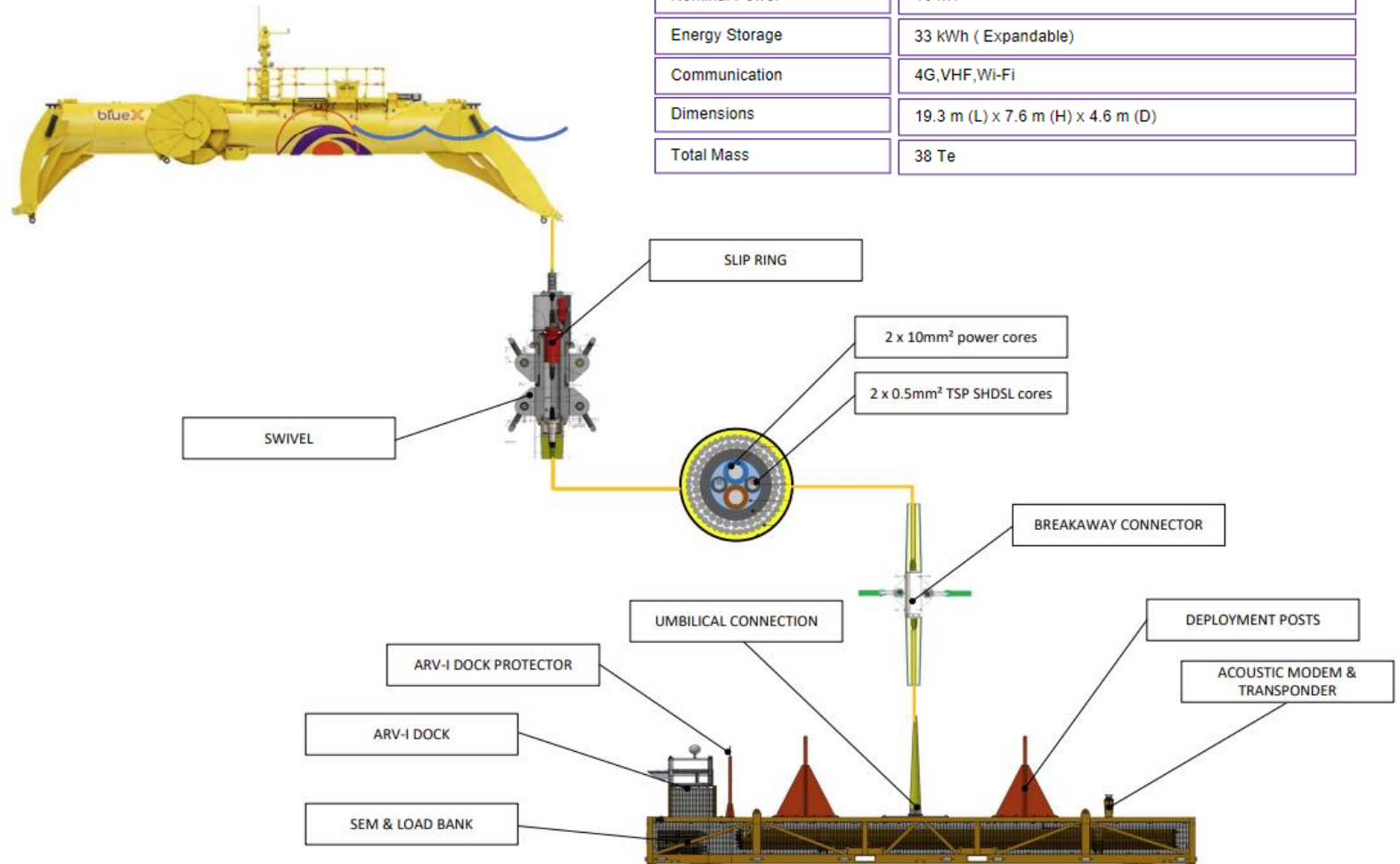
Power at XT (valve op's)	620 W with batteries charging and choke operating
Power at XT (valve op's)	770 W max power for fast charging
Power at XT (no valve op's)	535 W with no batteries charging or valve op's
Communication	DSL or Ethernet depending on offset (primary)
Communication	Electrical actuators are fault tolerant CAN

Verlume - HALO

Energy Capacity	46 kWh (Scalable to 10 MWh+)
Output 1A & 1B (SPCS)	415 VAC, 50 Hz, 2kW Max (Shared)
Output 2 (ARV-i)	220VDC, 1 kW Max
Dimensions	4 m (L) x 2.9 m (H) x 2.5 m (D)
Total Mass	10 Te

Mocean – Blue X

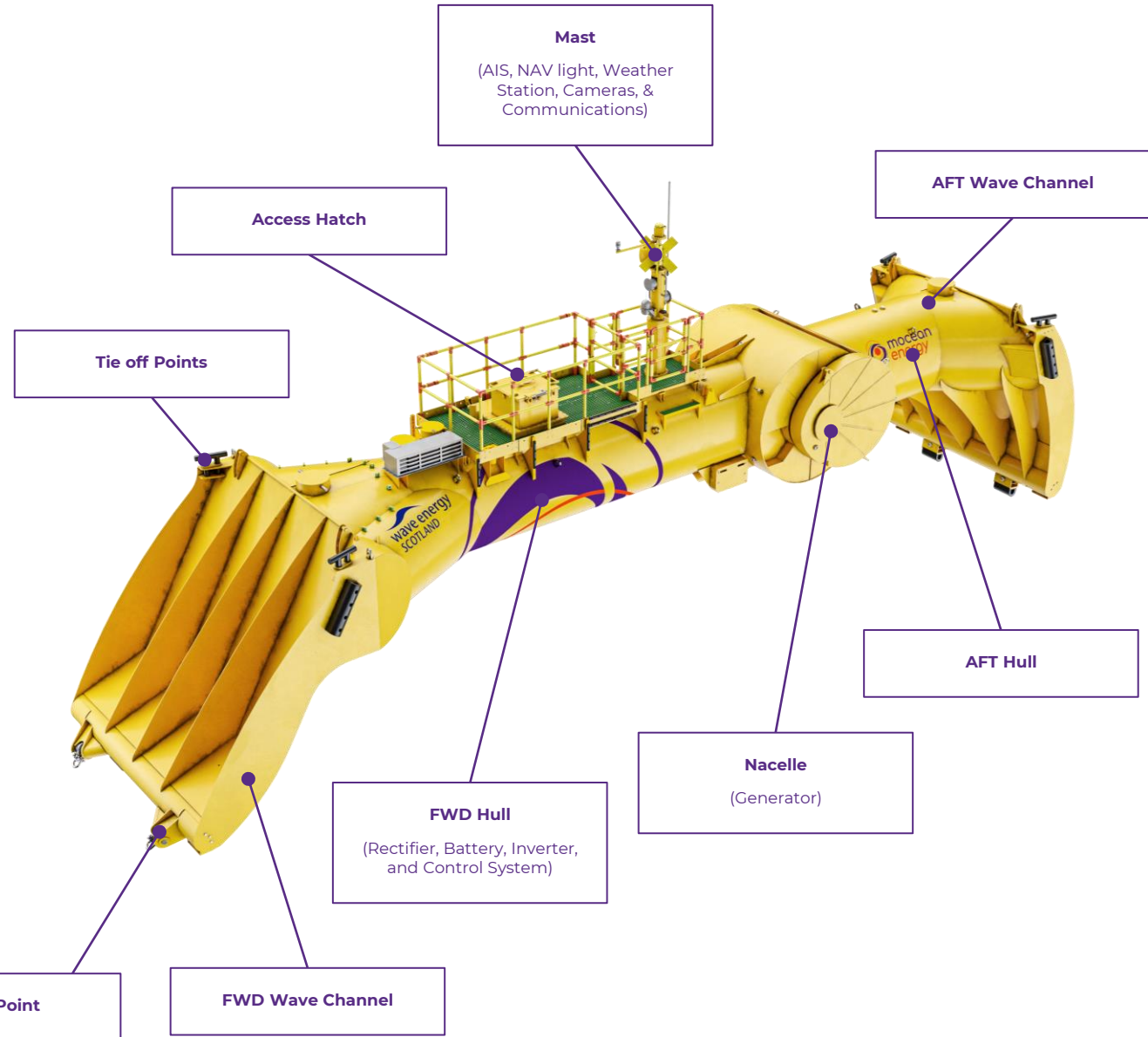
Nominal Power	10 kW
Energy Storage	33 kWh (Expandable)
Communication	4G,VHF,Wi-Fi
Dimensions	19.3 m (L) x 7.6 m (H) x 4.6 m (D)
Total Mass	38 Te





Specification

Dimensions	19.3m(L) x 4.6 (W) x 7.8m(H – with mast) <ul style="list-style-type: none"> • Nacelle OD 2.5m • Tube 1.85mOD • FWD 12.9m (L) • AFT 6.3m (L)
Weight	38T
Primary Structure Material	EN10025 S355 J2+N
Paint	RAL 1004 (Yellow)
Rated Power	10kW
Battery Storage	33kWh
UPS	2 x 1kWh + 1 x 540Wh
Power Export (Subsea)	3kW, 400Vac, 7.5A (single phase)
Solar	560Wp solar array with 2 solar panels on the forward hull and 2 solar
Remote Communications	Cellular
Subsea Communication	SHDSL
Design Life	5 years (prototype)
Moorings	2-Line, 360deg weathervaning



Learning by doing

In 2021, funded through **Wave Energy Scotland's (WES) competitive PCP program**, Mocean tested their Blue X wave energy converter device (10 kW, 20 m, 40 tonnes) for 5 months at the European Marine Energy Centre, in Orkney.

At-sea testing provided invaluable lessons learned:

- **Power production:** up to 5 kW sustained power and 30 kW instantaneous peak power.
- **Communications:** 99.99% comms system uptime
- **Survivability:** diving through waves to shed loads, equipment autonomously entering survival mode
- **Reliability:** no major equipment failures.
- **Operations & maintenance:** installation, removal, access as sea, battery charging, quick-turn-around removal and return to sea maintenance.

**Technology has been proven to TRL 6 (API 0-7 scale):
system prototype in operational environment**

Video of Blue X in action [here](#)



Blue X in action at Scapa Flow, EMEC (2021).

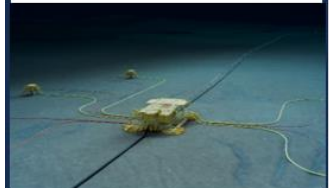
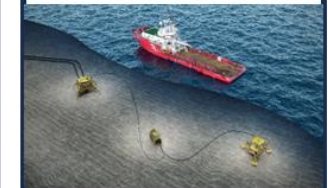
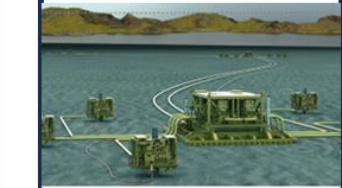


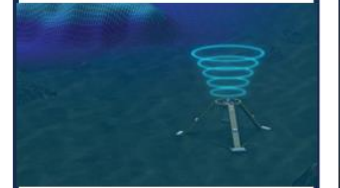

Mocean's technology has been selected over competition using international standards through six stage gates in WES and EuropeWave programmes.¹




¹ 3 stage-gates in [Wave Energy Scotland](#) program; 3 stage gates in [EuropeWave](#); The programs use IEA-OES International Evaluation and Guidance Framework for Ocean Energy Technology

Use Cases

RSP is an enabler for wide ranging electrification & decarbonisation of subsea solutions ...

Long Offsets	Umbilical remediation	CCS	Vehicle Residency	Brownfield Expansion	Metocean & Leak Detection	Decommissioning
						
<p>Enable Long Offset wells</p> <ul style="list-style-type: none">Removes need for Hydraulic umbilicalEmploy remote chem injection subseaMinimal impact on host infrastructureSimple transparent link remote SatCom/4G	<p>Reenable failed assets with electrical umbilical failures</p> <ul style="list-style-type: none">Energy securityRemote commsWorks with existing control architecture	<p>Adoption of all-electric subsea systems</p> <ul style="list-style-type: none">Green power generationAlternative to DFCO from shoreRemotely powered system	<p>Short/long term vehicle residency</p> <ul style="list-style-type: none">Over-the-horizon commsCharge on seabedReduce vessel GHG emissions	<p>Enable in-fill/stranded asset wells</p> <ul style="list-style-type: none">Minimal impact on host infrastructure control systemSimple transparent link remote SatCom/4G	<p>Long duration autonomous data monitoring</p> <ul style="list-style-type: none">Data redundancy remote comms & local data storagePower for retrofit leak detection	<p>Lower carbon operations</p> <ul style="list-style-type: none">Provides power/comms for nav aids/well monitoringRemoves needs for vessels/periodic recovery of wells dataLower carbon footprint/no marine diesel burn

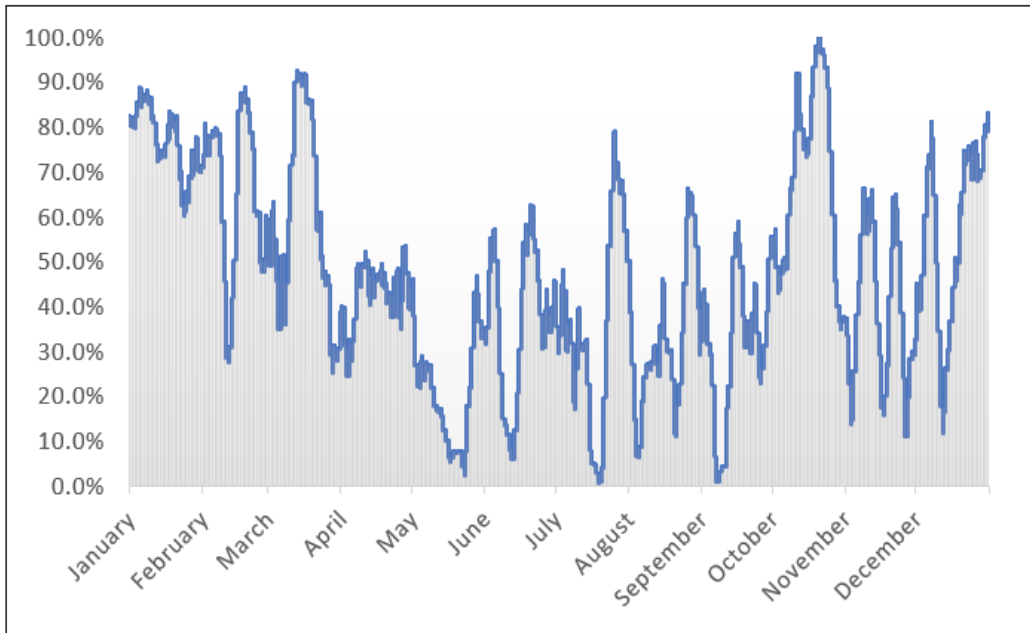
Decarbonise existing developments & enable electrification via new technology 

Power Stabilisation

Variable wave power availability → consistent power delivery.

RENEWABLE POWER GENERATED

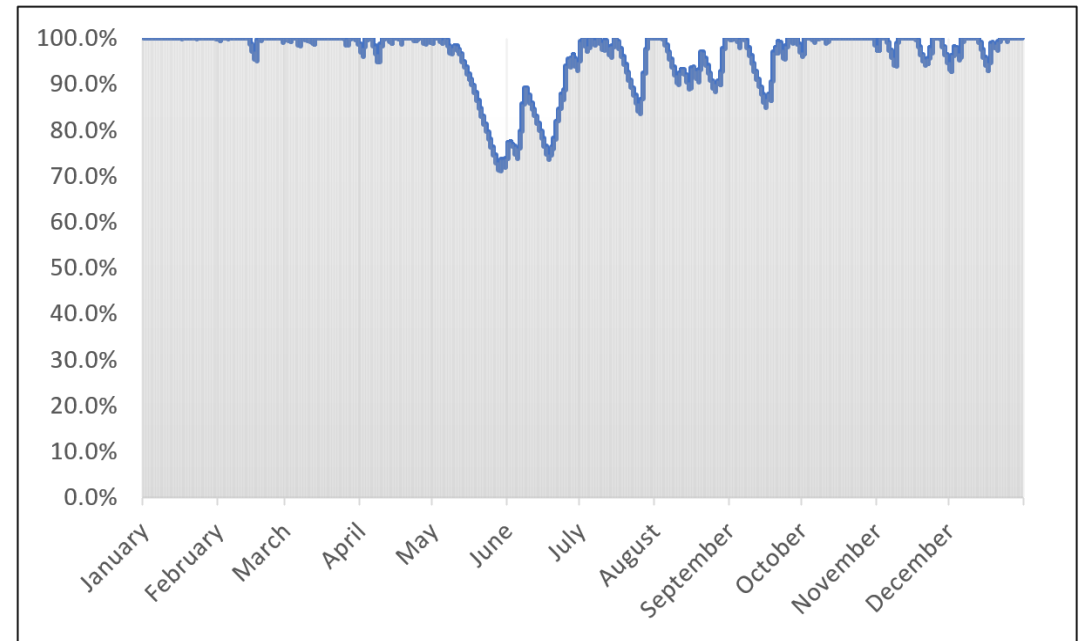
Blue X converts energy from waves with daily, monthly, and annual variability.



Normalised power generated.

POWER AVAILABLE

Halo ensures that there is always power available.



Normalised state of charge.

RSP Phase 3 Highlights

Key outcomes

Total energy converted:
>9 MWh
(as of February)

Solar contribution:
covers 200%
comms
demand

Max hinge angles:
+/- 50deg
(within limits)

ARV-i docking:
50 autonomous
docks/undocks

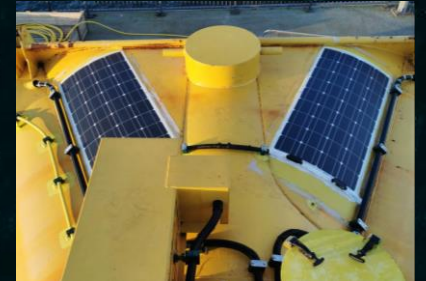
Average power:
~2.6 kW
(September)
~1.9 kW (overall)

Best daily solar yield:
800Wh

Max Hs encountered:
>7 m

Availability for comms:
99.9% uptime

Data from 12 months of operation proves robust wave & solar yields, and reliable system integration.



Showing solar panels at hinge & forward wave channel.

Video during Storm Babet [here](#)

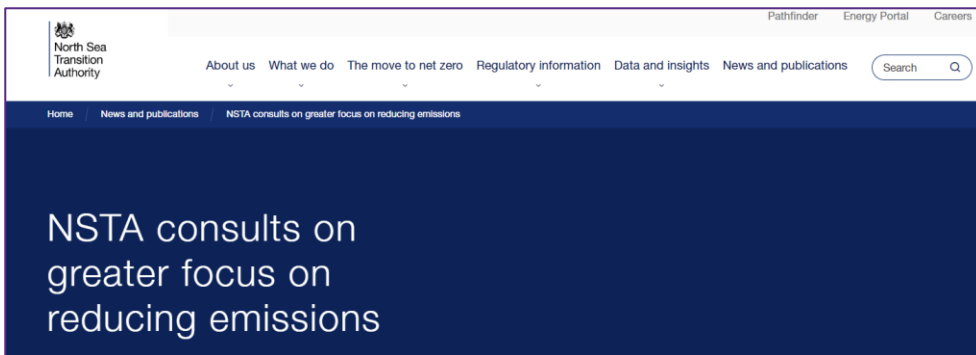
Next steps – Rollout

Build on market pull (bottom up):

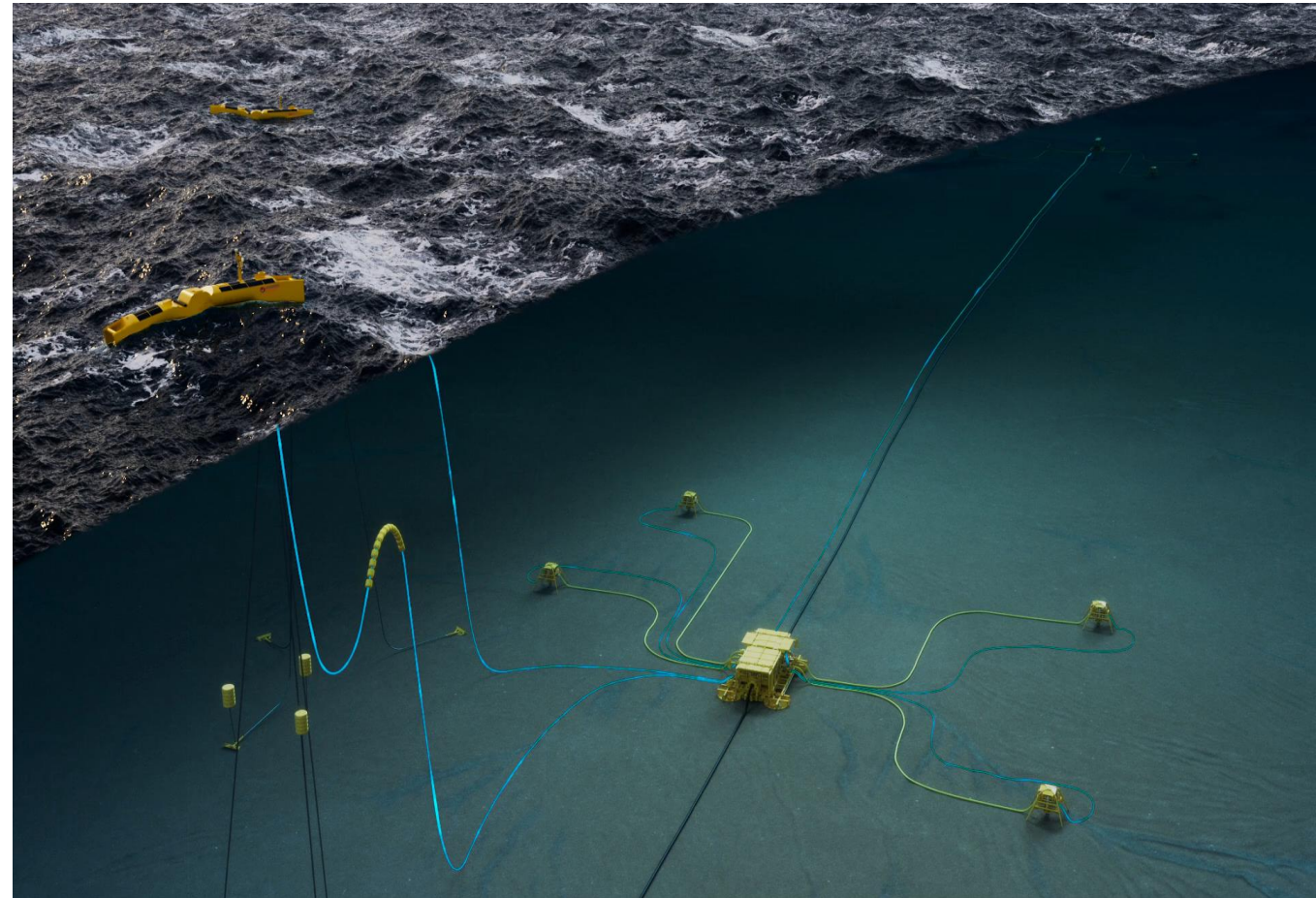
- Extension of RSP beyond 12 months
- Moving system to an operator site
- Near-term commercial WEC sale

Ensure we address policy push (top down):

- NSTA Nov '23 consultation includes query on: *Platform electrification and low carbon power*
- Sets 2030 conditions for North Sea O&G licenses



<https://www.nstauthority.co.uk/news-publications/nsta-consults-on-greater-focus-on-reducing-emissions>



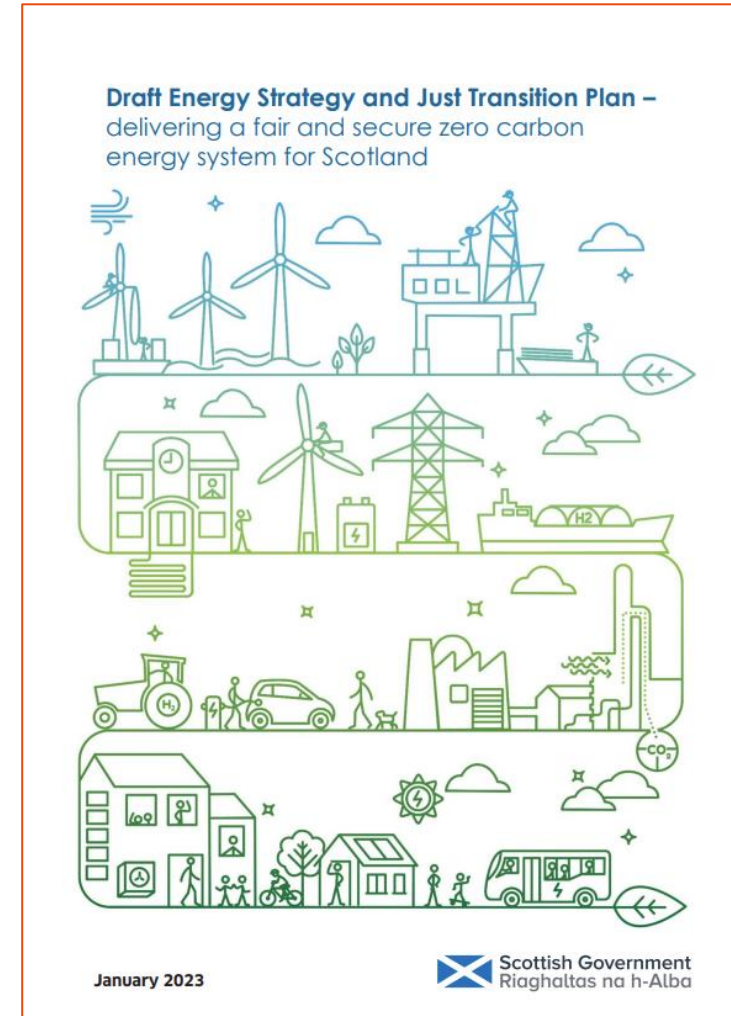
A typical RSP-type islanded renewable energy system powered by wave energy (Courtesy of Baker Hughes).

Next steps – Scaling up

Larger scale decarbonisation opportunities:

- **Mocean awarded £3.2m via EuropeWave** to build, deploy & test FOAK Blue Horizon 250kW WEC:
 - Demonstrate grid-connected electricity at EMEC Billia Croo
 - Targeting TRL7 (1-9 scale) by 2026
- **Adopt and adapt RSP model to Blue Horizon program**
 - Seeking industry partners to financially support & participate in development program
- **Policy seascape will be crucial to enable scale-up & continuity:**
 - WES support instrumental in enabling Blue X & RSP
 - Gaps exist – e.g. innovation funding for array demonstrations (links to ESJTP 2023)

**We are at a crucial juncture for the sector.
Let's keep building on this growing momentum!**



Draft Scottish Gov. Energy Strategy & Just Transition Plan, ESJTP (2023).



10 years



200 ocean technology projects enabled



20 communities empowered by ocean energy



Flagship wind wave farms



Mitigate 200,000 TCO2 per year

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