



Transformational low-carbon
subsea power project:

Renewables for Subsea Power (RSP)

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Diversification: Opportunity
through Evolution, Subsea
Expo

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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:

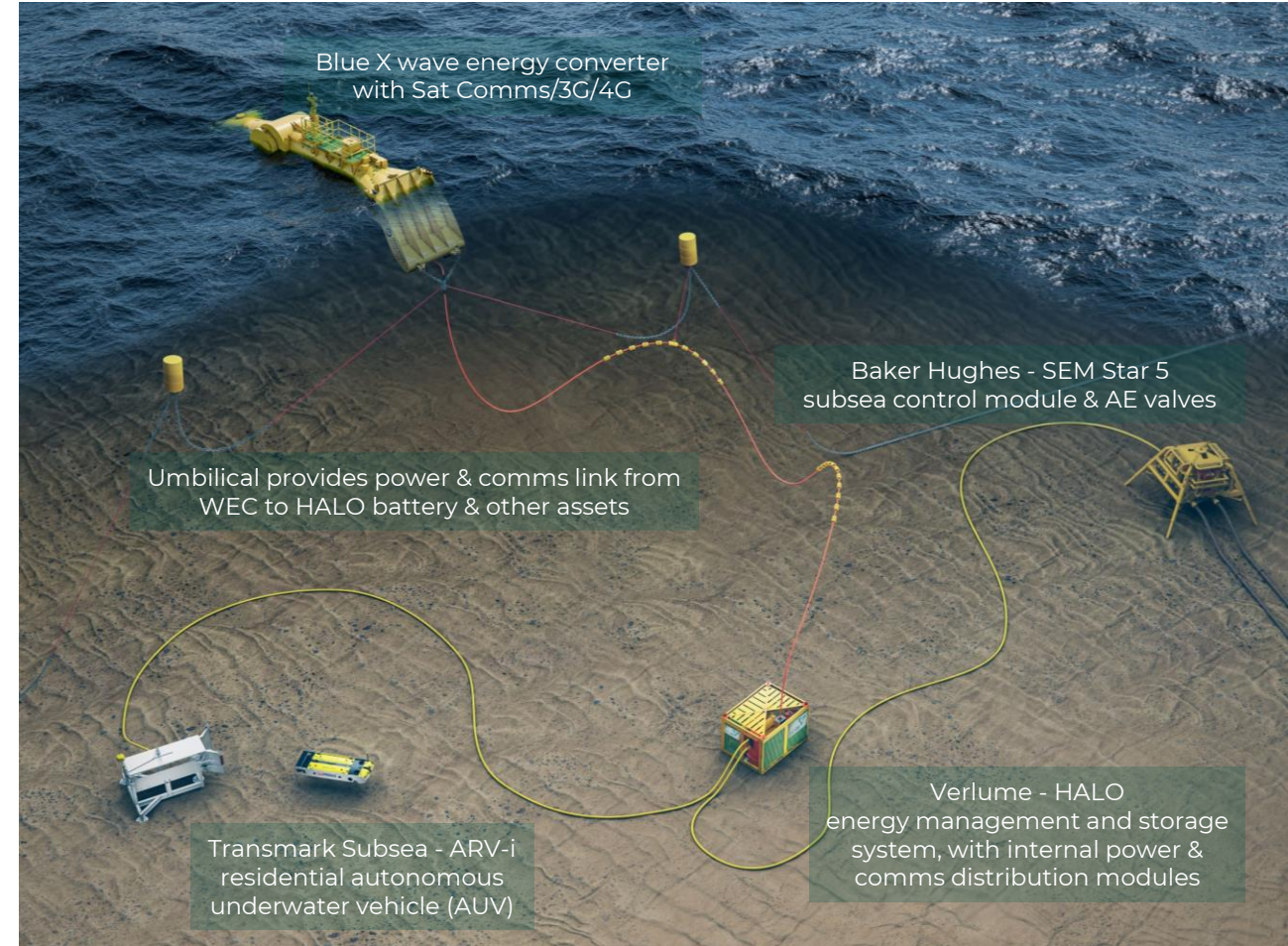
- 3.5 nautical miles east of Orkney mainland; 50-53m water depth
- Remote comms, control & monitoring

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

actual system completed & qualified via test and demo

RSP aims to:

- 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



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

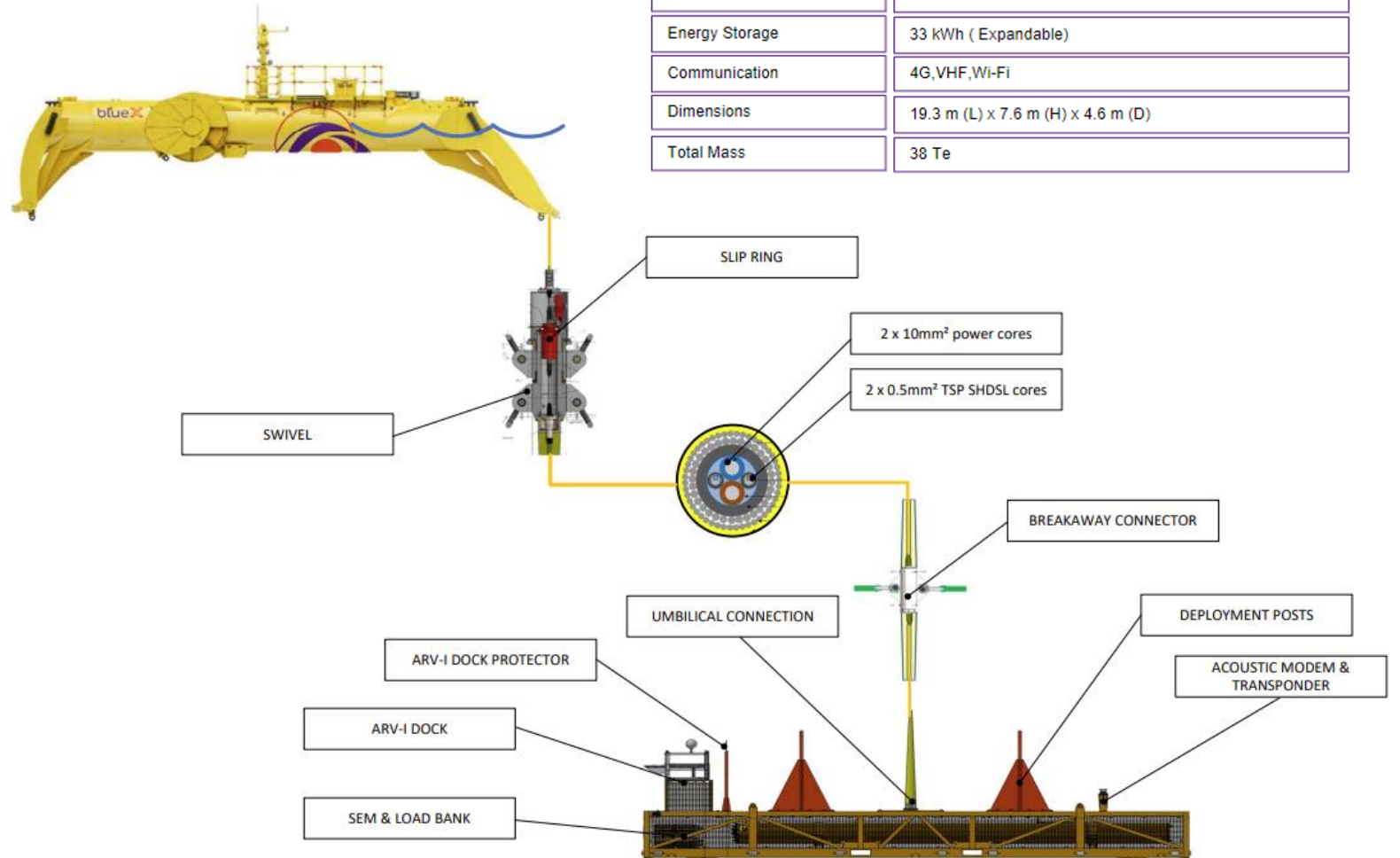
Power at XT (valve op's)	620 W with batteries charging and choke operating
Power at XT (valve op's)	770 W max power for fast charging
Power at XT (no valve op's)	535 W with no batteries charging or valve op's
Communication	DSL or Ethernet depending on offset (primary)
Communication	Electrical actuators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

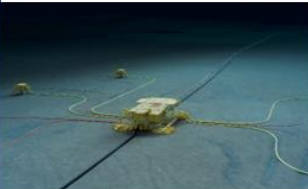
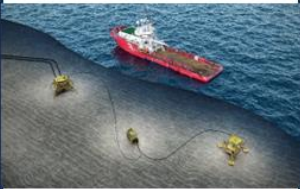
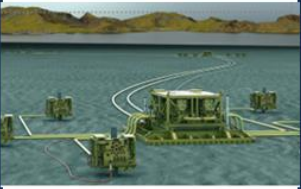
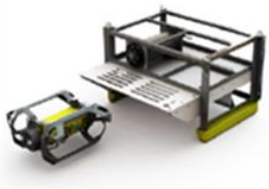

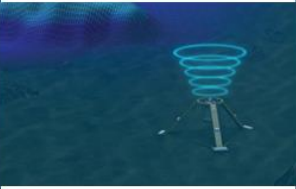

Mocean – Blue X

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



Use Cases

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

<p>Long Offsets</p>  <p>Enable Long Offset wells</p> <ul style="list-style-type: none"> Removes need for Hydraulic umbilical Employ remote chem injection subsea Minimal impact on host infrastructure Simple transparent link remote SatCom/4G 	<p>Umbilical remediation</p>  <p>Reenable failed assets with electrical umbilical failures</p> <ul style="list-style-type: none"> Energy security Remote comms Works with existing control architecture 	<p>CCS</p>  <p>Adoption of all-electric subsea systems</p> <ul style="list-style-type: none"> Green power generation Alternative to DFCO from shore Remotely powered system 	<p>Vehicle Residency</p>  <p>Short/long term vehicle residency</p> <ul style="list-style-type: none"> Over-the-horizon comms Charge on seabed Reduce vessel GHG emissions 	<p>Brownfield Expansion</p>  <p>Enable in-fill/stranded asset wells</p> <ul style="list-style-type: none"> Minimal impact on host infrastructure control system Simple transparent link remote SatCom/4G 	<p>Metocean & Leak Detection</p>  <p>Long duration autonomous data monitoring</p> <ul style="list-style-type: none"> Data redundancy remote comms & local data storage Power for retrofit leak detection 	<p>Decommissioning</p>  <p>Lower carbon operations</p> <ul style="list-style-type: none"> Provides power/comms for nav aids/well monitoring Removes needs for vessels/periodic recovery of wells data Lower carbon footprint/no marine diesel burn
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Decarbonise existing developments & enable electrification via new technology 



We make wave energy work



Independently de-risked



- Via internationally recognised IEA metrics and performance evaluation criteria
- Success in 6 consecutive PCP stage-gates (WES & EuropeWave)

Track-record



- At-sea validation via 5-month Blue X trial to prove behaviour and operations
- 1-year+ deployment via RSP at more energetic site east of Orkney

Integration



- Commercial traction & readiness
- Optimised in parallel with subsea energy management, subsea control, residential AUV technologies

Performance

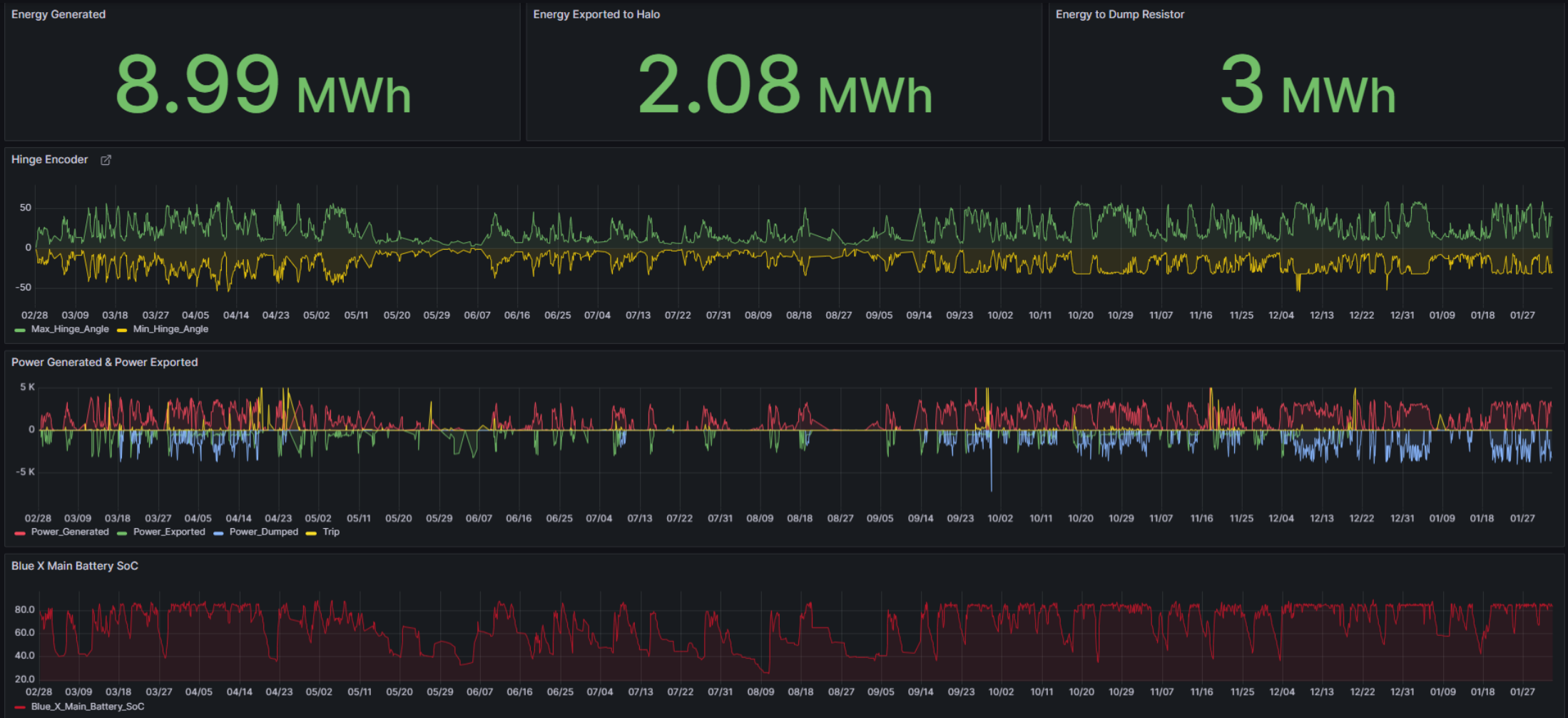


- Relevance across markets via scalability in WEC size and number
- Effective system hybridisation demo'd by robust wave + solar yields

Blue X WEC Dashboard



As of 2nd February; excess power is dumped to the resistor when the battery is at max capacity. This can be observed highlighted in **blue** in the middle graphic.



Halo: Robust Hardware for Marine Environment

- Designed specifically for integration of Marine Renewable Energy Converters to subsea payloads.
- State-of-the-art Lithium-ion battery technology maximises energy density and operating efficiency.
- Off-the-shelf hardware, combined with sophisticated IP from Verlume, minimises supply chain risk.
- Energy capacity and power output scalable and configurable to suit end user requirements.
- Adaptable for a range of output applications.

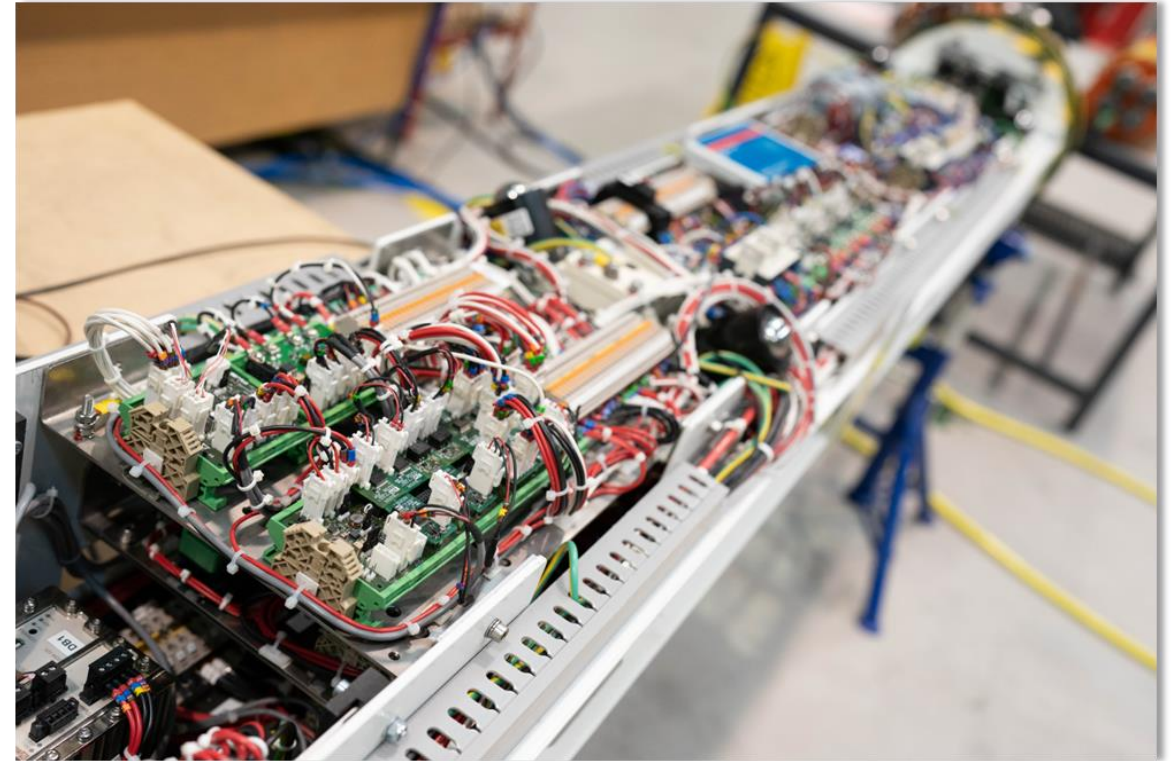


HALO



Intelligent Software – Verlume's Energy Management Solution

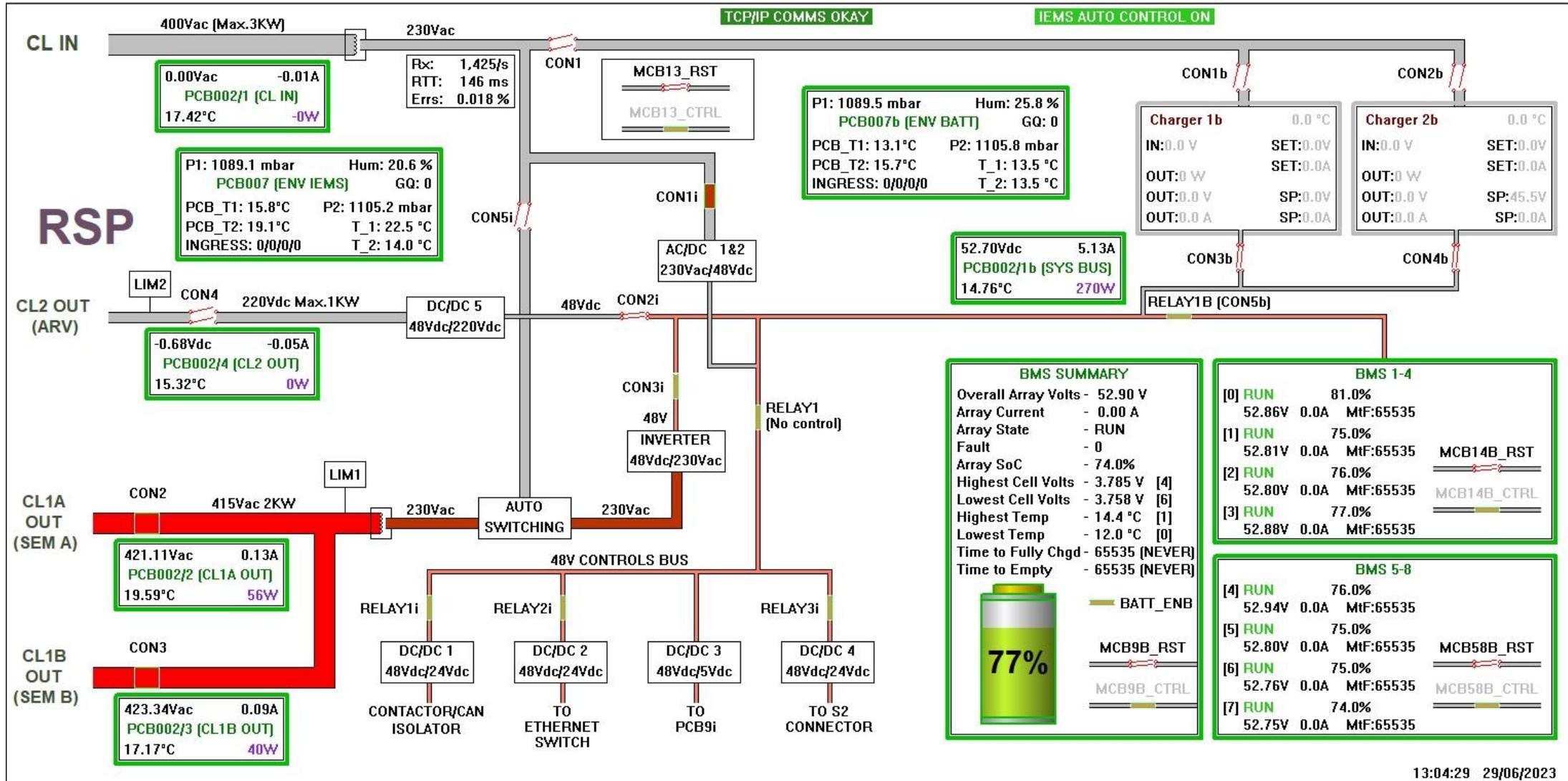
- **Resource and yield analysis:** assessment of energy resource at a project location to determine the optimum power generation system.
- **Capacity analysis:** optimised energy storage for overcoming generation intermittency and ensuring maximum energy availability.
- **Performance and safety management:** power management integrated with battery management for enhanced safety and performance in operation.
- Patented technology with no comparable on the market.



 Axonn



HaloView Dashboard



Autonomous Resident Vehicle (ARV-i)

The logo for ARV-i, consisting of three slanted parallel lines followed by the text "ARV-i" in a bold, sans-serif font.

Transmark Subsea 
Specialist in Subsea solutions

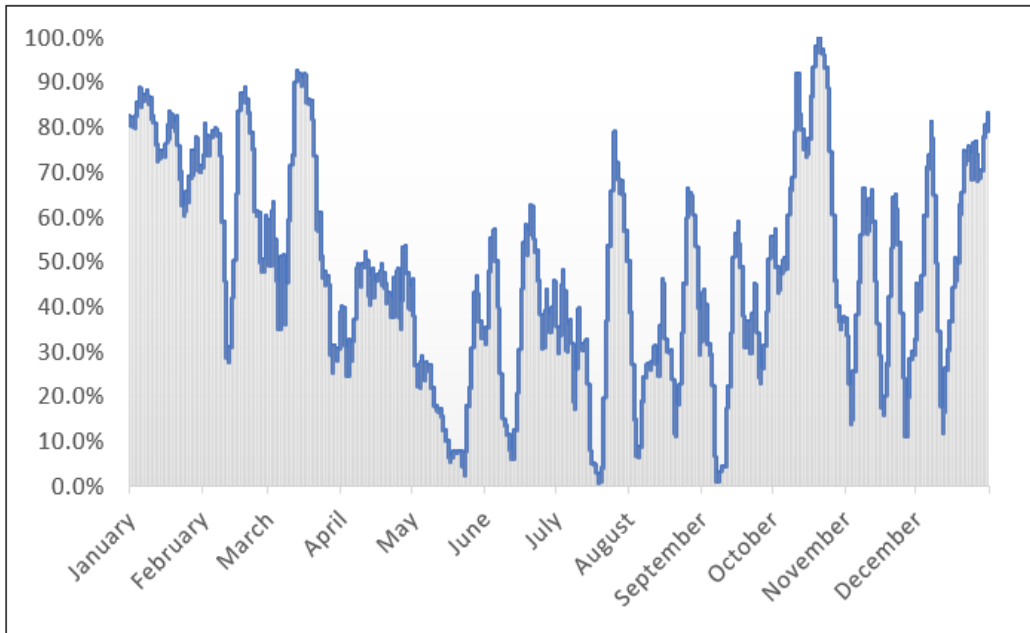


Power Stabilisation

Variable wave power availability → consistent power delivery.

RENEWABLE POWER GENERATED

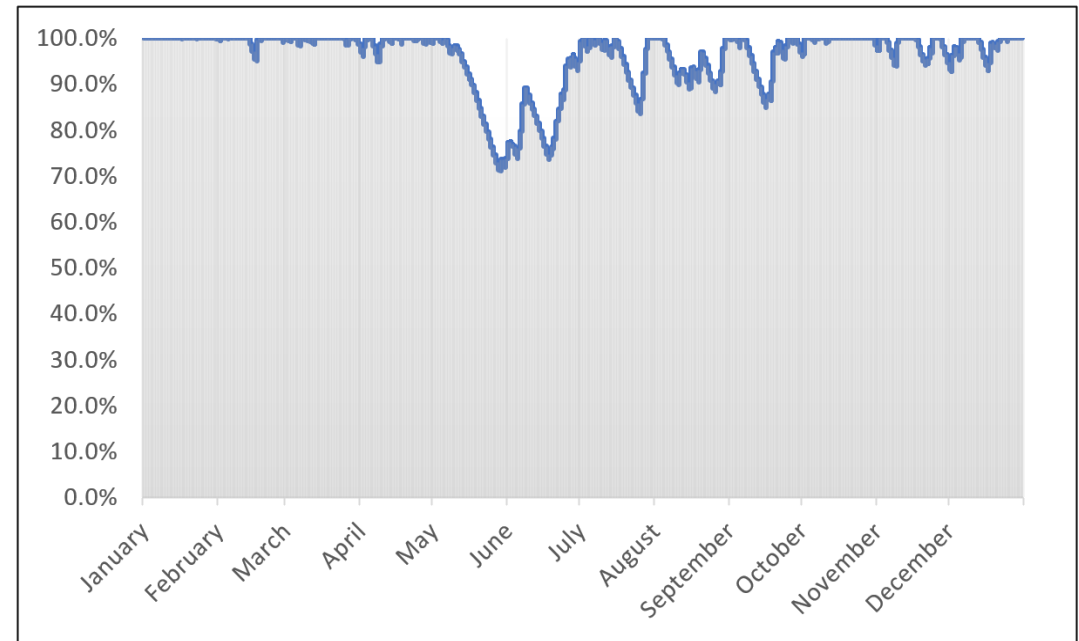
Blue X converts energy from waves with daily, monthly, and annual variability.



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 11 months of operation (Mar-Jan) suggests robust wave & solar yields, and reliable system integration.



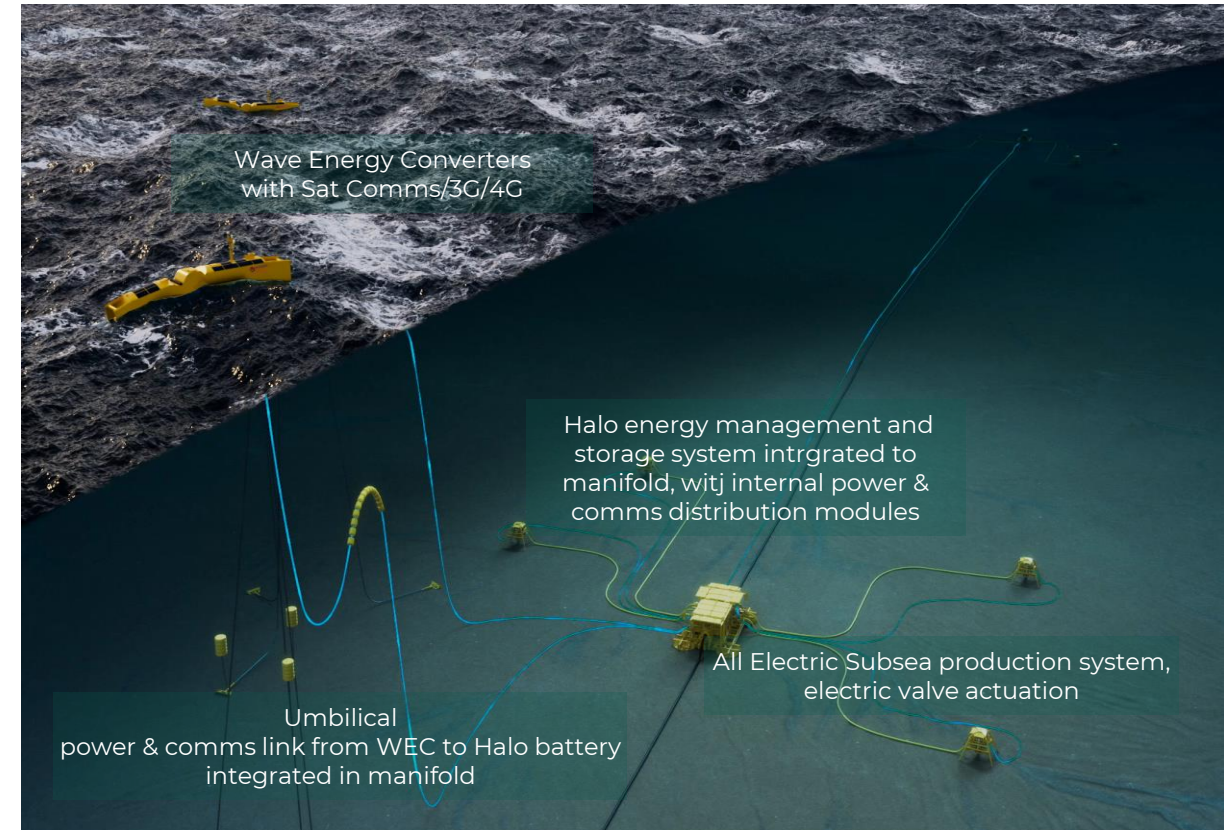
Showing solar panels at hinge & forward wave channel.

Concluding Remarks



RSP type solutions have a significant role to play in the North Sea, across Europe, and globally.

- Ready, reliable, renewable, source of local, clean energy at sea
- **Cross-industry collaboration is key:**
 - RSP brings industry together developers, operators, integrators – all building towards Net Zero targets
- Larger scale decarbonisation opportunities await:
 - Islanded systems and larger scale off-grid (e.g. CCS, hydrogen)
 - **Mocean** awarded **£3.2 Grant** awarded to deliver next size machine by 2025
 - **Verlume** technology is modular and scalable, with active offshore wind projects taking seabed battery storage to **MWh range**.
- **Gaining momentum and seeing growing industry traction**
 - Attracting international investment and energy super majors into demonstration projects
 - Several completed and active feasibility projects ongoing assessing global opportunities across the energy sector.



“How do wave powered RSP solutions fit with your projects, and how can they play a part in your strategy towards decarbonisation?”

