Funded by
UK Government

Department
for Transport

Innovate
UK

# UK SHORE

## Powering a Sustainable and Prosperous Maritime Future

**Clean Maritime Demonstration Competition Round 3**

**Clean Maritime Demonstration Competition Round 4**

**Clean Maritime Demonstration Competition Round 5 – International Green Corridors Fund**

**Smart Shipping Acceleration Fund**

**Published September 2025**

# Contents

Foreword

# Driving a Sustainable Maritime Future

The UK's maritime sector stands at a pivotal moment. The journey toward a sustainable future is not just an urgent necessity but also an incredible opportunity for UK economic growth. The recently published UK Maritime Decarbonisation Strategy sets out the Government's commitment to reduce Maritime's environmental footprint and to build on the UK's expertise and innovation to drive the sector's net zero transition.

The UK Shipping Office for Reducing Emissions (UK SHORE) R&D programme in the Department for Transport is at the forefront of this crucial transformation. Working closely with Innovate UK, we are actively fostering a dynamic ecosystem for cutting-edge research and development in clean maritime solutions led by UK industry and academia. This collaborative spirit is key to fast-tracking pioneering technologies, nurturing them from initial concepts right through to market-ready applications.

A vital pillar of the UK SHORE programme is the multi-year Clean Maritime Demonstration Competition (CMDC). This competition provides crucial match-funding, giving a powerful boost to the design and development of clean maritime solutions on their path to commercial viability. Since launching in March 2021, the DfT has invested over £136 million across five rounds of the CMDC, championing a remarkable array of projects dedicated to decarbonising the UK's maritime sector.



This brochure shines a spotlight on the significant achievements from Rounds 3, 4 and 5 of CMDC and from the Smart Shipping Acceleration Fund (SSAF). The projects mark a critical chapter in our journey, building on the foundations laid by earlier competitions, including through real-world demonstrations in UK ports and in UK waters. They demonstrate the impressive ingenuity and the rapid pace at which clean maritime technologies are advancing. These aren't just ideas on paper; they represent tangible strides towards a more sustainable future, with many securing further investments from major industry players and moving closer to widespread adoption.

My thanks go out to every organisation that has participated in CMDC and SSAF. Your dedication, deep expertise, and readiness to push the limits of what is possible will be instrumental in driving the UK's clean maritime agenda forward. The progress detailed within these pages fills me with enormous optimism. We look forward to seeing these technologies and innovations help forge a truly sustainable maritime future.

**Lola Fadina,**

Director, Maritime, Department for Transport

Introduction

# The UK is leading global maritime innovation by funding hundreds of decarbonisation research projects

This booklet provides brief summaries of each of the innovative maritime research projects funded by the UK Department for Transport under the Clean Maritime Demonstration Competition (CMDC) Rounds 3 and 4, CMDC 5: International Green Corridors Fund, and Smart Shipping Acceleration Fund competitions.

Behind each project summary is a wealth of new information and technology which UK maritime innovators have spent years and millions of pounds developing. All projects finished in March 2025 and the organisations involved are now exploiting the results of their hard-earned R&D achievements.

With the number of projects presented here, readers are encouraged to home in on topics that interest them. These research projects cover technology for both vessels and maritime infrastructure including alternative fuels, electrification, energy efficiency and digitalisation.

Many projects in this booklet have demonstrated their technology at sea in real-world operational environments.

The 77 projects have been funded by the UK Department for Transport's UK Shipping Office for Reducing Emissions (UK SHORE). This is a programme driving the shift towards a more sustainable maritime sector while delivering regional development and economic growth across the UK. It forms part of the Government's wider efforts to build a greener and more prosperous future for shipping by supporting design, manufacture, and operation of innovative maritime technology and infrastructure, continuing the UK's proud maritime heritage by paving the way in sustainable shipping.

The maritime sector is notoriously difficult to decarbonise, but the progress UK SHORE projects are making prove that collaboration and innovation can drive real change. Crucially, UK SHORE projects also show this can be achieved while boosting economic growth and opportunities.

Innovate UK and the Department for Transport encourage readers to reach out to either us or the organisations mentioned in this booklet to find out more about the projects and their wider work with clean maritime.

CMDC 3, 4, 5 – International Green Corridors Fund and the Smart Shipping Acceleration fund build upon the successes of CMDC Round 1 and CMDC Round 2, the project summaries for which are found in separate booklets found on our website at **www.iuk-business-connect.org.uk/programme/uk-shipping-office-for-reducing-emissions/**

# Numbers at a glance

**£16.1bn**
directly contributed to UK GVA by the maritime sector

**Domestic**
**8 $MtCO_2e$**

**International**
**9 $MtCO_2e$**
Estimated UK maritime well-to-wake GHG emissions 2019

**46%**
of UK domestic maritime emissions come from vessels at berth in our ports

**2.2bn**
litres of petroleum products were supplied from UK marine bunkers for international journeys in 2023

Maritime Decarbonisation Strategy (www.gov.uk/government/publications/maritime-decarbonisation-strategy)

**247**
Number of innovation projects funded under UK SHORE

**500+**
Number of organisations involved in UK SHORE

**£230m**
Amount of funding for UK SHORE projects

## Clean Maritime Demonstration Competition
### Round 3

**16** projects
**81** partners
**£52m** grant funding

## Clean Maritime Demonstration Competition
### Round 4

**30** projects
**132** partners
**£28.5m** grant funding

## Clean Maritime Demonstration Competition
### Round 5 - International Green Corridors Fund

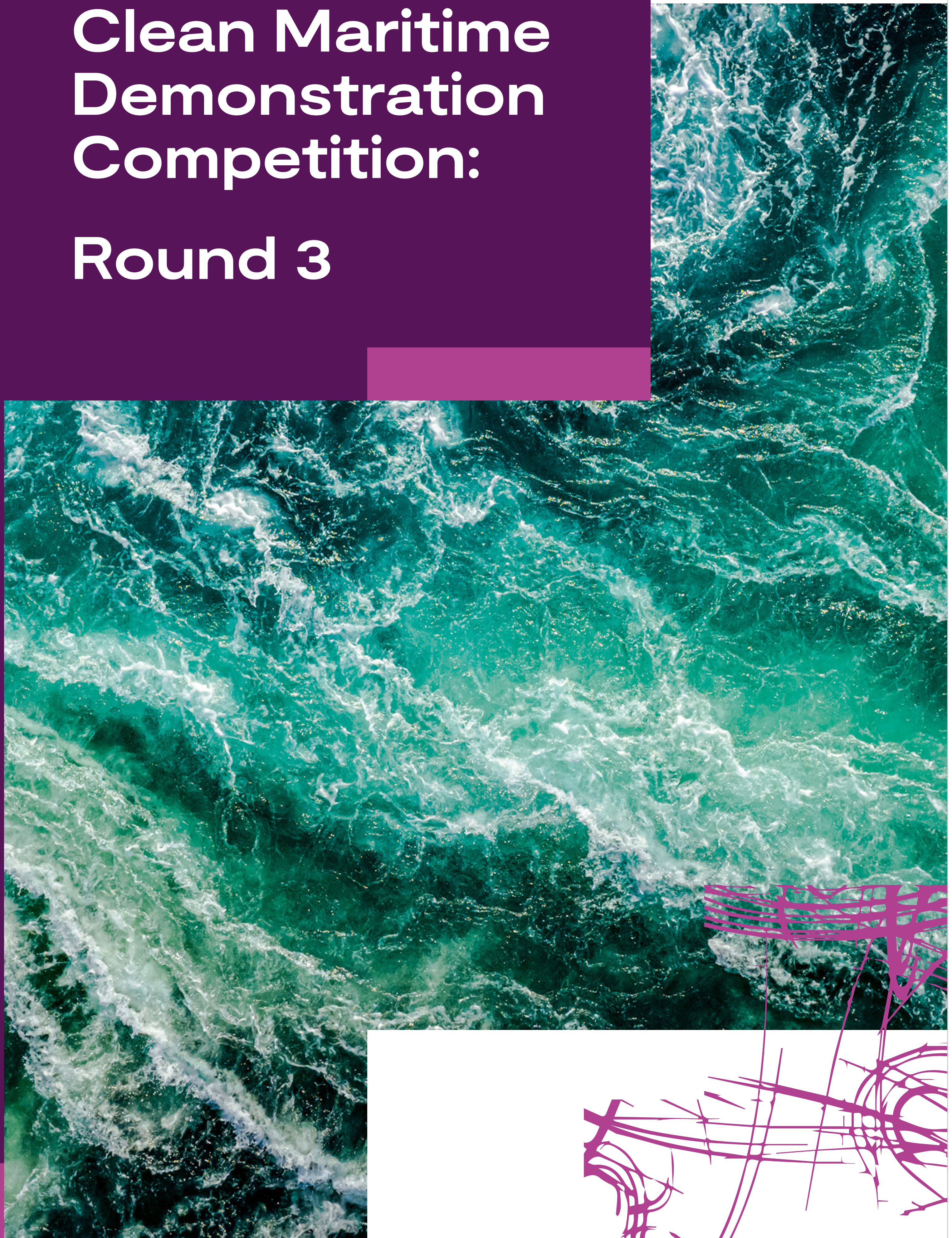
**2** projects
**9** partners
**£141k** grant funding

## Smart Shipping Acceleration Fund

**30** projects
**99** partners
**£7.6m** grant funding

# Clean Maritime Demonstration Competition:

# Round 3





# Multipurpose eFoiler Platform

## Objective

To develop a high-performance electric hydrofoiling vessel system adaptable for various use cases — from water taxis to leisure boats.

**Lead:** Artemis Technologies

**artemistechnologies.co.uk**

**Partners:** Condor Ferries

## What was the aim?

This project focused on the development and demonstration of a high-performance Multipurpose eFoiler® Platform system, targeting a top speed of 40kts, with range of 70 nautical miles at cruising speed. In order to maximise the global opportunity of maritime decarbonisation Artemis has also developed a 'bustle concept', an innovative change to the manufacturing approach which will facilitate large scale build of vessels at shipyards around the world, whilst manufacturing the high-value Multipurpose eFoiler® Platform system in Belfast.

## How did it go?

We were able to successfully prove the bustle methodology, which involves the standalone manufacture of a section of the lower portion of the hull, by creating two different vessel types (a water taxi and a day boat) using the same bustle platform. These vessels were built by two different vessel manufacturers proving that the system can be used to deploy the vessels throughout the globe using local ship builders while maintaining core technologies here in Belfast.

## The next steps

We are now offering both vessel types created during this project as products available for sale. We are also adopting this methodology across all of our EF-12 platforms allowing for flexibility on design by using the platform method and modifying the top hat to suit the required use case.

# Zero Emission Solent Tri Foiler

## Objective
To demonstrate the zero-emission of an innovative very low drag, high speed electric foiling trimaran passenger ferry.

## What was the aim?
The aim was to use off the shelf technology to create a demonstrator foiling vessel which has no moving parts under the water (except for propellers). This vessel was hydrodynamically representative of a larger fast ferry (with 40 pax) which could be used for inshore routes, between e.g. Southampton and Cowes. This demonstrator vessel would then be used to analyse whether the technology is viable alongside whether the theoretical GHG savings were correct.

## How did it go?
The project was a success in part, and we have successfully demonstrated that both the electric low drag trimaran concept, alongside simple foiling is achievable with significant reductions in $CO_2$ emissions. Our demonstrator flies although we cannot demonstrate full foiling, as the vessel is not stable under foiling conditions. Further time spent on stabilisation could prepare the concept for commercialisation.

**Lead:** Chartwell Marine

**chartwellmarine.com**

**Partners:** Newcastle Marine Services, Southampton Solent University

## The next steps
The next steps are to continue to test the boat, alongside exhibiting at e.g. Seawork 2025. We aim to find a project partner to help us commercialise the larger-scale vessel. We may need to apply for further grant funding to test modified stabilisation systems.





# The Winds of Change

## Objective
To build confidence in SGS and FastRig™ to accelerate market uptake.

## What was the aim?
The aims were to prove the safety and robustness of the hardware, to have external academics and naval architects validate fuel/GHG saving models to give customers confidence in savings claims and to develop a full business case for project sponsors Drax to trigger a full commercial installation.

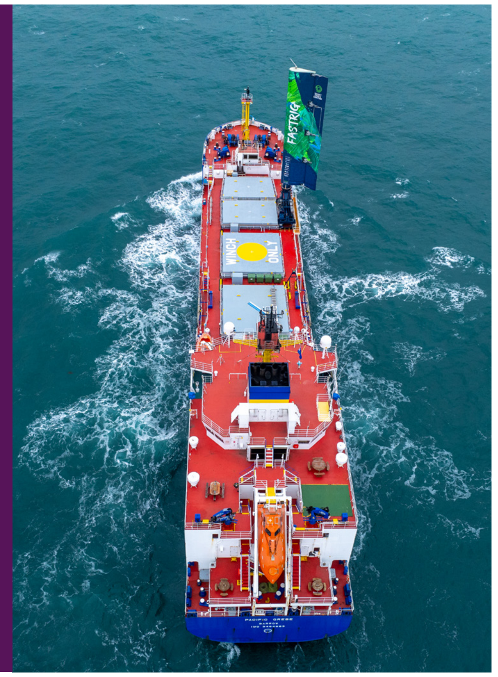
## How did it go?
It was a huge success. We expedited on time, on budget delivery of a complex interconnected project via an excellent collaborative network of UK based naval architects, marine engineers, shipowners, ship operators, cargo owners, insurers, financiers and lawyers. We proved the tech to be safe and robust; the sea trials corroborated our FastRoute™ numerical models and gave market confidence in our Business Case. We secured global media coverage and a strong pipeline of potential customers.

**Lead:** Smart Green Shipping Alliance

**smartgreenshipping.com**

**Partners:** University Of Southampton

## The next steps
The next steps are to raise £10m investment to accelerate business development to capitalise on the global export opportunity. These funds are to recruit more people, progress the FastRig design, to build out our smart digital core to support our unique wind-as-a-service customer proposition, FastReach™ - a lease-finance, no capex installation option designed to de-risk FastRig adoption through integrated insurance, operation and maintenance agreements and make regulatory compliance straightforward via automated verification certificates.



# Carnot High Efficiency Hydrogen Combustion Engine Demonstrator

## Objective

To develop and run a containerised hydrogen-fired Carnot auxiliary engine in sea trials onboard a Carisbrooke Shipping vessel.

## What was the aim?

To prepare technology developed under previous research for fired testing using hydrogen and then containerise it into a system for use in a sea-trial aboard a Carisbrooke general cargo vessel. The project required development across several key aspects of the technology underpinned by developing a more detailed understanding of the marine regulations.

## How did it go?

The project was successful, with a 50kW hydrogen engine designed, built and tested, a 100bar H2 injector developed and a 200kg compressed H2 storage tank designed and built. The team are currently completing commissioning of the plant container and installation on the Carisbrooke vessel. Hydrogen safety training was developed with MCA and Orkney College, with Carisbrooke crew undertaking training.

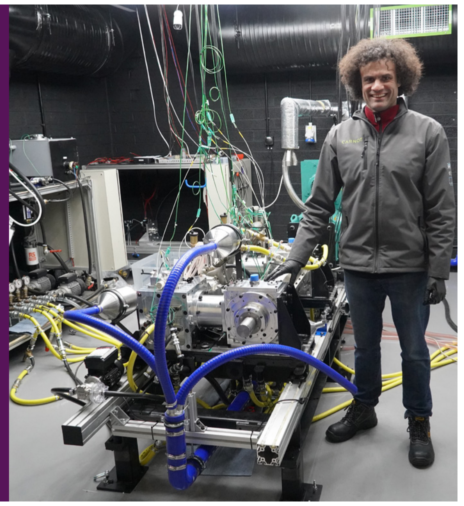
**Lead:** Carnot

**carnotengines.com**

**Partners:** Brunel University London, Carisbrooke Shipping, The Manufacturing Technology Centre

## The next steps

Following successful trial we have several commercial engagements lined up to further demonstrate the technology and work towards joint development programmes for using our technology in real-world applications. We also plan further research activity to scale up the technology to produce more power which would be better suited to the maritime industrial applications.









# Clean Hybrid Alternative Marine Powertrain (CHAMP) 2

## Objective

To develop an engineering pipeline to characterise the operational needs of specific vessels, test clean powertrain technology options for suitability, and to rapidly deliver and demonstrate examples on-water.

## What was the aim?

To combine digital testing and real-world validation to improve technology and solution definition by capturing and analysing duty cycle data to develop a clear and quantified understanding of their operational needs. The team used simulation tools to test powertrain technologies, combinations, and architectures against vessel operational needs to rapidly deliver example clean powertrains for on-water testing to build industry confidence, support marine standards development and workforce skills.

## How did it go?

Data capture instrumentation was developed and installed on 30+ partner vessels, and the operational needs were characterised. Thousands of powertrains were simulated, and the optimal configurations and performance trade-offs for each partner vessel were identified. Three powertrains were engineered and delivered, including a sustainably fuelled eMethanol hybrid electric option which was demonstrated on-water and at Seawork.

**Lead:** Purple Sector

**purplesector.tech**

**Partners:** BAE Systems Surface Ships, Cowes Harbour Commission, Princess Yachts, RNLI, Serco, Solis Marine Engineering, South Devon College, University Of Bath

## The next steps

To deliver the two follow-on commercial opportunities using the developed tools and exploit opportunities to improve existing vessel emissions with better journey planning. Further, to continue development of powertrains and their application to highest impact opportunities.

# Pioneering Onboard Carbon Capture – Pilot Project

**Lead:** Seabound Carbon

**seabound.co**

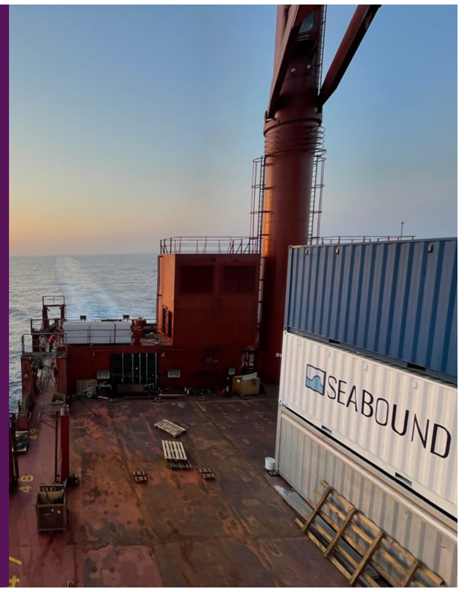
**Partners:** Lomarlabs, Lomar Shipping

## Objective
To design, test, and de-risk Seabound's novel onboard carbon capture technology to enable scalable commercial deployment across the global shipping industry.

## What was the aim?
To demonstrate a world-first carbon capture system on an ocean-going vessel and to develop Seabound's first full-scale commercial unit. Phase 1 involved testing a prototype onboard a Lomar Shipping vessel. Phase 2 focused on iterative land-based R&D and final design of a modular system that captures $CO_2$ in 20ft containers. The project also sought classification society engagement and stakeholder validation to prepare for future commercial trials and scale-up.

## How did it go?
The pilot successfully tested a ship-based prototype in 2023, capturing 1.6 tons of $CO_2$/day. Seabound then made a breakthrough by modularizing its system into 'Seabound Containers,' enabling flexible ship integration. Final designs were completed and procurement for the first containerized unit began. While a second shipboard trial was postponed beyond project scope, key technical and strategic milestones were achieved.

## The next steps
Seabound will deploy its first full-scale containerised carbon capture unit in a demonstration in 2025. It is advancing commercial discussions with shipowners and ports and preparing for further development. In parallel, Seabound is scaling internal sorbent production capacity and developing partnerships with classification societies and $CO_2$ offtakers. These steps will enable commercial pilots across different ship types and support the UK's broader CCUS and clean maritime goals.








# TransShip II – RV Prince Madog Hydrogen Retrofit

**Lead:** O.S. Energy (UK)

**os-energy.de**

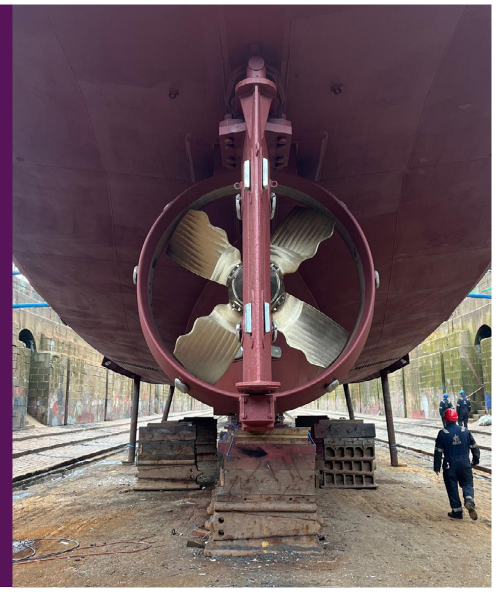
**Partners:** Cedar Marine, Chartwell Marine, Engas Global, H2Tec, Newcastle Marine Services, Newcastle University, Solis Marine Engineering, Stone Marine Propulsion, University Of Exeter

## Objective
To deliver the largest hydrogen retrofit undertaken to date on any vessel, transforming RV Prince Madog to support zero-emission propulsion for maritime research & surveys.

## What was the aim?
To establish a replicable solution by retrofitting the vessel with a hydrogen-battery system on top of the vessel's existing conventional diesel systems, to enable zero-emission scientific research survey operations. The target was to develop a detailed design compliant with Class & Statutory regulations, and to procure ClassApproved equipment.

## How did it go?
Despite major challenges, this, the team achieved significant milestones as a pioneering marine hydrogen refit, including a class-compliant system design, innovative propeller installations, and critical works for required auxiliary systems. The consortium delivered technical breakthroughs and real-world implementation milestones.

## The next steps
Prince Madog entered drydock in June for critical dry condition works including the installation of the innovative propeller blades and hull penetrations for auxiliary systems. Final approval of the hydrogen system design is underway with Lloyds Register. The vessel will return to the shipyard over the winter for final systems installation, followed by commissioning and demonstration phase to showcase the hydrogen-electric system operation in early 2026.



# Hydrogen Innovation – Future Infrastructure & Vessel Evaluation and Demonstration

## Objective
To demonstrate a hydrogen bunkering station and zero-emission SWATH vessel in Plymouth over four weeks, showcasing green short-sea shipping benefits, safe hydrogen handling, and UK supply chain assessment.

## What was the aim?
To demonstrate a complete marine hydrogen supply chain, including bunkering and vessel operation, for short-sea logistics. This addressed key challenges in developing green shipping corridors, safe hydrogen handling, and assessing the UK supply chain. The project delivered a 4-week at-sea demonstration to TRL8, showcasing the commercial viability of hydrogen-powered vessels and infrastructure, and paving the way for future investment and market opportunities.

## How did it go?
Following extensive consultation the decision was taken to pivot from LH2 to GH2. The project successfully built and tested the vessel and bunkering manifold using gaseous hydrogen in a port environment. Demonstrations were completed in Plymouth and Falmouth, yielding significant learnings that advanced the regulatory landscape and successfully proved hydrogen power train integration into an autonomous SWATH vessel.

**Lead:** ACUA Ocean

**hi-fived.com**

**Partners:** Aberdeen Harbour Board, Composite Mouldings, NASH Maritime, Trident Marine Electrical, Unitrove, University Of Southampton, Zero Emissions Maritime Technology

## The next steps
ACUA aims to continue testing its prototype vessel through the summer of 2025, progressing towards demonstrations and pilot projects for potential end-users and customers, driving commercialisation. Alongside work to develop future capabilities ACUA is now focused on bringing its solution to market.





# Demonstration of Direct Ammonia Fuel Cells for Maritime Propulsion

## Objective
To develop and demonstrate an Auxiliary Power Unit (APU) based on a 1kW ammonia fuelled fuel cell for marine application.

## What was the aim?
The project aims to show effective' conversion of ammonia to electricity by performing a demonstration on the direct utilisation of ammonia in fuel cells to power-up auxiliary loads on a water vessel. This is an entry step for the technology that seeks to normalise its application.

## How did it go?
The project concluded successfully, despite facing initial challenges from partner changes and a tight timeline. In collaboration with our partners, the final phase culminated in the development and demonstration of an ammonia fuel cell and cracker system, which included an auxiliary power unit. This innovative fuel cell produced a power output of 1KW, successfully powering the auxiliary loads on the Srian vessel at Eyemouth Marine.

**Lead:** ZEM Fuel Systems

**zemfuelsystems.com**

**Partners:** Echandia Marine UK, Eyemouth Marine, Inverness And Cromarty Firth Green Freeport, Moray First Marine, Seaking Electrical, University Of St Andrews

## The next steps
We are continuing the evaluation and demonstration of the system in the immediate term, to generate further operation hours. The demonstration of the fuel cell technology developed by ZEM, along with their high-efficiency ammonia cracker unit, has led to the planning of a further project aimed at integrating ammonia propulsion technology into a hybrid hydrofoil-torpedo system. This system proposes a zero-emission propulsion solution ideal for small to medium-sized ferries and offshore vessels that need to operate under harsh sea conditions.

# Retrofittable Propulsion System for Electric Vessels with Hydrogen Range Extender

## Objective
To develop, test and deploy an innovative battery and hydrogen powered retrofittable propulsion technology to achieve Net Zero Emissions for an existing UK certified, Crew Transfer Vessel.

## What was the aim?
RESTORE showcased and demonstrated real-life sea trials in the North Sea to show the rest of the world a UK Innovation that has already brought attention to the Ukraine Hydrogen Council in Kyiv. Video and drone footage shows real-time demonstration in the North Sea.

## How did it go?
The project was a major success. The RESTORE team delivered a live North Sea demonstration of pioneering UK innovation, drawing international attention—including from the Ukraine Hydrogen Council in Kyiv. Striking video and drone footage captured the vessel in real-time, proving the effectiveness of retrofittable zero-emission technology. The project firmly positions the UK at the forefront of clean maritime solutions, demonstrating a scalable model for decarbonising existing fleets worldwide.

**Lead:** Aceon Battery Solar Technology

**aceongroup.com**

**Partners:** Cage Technologies, Engas Global, Liverpool John Moores University, Newcastle University, Offshore Renewable Energy Catapult, Taurus Engineering, University Of Liverpool

## The next steps
RESTORE team plan to continue collaboration as the maritime industry is key for all partners to use the learning and experience gained within this RESTORE project. AceOn sees opportunities with off and onshore power as well as supporting electric vessels with battery technologies. A huge cross-sector opportunity to transfer knowledge for e-mobility, rail and autonomous vehicles.






# Zero Emission Cross River Ferry

## Objective
Delivering the UK's first all-electric cross-river ferry by replacing a 50-year-old diesel-powered vessel with a cutting-edge vessel that achieves zero tailpipe emissions.

## What was the aim?
Orbit Clipper exemplifies how the maritime sector can evolve to meet environmental targets, and improve both the passenger experience and the health and wellbeing of nearby communities. Delivering both the vessel and supporting infrastructure, the project sets a precedent for future clean marine transport in urban settings, highlighting the demand for greener alternatives and the benefits of proactive investment in emission-reducing technologies.

## How did it go?
Orbit Clipper has successfully completed construction and passed all MCA compliance testing, confirming its readiness for full deployment and becoming the first in the UK to deploy a fully electric ferry on a continuous operational schedule. However, while demand for electric vessels is clearly emerging, infrastructure development continues to lag behind, creating barriers to widespread adoption.

**Lead:** Collins River Enterprises

**uberboatbythamesclippers.com**

**Partners:** Aqua Superpower, Beckett Rankine, Wight Shipyard Company

## The next steps
While challenges remain, the collective vision for a cleaner, more sustainable Thames is widely shared. Though the commercial case for zero-emission vessels remains fragile under current conditions, Orbit Clipper represents a vital step forward. With continued financial support and policy backing, this project has the potential to be replicated in London and beyond, serving as a model for future low-carbon transport solutions, and will continue through the parallel ZEVI project.

# Demonstration of 12pax fully-electric hydrofoiling Crew Transfer Vessel

## Objective
To continue the development of a disruptive electric propulsion system, the Artemis- eFoiler®.

## What was the aim?
To develop, test and deploy a 12m 100% electric foiling CTV, 'eFoiler Small-CTV' and shore-based charging infrastructure, to deliver zero emission crew transfer operations at a wind farm, in order to address market queries on safety and operability through a real-world demonstration.

The innovation includes a high power density electric drivetrain into an autonomously controlled hydrofoil, combining technologies from motorsport, yacht racing, and the aerospace sector. As an Artemis-eFoiler® propelled vessel accelerates, the hydrofoils lift the hull up and out of the water, greatly reducing the wetted area and therefore drag.

## How did it go?
Within this project Artemis Technologies in partnership with Tidal Transit, Orsted, Lloyds Register & Vattenfall, have successfully designed, developed, manufactured & tested a dual propulsion 12m eFoiler® CTV in Belfast and at Vattenfall's windfarm in Aberdeen to validate usability in real world scenarios.

**Lead:** Artemis Technologies

**artemistechnologies.co.uk**

**Partners:** Lloyd's Register EMEA, Orsted Power (UK), Tidal Transit

Artemis TECHNOLOGIES

LR

TIDAL TRANSIT

Ørsted

## The next steps
We are now offering both vessel types created during this project as products available for sale. We are also adopting this methodology across all of our Artemis EF-12 platforms allowing for flexibility on design by using the platform method and modifying the top hat to suit the required use case.



# Coastal Workboats: E-LUV – inter-island workboat demonstration

## Objective
To deliver the UK's first MCA-certified, fully electric inter-island workboat demonstration, supported by a Shore Power Storage System (SPSS), proving the commercial viability of zero-emission maritime operations in remote locations.

## What was the aim?
To demonstrate a fully electric, net-zero emissions workboat/ferry capable of operating in challenging, low-grid environments. The project integrates innovative shore-based rapid-charging infrastructure with a 22-metre Electric Landing Utility Vessel (E-LUV), designed to serve both passenger and cargo transport needs.

## How did it go?
The E-LUV project addresses the critical challenge of decarbonising maritime transport in remote coastal areas where grid access is limited. The vessel and SPSS were designed and constructed to meet Bureau Veritas and MCA Workboat Code Edition 3 standards, with final certification expected in August 2025. The demonstration route spans from Leverburgh to Berneray, shadowing an existing ferry service over a 9- nautical-mile passage. The vessel will also perform multiple fish farm operations on Wester Ross Fisheries at Ullapool.

**Lead:** Coastal Workboats

**coastalworkboats.co.uk**

**Partners:** BK Marine, Coastal Pure

COASTALWORKBOATS

B.K Marine Ltd

## The next steps
The project will seek further funding to evaluate long-term operational performance and cost-effectiveness over a 10-year lifecycle compared to diesel alternatives. It will also explore cross-sector learning opportunities and identify strategies to overcome market entry barriers.

# The Electric Seaway (TES)

## Objective

The Electric Seaway (TES) aims to deliver the first cohesive network of electric vessel charging infrastructure, enabling standardised charging across multiple locations.

**Lead:** Aqua Superpower

**aqua-superpower.com**

**Partners:** Bournemouth, Christchurch And Poole Council, South Hams District Council, UK Harbour Masters Association, University Of Plymouth, ZPN Energy

## What was the aim?

TES aimed to prove that a cohesive charging network can be delivered, which would in turn expedite the uptake of electric vessels. To achieve this, the project sought to overcome concerns related to grid capacity by integrating battery storage to enable greater power for charging sessions. This was coupled with a deployment strategy to inform wider scale delivery of infrastructure and the installation of environmental sensors to measure the impact.

## How did it go?

TES successfully delivered charging infrastructure at multiple sites along the south coast of England. A range of solutions were deployed to meet the local requirements, including battery-backed solutions, AC and DC charging. Environmental sensors were deployed, with a live dashboard providing visibility to site operators. The project enabled challenges to be identified, including land ownership, rural grid connections, vessel and charger integration, providing a focus for future projects.

## The next steps

The learnings from TES need to be applied to scale up and speed up the delivery of charging infrastructure to enable faster uptake of electric vessels. This has to be achieved in collaboration with site owners, ports, harbours and vessel operators, alongside continued discussion with regulators and energy network operators. In this early stage of electric boating, a concerted effort to work together is essential to long-term success.





# High Power Electric Offshore Charging Demonstrator

## Objective

To aid decarbonisation of offshore windfarm operations and maintenance by developing an offshore charging system able to supply crew transfer vessels with electric power.

**Lead:** Oasis Marine

**oasismarine.co.uk**

**Partners:** Offshore Renewable Energy Catapult, Turbo Power Systems, Verlume

## What was the aim?

To develop the Oasis Power Buoy and its wider system components to the point of carrying out a four-week demonstration where a Crew Transfer Vessel (CTV) would operate on 90% electric power throughout the period. The power supply unit to be developed would be scalable, modular and compatible with the communication systems and power requirements most likely to be widely adopted across the industry.

## How did it go?

The main system components were tested in operational and onshore test environments. Development of the product and essential demonstration preparations were carried out, advancing this technology project substantially and paving the way for a future demonstration. However, an unavoidable delay in external investment into the meant that the four-week offshore demonstration had to be postponed.

## The next steps

Oasis Marine will complete offshore trials of the marine and operational aspects of the charging buoy during summer 2025, with further offshore trials of the electrical system being completed in autumn 2025. A longer-term offshore charging pilot study will then be carried out with an offshore wind operator. The groundwork completed during this project has been instrumental to the success and future commercialisation of this offshore charging technology system.

# Clean Maritime Demonstration Competition:

# Round 4



## Novel High-Efficiency Ammonia engine Technology for Heavy Duty marine applications (HEAT-HD)

### Objective
To explore the feasibility of and produce lab-scale demonstrations of various technologies that can be deployed in vessel auxiliary power systems focussed on the use of ammonia as a fuel.

### What was the aim?
To accelerate development across several key aspects of the consortium's technology and market awareness, focusing on the development of an ammonia/hydrogen injector and modification of the Carnot engine, and development of ammonia cracking technology. The team also carried out lifecycle assessment, regulatory compliance and commercialisation research.

### How did it go?
The design, manufacture and testing of an ammonia injector and a hydrogen injector were completed successfully, as was the redesign of the Carnot engine to accommodate changes and improvements. A modified design, build and testing of ammonia cracker technology was also completed, but it proved infeasible to build a storage and gas processing coupling for supply of Hydrogen. Instead, technologies were tested independently.

**Lead:** Carnot

**carnotengines.com**

**Partners:** Brunel University London, Carisbrooke Shipping, De Courcy Alexander, O.S. Energy (UK), Transformational Energy, University Of Southampton

### The next steps
Carnot will be working with partners in upcoming projects to scale the engine toward customer/partner expectations (circa 500kW), with initial design and feasibility work planned for later this year.

Transformational Energy will continue to demonstrate their technology looking to scale up further and commercialise their technology.

# ENTICE: Enhanced Ammonia Cracking to Improve Engine Combustion and Emissions

## Objective
The ENTICE project evaluated the feasibility of novel ammonia cracker technology to radically improve the combustion and emissions of future ammonia fuelled marine engines.

## What was the aim?
To develop a high efficiency cracker with heat exchange to maximise H2 yield via waste exhaust heat without impeding engine performance. Further, to assess the impact of the cracker on engine performance and emissions, evaluate the impact of ammonia cracking on fuel injection equipment, and to assess scalability of the technology.

## How did it go?
A 100% ammonia-fuelled, four-stroke advanced single cylinder research engine and a heavy-duty four-stroke engine were successfully retrofitted with ammonia cracker technology to achieve diesel-like performance across the operating range, with fast combustion and lower emissions via a novel developed engine operating strategy. A  bespoke ammonia cracker reactor enabled in-situ hydrogen production on both engines, allowing complete fossil fuel substitution.

**Lead:** AFC Energy

**afcenergy.com/**

**Partners:** Clean Air Power GT, Mahle Powertrain, University Of Nottingham

## The next steps
The next phase will involve pre-deployment trials of a mono-fuelled ammonia engine generator set, developed as a retrofit solution for current diesel engines. This will overcome proven challenges with green ammonia engine exhaust emissions, including during cold start. Ultimately, the work will allow the UK based partners to undertake immediate future demonstration and commercial exploitation of this key technology, enabling mass adoption of ammonia without reliance on fossil fuel.




# Advanced Zero Emission Analysis Tool

## Objective
To develop software that utilises big data and advanced simulation techniques to develop emission reduction strategies for marine vessels, achieved through technical and operational optimisations.

## What was the aim?
To facilitate professionals in the marine industry in rapidly assessing the environmental and financial impact of replacing current fossil fuels with alternative maritime fuels, fully electric, or hybrid systems, and in optimising operational profiles including speed, route, and tasks schedule. Based on assessment of alternative options, it proposes optimised technical and operational specifications that ensure long-term environmental sustainability and financial feasibility.

## How did it go?
An advanced maritime powertrain simulator and an evolutionary algorithm-driven vessel operational profile optimiser have been developed. A comprehensive database that includes a variety of maritime powertrain specifications, vessel duty cycles and routes for different jobs, as well as the speed-power curve of representative vessels was built to inform the simulation and optimisation, and demonstrates the potential for significant reductions in emission and costs.

**Lead:** Newcastle Marine Services

**ncl-marine.com/azeat-page**

**Partners:** University Of Exeter

## The next steps
The team will continue to develop and market the software across a broader range of vessel types and applications to assess its effectiveness in reduction of emissions, thereby making it more compelling and appealing to customers. The team will also continue to explore additional opportunities for emission reduction opportunities and incorporate them into future software upgrades.

# Highly Efficient Retrofitted Zero Emissions Coaster

## Objective
To offer a modular, innovative, zero-emission solution for existing short sea shipping coasters to provide disruptive technologies for the UK and European short sea fleets.

## What was the aim?
To combine two novel technologies into a package that could be retrofitted to an existing coaster, making the vessel's emissions compliant whilst minimising the financial and technological risks to the Owner. The technologies are a gate rudder system and a modular powertrain running on alternative fuels. These should offset the additional fuel costs by improving efficiency.

## How did it go?
The project presented some challenges and had to deviate from the original specification as the comparison of alternative fuels crystalised. Market analysis and preliminary design and safety investigations led to the team demonstrating that in the medium term, a significant improvement in emissions can be achieved through the complementary powertrain and gate rudder systems. The project has proven that a demonstration vessel is feasible.

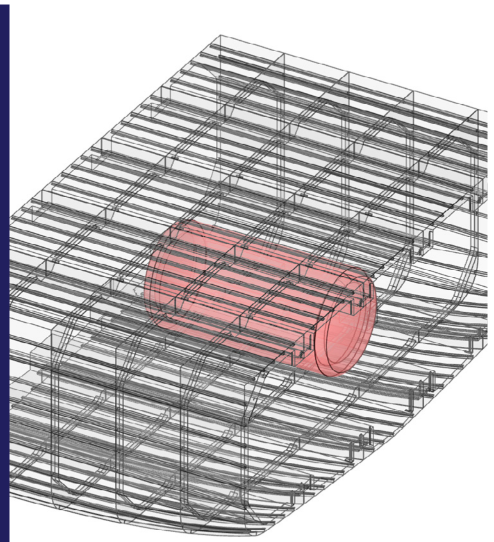
**Lead:** Intrada Ships Management

**intrada.co.uk**

**Partners:** Ecomar Propulsion, University Of Strathclyde

## The next steps
The feasibility project has taken this work as far as it can now, and the next logical step will be a demonstrator. A business case and demonstration plan has been produced which shows how this project can be moved forward.

Although this demonstrator would be at a high TRL, it is shown in our business plan that, with all other things being equal, the system would actually have a payback period of 14 years, compared to a conventional vessel.







# Safe installation and operation of a fuel cell system and hybrid powertrain in offshore CTV

## Objective
To de-risk the implementation of a fuel cell and powertrain system to power a Crew Transfer Vessel (CTV) in compliance with safety requirements.

## What was the aim?
The project aimed to confirm the ventilation and cooling systems design for the CTV fuel cell system and the dispersion behaviour of hydrogen gas, including that from periodic contaminant purging and any unlikely leak points by modelling to be consistent with safe zone 2 operations, to satisfy the requirements for a type approval by Lloyd's register.

## How did it go?
The project has confirmed the sizing of the power management circuitry, motor fuel cell room ventilation for safety and cooling. Gas dispersal modelling has helped confirm fluid handling and ventilation sizing and safe operation of the system.

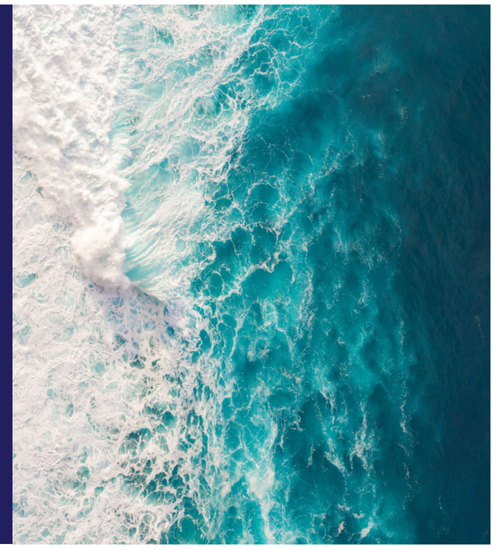
The inductors used in the motor/inverter and DC/DC converter designs have been modelled and their power and thermal performance confirmed via tests with a refinement of component definition for increased efficiency.

**Lead:** Auriga Energy

**auriga-energy.com**

**Partners:** Compound Semiconductor Applications Catapult, Deregallera, Efectis UK/Ireland

## The next steps
A future demonstration project will build, test and confirm the performance of the fuel cell system and powertrain designed in this study project. It will also define a multi-modal project to utilise the port-side fuel generation and refuelling infrastructure for commercial justification/sustainability and de-risk the installation of the port-side refuelling infrastructure, resolving planning and certification issues.



# Powering Small Craft with a Novel Ammonia Engine

## Objective
To prove the feasibility of an innovative, lightweight and compact small-craft engine that can efficiently burn ammonia by virtue of novel engine architecture.

**Lead:** Osprey Research

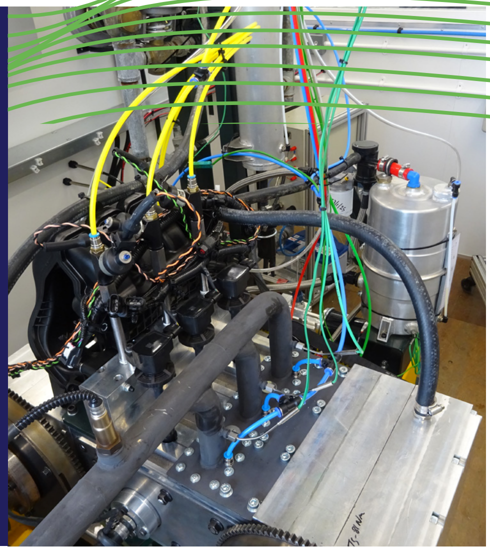
**ospreyresearch.co.uk**

**Partners:** Pascoe International, Southampton Solent University

## What was the aim?
To prove the feasibility of a novel engine design which addresses known technical issues with the use of ammonia as a fuel. The engine and fuel system will be packaged into a representative small craft used for leisure and commercial applications. The hull design for this vessel will be optimised by a theoretical study to maximise its efficiency to offset the potential range and performance penalties incurred by the use of ammonia as a fuel.

## How did it go?
The engine design was successfully created, built and tested. We were able to run the engine at up to 80% ammonia with 20% hydrogen. The engine is approximately 50% smaller and lighter than the engine it would replace. This allowed for the boat installation to be created without any penalty to the weight or utility of the vessel. The hull form study was able to produce an optimised concept which would maximise the boat efficiency through the water.

## The next steps
A second-generation engine will be designed and built. This engine will be tested and optimised for use with ammonia. It will then be installed into a prototype of the proposed new vessel which will be created with a full ammonia fuel system which takes the hazardous nature of the fuel into account. The boat will initially be land tested whilst the regulatory issues about the use of ammonia on the water are explored.







# MORSE – MOFs for Reduction of Ship Emissions

## Objective
The objective is to integrate a compact, high-efficiency filtration module into ships' exhaust to capture carbon dioxide ($CO_2$) on board of ships.

**Lead:** C-MAT Technologies

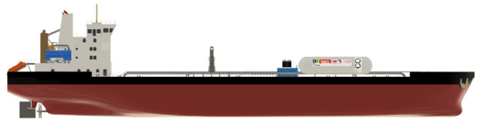
**cmattech.co.uk**

**Partners:** The Natural Environment Research Council, Tope Ocean, University College London

## What was the aim?
In order for the International Maritime Organisation and the UK government to meet their targets of 50% reduction in carbon emissions by 2050, technologies such as MORSE must be developed to reduce maritime carbon emissions. The project aims to design and test an onboard $CO_2$ capture system for maritime vessels, employing solid adsorbents such as metal-organic framework (MOFs) materials with high $CO_2$ adsorption capacities.

## How did it go?
The team have developed a unique and efficient computational screening platform to quickly and efficiently identify promising MOF materials for carbon capture in the pool of 1000s of existing structures. Our proposed process simulations and experimental tests have enabled the design of a system-level carbon capture unit on-board of a ship.

## The next steps
We will integrate a prototype MOF filtration unit into a test engine or equivalent facility, simulating real-world maritime conditions. In the future, periodic regeneration cycles powered by low-grade waste heat will be tested to release the captured $CO_2$ for temporary onboard storage. This process not only achieves high capture efficiency but also avoids the corrosive solvents and high-temperature requirements associated with conventional amine scrubbing systems, making it ideally suited for the constrained and dynamic marine environment.



# Ultra-efficient electric boats

## Objective
To produce electric boats and water taxis that are significantly more energy efficient to increase range and reduce charging times, overcoming the concerns of range-anxiety.

## What was the aim?
To demonstrate the Optima e10 vessel in real-world settings, and to design larger 14m versions of the Optima vessels for leisure use and commercial water-taxis. To enable this, the team also designed and analysed a foil-assistance system to increase speed and efficiency, developed more energy-efficient propellers, and developed and tested a biocide-free marine coating to replace toxic antifoul and reduce drag/increase range.

## How did it go?
This project was very successful and resulted in extensive testing and demonstration of the Optima e10, and the development of designs for future leisure boats and water taxis.

**Lead:** Optima Projects

**optima-yachts.com**

**Partners:** Edwards & Renouf, Fawley Waterside, Seabird Technologies, Teignbridge Propellers International

## The next steps
Optima are in discussions with potential builders and investors to bring vessels to market. This will require some significant investment for tooling and manufacture, in addition to growing the business including taking on new key members of staff.

Optima are also investigating the development of an autonomous version of the e14 water taxi.

# HyCap Drive

## Objective
The HyCap Drive project aimed to build a prototype marine parallel hybrid drive in which the electrical power is provided by a super-capacitor energy store.

## What was the aim?
The HyCap Drive would offer enhanced power density compared with lithium-ion batteries, meaning potentially a smaller weight and volume overhead on the vessel, reduced fire hazards and a lower cost and longer life, as well as being suitable for retrofitting. Achieving this would offer a stronger investment case for decarbonising existing diesel-powered vessels and meeting the net zero commitments of the marine sector.

## How did it go?
Super-capacitors are frequently reported to have very high round-trip efficiency, and this characteristic is important in the use-case where energy is passing into and out of the device at a high cycle rate. Whilst this may be true of the super-capacitor itself, it was found not to be true for the complete super-cap sub-system including the electronic circuits to manage the charging and discharging processes. For these reasons, the prototype drive suffered from serious shortcomings in performance.

**Lead:** Blue Tech Ventures

**mseinternational.org**

**Partners:** Aluminium Marine Consultants, Marine And Industrial Transmissions, UK Harbour Masters Association, University Of Birmingham

## The next steps
Although the HyCap project has successfully demonstrated key aspects of supercapacitor-based hybridisation—particularly high-power density and cyclic load smoothing—the resulting technical and commercial findings indicate limited potential for wide adoption in mainstream marine propulsion, especially for retrofit applications. However, the underlying technology offers promising advantages for niche marine and land-based maritime applications where power density and fire safety outweigh energy density and cost.

# MariLight 2

## Objective

MariLight 2's objective is to transform marine manufacturing with Large Scale Additive Manufacturing, reducing emissions and material use, while improving productivity, certification, and lightweight vessel design.

## What was the aim?

To develop and implement Large Scale Additive Manufacturing (LSAM) technologies to revolutionise the design and fabrication of marine structures. This included reducing vessel weight, improving fuel efficiency, and decreasing emissions without compromising performance. Working closely with industry leaders, MariLight 2 aimed to ensure the new technologies met UK maritime regulatory requirements and set new standards for marine manufacturing.

## How did it go?

The project made significant progress in advancing LSAM technology for marine applications. It successfully demonstrated a 40% weight reduction on a tapping ring using topology optimisation and pre-deployment testing was successful. Regulatory frameworks were developed in collaboration with Lloyd's Register, establishing new standards for additive manufacturing in the maritime industry. While progress has been strong, further validation and certification steps are still underway.

**Lead:** Malin Marine Consultants

**malingroup.com/malin-marine-consultants**

**Partners:** Altair Engineering, BAE Systems Surface Ships, Caley Ocean Systems, Lloyd's Register, NMIS, University Of Strathclyde, Siccar

## The next steps

The team will seek to continue to the next stage of this project with further in-field testing and certification of an optimised LSAM component. The team will focus on scaling production methods and securing full regulatory approval for LSAM technology with more extensive pre-deployment testing. Progress on addressing the skills gap is also a key focus.



# WAVES – Wind and Aquaculture Vessels: Emission less Sailing

## Overview

W.A.V.E.S will demonstrate the technical and economic feasibility of achieving zero-emission operations by an Offshore Service Vessel (OSV), designed for build by UK aluminium shipyards. The vessel will be flexible in its design approach, both for the types of operations as well as the fuel the vessel may carry onboard. This option allows the vessel to be easily retrofitted in the future if a more suitable and/or economical fuel is identified.

The project will investigate innovative ship design ideas and integration with emission-free hybrid drive-train systems to increase overall ship efficiency, reducing the total amount of power required to run the vessel, thus accelerating the transition to zero-emission fuels. In the short term, a dual fuel approach may be used in an innovative engine room configuration, moving with regulatory and technological developments. In the long term, the vessel will be able to operate purely on selected future-fuels and therefore zero-emission.

**Lead:** O.S. Energy

**Partners:** Autonomous Devices, Brunel University, Chartwell Marine, Cummins, Newcastle University

# High Performance Reefable Wingsail Rig Design and Pre-deployment Trial

**Lead:** Oceanic Wingsails

**oceanicwingsails.co.uk**

**Partners:** IDPortal, University Of Southampton

## Objective
Design, develop and construct a practical wingsail prototype including CFD aerodynamic analysis, composite engineering design of mast with masthead crane. Demonstrate and test in a shorebased setting.

## What was the aim?
Design, develop and construct a patented novel practical flapped wingsail prototype for use on a 7.6m trimaran including computational fluid dynamic (CFD) analysis of the aerodynamics, composite engineering design of mast and framing with masthead crane etc. as well as sail hoisting and control system designs suitable for scaling up for future larger vessels, with a higher performance than can be achieved using currently available practical systems. Demonstrate and test the wingsail in a shorebased setting.

## How did it go?
The project proceeded successfully apart from the final testing of the rig which has been delayed due to issues relating to the completion of the removable temporary framing necessary to allow safe raising and lowering of the mast. This is necessary to allow the wing ribs to be placed around the mast for sail testing.

## The next steps
Turn the prototype trimaran into a seagoing vessel suitable for demonstrating the wingsail rig to potential end users and sailmakers, and to demonstrate it to potentially interested parties, initially in the UK and later abroad.



# AirWing Maximised Thrust Wind Propulsion Demonstration

**Lead:** GT Green Technologies

**gtwings.com**

**Partners:** Carisbrooke Shipping, University Of Bristol

## Objective
Build and install a full scale 20m AirWing™ wind assisted propulsion system onto a commercial vessel to demonstrate it can significantly reduce vessel emissions and fuel use.

## What was the aim?
To develop, test, and deploy AirWing™, a novel Wind Assisted Propulsion System designed to enable more vessels to adopt wind propulsion. By using patented boundary layer manipulation, AirWing™ achieves high thrust within a compact footprint, helping vessels—especially those with cluttered decks—reduce carbon emissions and fuel costs by 10–30% for retrofits and up to 50% for new builds.

## How did it go?
The AirWing™ was successfully designed, built, installed and fully approved to BV classification requirements onto the Vectis Progress vessel within the extremely challenging 12 month timescale and has now safely completed two transatlantic crossings. The design comprises both steel and advanced composite materials made in the UK which were then assembled, installed and commissioned within a shipyard in Hull.

## The next steps
Further testing in the coming months will enable AirWing's performance to be optimised across varying wind conditions and validate its design and CFD models, and to identify improvements, cost reductions, and supply chain efficiencies.

Insights from this work are being fed into the design of a more commercially efficient, lower-cost version of AirWing, aimed at preparing for the manufacture and delivery of the first commercial units by the end of 2025.




CMDC4 : Vessel : Wind Propulsion
Clean Maritime Demonstration Competition: Round 4

# Pioneering UK Rotor Sail Technology: 3.5 metre Rotor Sail design and demonstrator

## Objective
To develop and demonstrate a cost-effective, optimised 3.5-metre Rotor Sail to accelerate wind propulsion adoption and reduce emissions and fuel use in the global maritime sector.

## What was the aim?
To develop and validate a compact, cost-effective and optimised 3.5-metre diameter Rotor Sail, enabling significant fuel savings and emissions reductions. Through land-based testing, design development, market analysis, and regulatory study, the project seeks to accelerate adoption of wind propulsion technology, strengthen the UK supply chain, and support the transition to cleaner shipping.

## How did it go?
Prototype testing successfully validated the novel Rotor Sail's design, performance and reliability. Supply chain research, regulatory study and market analysis conclusions provide a strong foundation for continued product development and commercialisation, unlocking significant growth potential for Anemoi and the UK economy.

**Lead:** Anemoi Marine Technologies

**anemoimarine.com**

**Partners:** Connected Places Catapult, Frazer-Nash Consultancy, Victoria Steamship Company

## The next steps
Achieving market entry with the initial 3.5-metre Rotor Sails vessel installation and demonstration alongside growth of the global market share are the immediate next steps. Dissemination of project learnings will support industry adoption and regulatory clarity. Anemoi will continue to refine its existing product line and new innovations through collaborative R&D, further positioning Anemoi as a leader in clean maritime innovation.





# Supercharging Wind Propulsion: Advancing Digital Tools in Maritime

## Objective
This project focused on maximizing the effectiveness of Wind Propulsion Technology (WPT), through furthering accuracy in performance prediction, validation and real world application impacts.

## What was the aim?
To optimise and demonstrate the technical and economic feasibility of Spaera's novel WPT and to improve the accuracy of performance prediction techniques for WPT equipped commercial vessels. Further, to extrapolate out performance prediction across actual journey profiles to deliver real world and lifetime performance capability.

## How did it go?
The project identified significant knock-down effects to the introduction of WPT not currently accounted for, explaining the disparity between promised and delivered performance. Significant progress made in mitigating knock downs with appropriate vessel design, and the Spaera Virtual Model was coded and tested, delivering a wealth of analytical data.

**Lead:** Spaera

**spaera.eco**

**Partners:** Scotline, University Of Southampton

## The next steps
The project identified significant opportunities to further improve and optimize WPT effectiveness through ship design. The most significant contributors include appropriate hull, rudder and propulsor design and balance of these systems to mitigate introduced yaw and leeway effects. The virtual model will be further developed and commercialized to help with multiple decarbonization investigations and net-zero ship development.

# ZETour

## Objective
To deliver a first of its kind battery-electric tourist vessel operating in central London. Designed to enhance visitor experience while supporting net-zero and clean air goals.

**Lead:** Tower Cruises

**toweroflondonrivertour.com**

**Partners:** Aqua Superpower, Pendennis Plus, Woods River Cruises

## What was the aim?
ZETour aimed to demonstrate how battery electric propulsion can meet the commercial and operational requirements of a high duty cycle tourist vessel through an innovative lightweight vessel design and propulsion system that meets MCA requirements. The solution would be demonstrated alongside a battery-backed charging solution and deliver a 2-week commercial demonstration on the Thames with up to 2000 passengers per day.

## How did it go?
ZETour highlights the excellence of UK shipbuilding and successfully delivered the 'Silver Raven', the first large electric tourist vessel. Technology advancements were achieved in the development of lightweight craft, making electrification viable for commercial operations. The solution gained significant commercial interest, and Woods partnered with Historic Royal Palaces to create the Tower of London River Tour.

## The next steps
The next steps for ZETour are to launch a commercial zero-emission boat tour from Tower Bridge Quay, offering reduced noise, pollution, and an enhanced visitor experience. This operation will showcase the potential for wider adoption nationally and internationally. Partners aim to establish a long-term charging solution at Tower Bridge Quay to support reliable electric services, requiring additional funding to implement infrastructure designs developed during the ZETour project.





# Smart Shore Power System with Intelligent Energy Storage and Management

## Objective
To install a smart and predictively controlled 415V shore connection capable of supplying vessel, supporting wharf operations, utilising renewables and exporting to grid.

**Lead:** Cemex

**cemex.co.uk**

**Partners:** Iconsys, University Of Warwick

## What was the aim?
To develop a shore power energy delivery system, incorporating Battery Energy Storage and solar energy generation, capable of meeting the electrical requirements of our vessel while berthed. The system will also be utilised for partially delivering power to land-side processing equipment, and further, to understand potential benefits from additional revenue through supporting the grid with stored energy when not required for our operations.

## How did it go?
All partners built upon a good relationship from CMDC2 and worked collaboratively throughout the duration of the project to generate a real-world technical solution, a smart Advanced Predictive Controller, working HiL model, and enabling realisation of benefits from various scenarios covering the operation of the vessel and site. Thanks to all partners sharing a clear objective, we have been able to deliver on all our projected outputs.

## The next steps
The successful delivery of the smart shore power system has validated the technical feasibility and laid a robust foundation for commercial developments for all partners. While the scale of these will be shaped by market dynamics and the regulatory environment, the demonstrator has provided clarity and confidence to move forward with scoping further development and deployment.

# Cammell Laird Green Shore Power Project

## Objective
The national grid is progressing to zero emissions. The ability to connect this power to ships in port provides a solution to in-port emissions.

## What was the aim?
To develop a Shore Power solution that is both mobile and can be utilised across different vessel types in different locations to realise immediate tangible benefits, including 15,000T/year $CO_2$ reduction, new jobs, and new apprenticeships. By the installation of 5 bespoke containerised power distribution systems consisting of the provision of a 6.6Kv 50 Hz HV supply through a transformer / inverter giving output voltages of 60Hz between 380, 440v & 690v respectively around the Dockyard.

## How did it go?
The project, which was delivered to schedule, has afforded Cammell Laird the ability to offer shore power across a range of commercial / UK MOD vessels for both ship repair and other port-related activities, with Project partners and support organisations working incredibly well together to deliver the project benefits. The migration to a mobile shore power solution in lieu of a fixed solution further enhanced the project without adding any disruption to the schedule.

**Lead:** Cammell Laird Shiprepairers & Shipbuilders

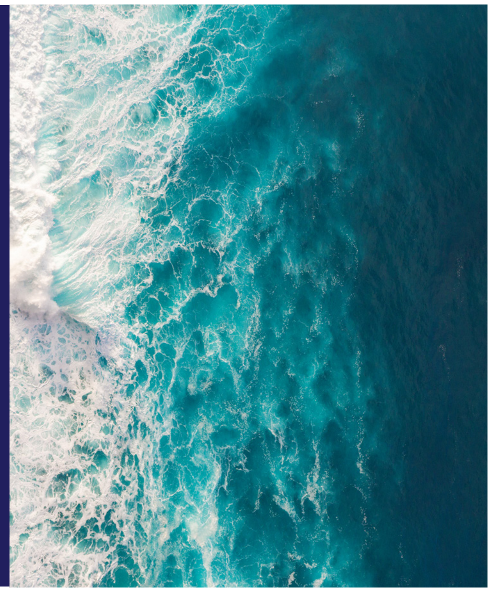
**cammell-laird.co.uk**

**Partners:** Integrum Power Engineering

CAMMELL LAIRD

INTEGRUM POWER ENGINEERING

## The next steps
Following a successful demonstration, this project will now allow us to maximise our occupancy and win higher value work. Through exploitation of our new capability our estimate is a 40% increase in turnover. The Cammell Laird dockyard facilities are now more attractive to high value operators such as cruise lines. Before this project green shore power was almost non-existent in dockyard sites, being first to market is critical in exploiting this market as a leader.







# Future FOW Installation Vessel (FFIV)

## Objective
The overall objective of the Future FOW Installation Vessel (FFIV) project was to evaluate the technical and economic feasibility of a new class of low-carbon FOW installation vessel.

## What was the aim?
The project aim was to use a bottom-up evaluation of FOW installation operations to design (to concept stage) a dedicated, low-carbon vessel with specification and performance tightly linked to user operational requirements – this contrasts with the status quo where generalised, multi-purpose vessels such as Anchor Handler Tug Supply Vessels (AHTSVs).

**Lead:** Morek Engineering

**morek.co.uk**

**Partners:** Celtic Sea Power, First Marine Solutions, Solis Marine Engineering,

Tope Ocean

MOREK

FMS FIRST MARINE SOLUTIONS

TOPE OCEAN

SOLIS MARINE ENGINEERING

CELTICSEAPOWER

## The next steps
The project delivered against the above overall objective and initial work scope, finishing on time and 10% under budget. Through consultation with end users, the project team focussed on the FOW installation task of synthetic mooring line installation. The concept design developed carries up to 5 times as much mooring line as a typical general purpose installation vessel and performs the same tasks with low-carbon methanol fuel, delivering up to 2.5% (absolute) increase in internal rate of return compared to a new build AHTSV.

# Techno-economic Feasibility Study of ClimaHtech innovative clean maritime solutions

## Objective

This project investigated the potential of CATAGEN's ClimaHtech clean fuel production technology to produce fuels that could significantly decarbonise UK maritime activities.

## What was the aim?

The study aimed to complete a techno-economic feasibility study to define the benefits and challenges to producing bio/e-fuel using ClimaHtech technology and direct air capture (DAC) technology to decarbonise marine fuel demand with continued use of existing fuel infrastructure.

## How did it go?

The project has determined two sites, one in Belfast and one in Orkney, that would be suitable for a First of a Kind (FOAK) Project to produce sustainable fuels in a distributed way that enables better use of variable renewable energy generation.

The techno-economics of the process, whilst challenging, do present opportunities to decarbonise, not only for the marine sector, but also for other hard to abate industries such as aviation.

**Lead:** Catagen

**catagen.com/clean-maritime-demonstrator-competition**

**Partners:** Belfast Harbour Commissioners, Highland Fuels, Orkney Islands Council, The European Marine Energy Centre

## The next steps

The next step for the project is initiation of a pre-Front End Engineering Design (pre- FEED) study, followed by a FEED study, and subsequent deployment of a FOAK project at one of the suitable sites identified in this study.





# An innovative hybrid infrastructure system delivering both electric and hydrogen for vessel fast charging/refuelling using off grid renewable energy and onsite wastewater

## Overview

In the transition to low carbon shipping, multiple low carbon fuels are currently being investigated. It is likely that in the future different fuel types will be used by ships depending on their operational requirements, such as voyage duration or cargo being carried. This poses a difficulty for port operators in the development of infrastructure which can supply multiple different fuel types to ships, representing significant investments for infrastructure which is often very case specific.

Two technologies currently being developed extensively are electric and hydrogen vessels, with electric focussing on short 'green corridor' trips, and hydrogen for supplying longer duration trips. Electrical grid connections are currently very difficult to develop due to National Grid constraints, which poses a difficulty not only for electric vessel charging.

Within this project, the collaboration team of HydroStar, Waterwhelm and London South Bank University will develop an innovative infrastructure system which can deliver both electrical and hydrogen vessel fast charging/refuelling in a hybrid system using off grid renewable energy and onsite wastewater. This enables ports to develop their low carbon infrastructure to supply both fuel types from a holistic standpoint.

**Lead:** Hydrostar Europe

**Partners:** London South Bank University, Waterwhelm

# PALM Charger

**Lead:** Apollo Engineering Consultants

**apollo.engineer**

**Partners:** Leask Marine, The European Marine Energy Centre

## Objective
To develop and demonstrate the PALM Charger, enabling offshore wind support vessels to charge efficiently, reducing emissions and supporting offshore electrification.

## What was the aim?
To adapt the existing PALM prototype for offshore vessel charging, validating its mechanical and electrical performance through offshore trials. The goal was to create a reliable, repeatable, and safe offshore charging solution that extends the range and operational capability of battery-powered vessels to be used in the offshore wind arrays.
A further objective was to develop a commercial design, exploring commercial viability and engaging stakeholders to support future deployments.

## How did it go?
The project successfully demonstrated the PALM Charger's ability to provide safe and reliable offshore charging. Field trials verified mechanical integrity and electrical power transfer. The PALM Charger is considered to have reached TRL 4 as an electrical charging system and TRL 6 as a mechanical device, laying the groundwork for future development. Following learnings from the trial, a commercial design has been developed into early engineering and design.

## The next steps
The system will be refined for full-scale deployment, securing third-party certification, and forming industry partnerships. A roadmap sets out to progress the system from TRL 4/6 to TRL 9, with full-scale certification targeted for 2027 and a pilot deployment planned for 2028. Continued stakeholder engagement and commercialisation efforts will support widespread adoption by 2030, ensuring the PALM Charger contributes to decarbonising offshore wind support operations.



CMDC4 : Infrastructure : Charging
Clean Maritime Demonstration Competition: Round 4

# Technical and operational requirements for the integration of charging infrastructure

**Lead:** London Offshore Consultants

**abl-group.com**

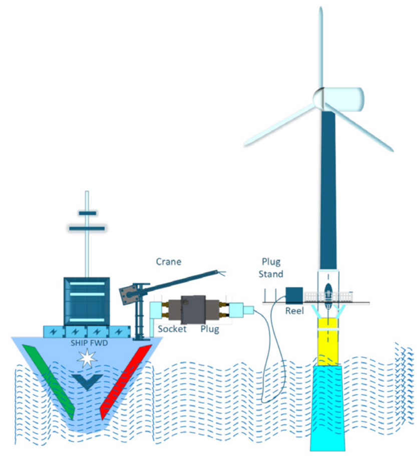
**Partners:** Bibby Marine Services, Offshore Renewable Energy Catapult

## Objective
To understand the technical and operational challenges to implement offshore charging of vessels and the risks it poses.

## What was the aim?
To understand the challenges in designing charging systems capable of providing power to a charge battery energy storage systems installed on Service Operations Vessel (SOV) from an offshore wind farm. This is a newly emerging technology where several OEMs are developing solutions, however challenges remain in understanding the integration of the technology as well as operational and risk factors of implementation.

## How did it go?
The objectives of the project have been met. Calculations and modelling of the electrical system has been completed along with specification required for such systems. Operational procedures and training requirements for vessels utilising offshore charging were developed. A high level review of the risks associated with conducting offshore charging operations has been completed with mitigation actions identified to mitigate these risks.

## The next steps
The consortium are keen to push ahead with further projects with the goal of completing a demonstration of offshore charging at power levels appropriate for a SOV. In the short term a design and shoreside demonstration of am SOV scale charging system is being considered where an offshore demonstration is the eventual goal.



# Virtual Bunkering for Electric Vessels (VBEV) Demo

## Objective
The Virtual Bunkering for Electric Vessels (VBEV) set out to prove the technical viability of vessel-to-everything (V2X) in the maritime sector.

## What was the aim?
To provide a real-world demonstration of bi-directional charging technology for the maritime sector. This involves being able to charge an electric vessel, and when it is not in use, to discharge energy from the battery. This energy is then used to support the power grid (vessel-to-grid) or to support marinas, harbours and ports (vessel-to-building). VBEV aimed to identify the benefits to the maritime sector and route to wide-scale deployment.

## How did it go?
VBEV achieved the first UK demonstration of vessel-to-grid. The highly collaborative project resulted in the RS Electric vessel being able to discharge energy from the battery when the vessel was not in use, into the University of Plymouth Marine Station building and the local grid network. This was achieved through the deployment of bi-directional infrastructure, development of a V2X software platform, battery and compatibility testing.

**Lead:** Aqua Superpower

**aqua-superpower.com**

**Partners:** Cenex (Centre Of Excellence For Low Carbon And Fuel Cell Technologies), City College Plymouth, EDF Energy R&D UK Centre, Fuuse, H.Taylor & Son (Brockley), Ingenity Electric, University Of Plymouth

## The next steps
Building upon the success of VBEV, there is a need to address key learnings. There needs to be greater data collection from vessels to inform their suitability for V2X and educate business models. Further battery testing is required to understand the impact on battery health. Greater alignment of the supply chain is required to ensure compatibility between chargers and vessels. Finally, more long-term demonstrations are required across a range of vessels, battery chemistries and locations.





# Cold-ironing buoy

## Objective
Using Kirkwall as a case study for a pilot demonstration, the consortium is developing a cold-ironing buoy solution to bring onshore power supply to anchorages.

## What was the aim?
This project aims to develop the concept design of the solution into Front-End Engineering Design. This will allow the team to carry out a techno-socioeconomical feasibility of the concept by using Kirkwall as potential project site.

## How did it go?
The feasibility study was completed successfully within the project timeline, with all the objectives achieved. It was determined that the concept is feasible for execution but will be largely dependent on the availability of sufficient public funding. It was found that shorepower will not be commercially competitive against traditional marine fuel used by vessels in the UK, largely due to the high electricity prices. The project garnered mostly support and interest from stakeholders consulted.

**Lead:** Orcades Marine Management Consultants

**orcadesmarine.co.uk**

**Partners:** Aquatera, GAC Services (UK), Orkney Islands Council, Schneider Electric

## The next steps
Public version of the final report will be distributed to key stakeholders. The consortium intends to continue technology development and towards a pilot demonstration at Orkney in parallel. The technology will undergo Detailed Engineering Design next, while the pilot demonstration will require funding and financing to be secured, as well as a detailed business plan. The team has identified additional key partners and are in discussions to collaborate/partner with them officially for future phases.

# Net Zero Ports of the Future: Demonstrating the Integration of Green Hydrogen Shore Power with Water Reuse

**Lead:** Waterwhelm

**waterwhelm.com**

**Partners:** Logan Energy, Pluszero Power, Targe Towing

## Objective

To show how new innovation could sustainably produce hydrogen for use towards decarbonisation at a UK port.

## What was the aim?

To deliver a state-of-the-art demonstrator system at the Port of Leith for production, storage and utilisation of green hydrogen to supply green shore power for vessels at berth. Waterwhelm supplied re-cycled water to a Logan Energy electrolyser who then supplied the hydrogen to PlusZero Power's hydrogen internal combustion engine (HICE). The on-demand electricity produced was used by Targe Towing Limited's tugboats at the port.

## How did it go?

With Forth Ports support, the project successfully demonstrated the sustainable production of hydrogen for use and potential distribution at UK ports. This has the impact of supporting the hydrogen economy, decarbonisation and improving the working environment for workers at ports. The project included a full review on UK H&S hydrogen legislation that can be used at other UK ports.

## The next steps

The next steps are system scale-up at the Port of Leith for larger scale hydrogen production and use. This would shift from simulated waste heat to waste heat from the hydrogen production process and a larger capacity electrolyser supplying HICE for increased shore power. Forth Port's has ambitions to use hydrogen for on-demand shore power and to power vehicles at port, driving decarbonisation of the maritime sector.



# S-TGG: A novel Tidal Gravity Generator for renewable shoreside energy in ports and harbours

**Lead:** Sunborn Energy

**sunbornenergy.com**

**Partners:** Imperial College London

## Objective

To evaluate the feasibility of a novel tidal energy innovation, for shoreside renewable energy generation in ports and harbours.

## What was the aim?

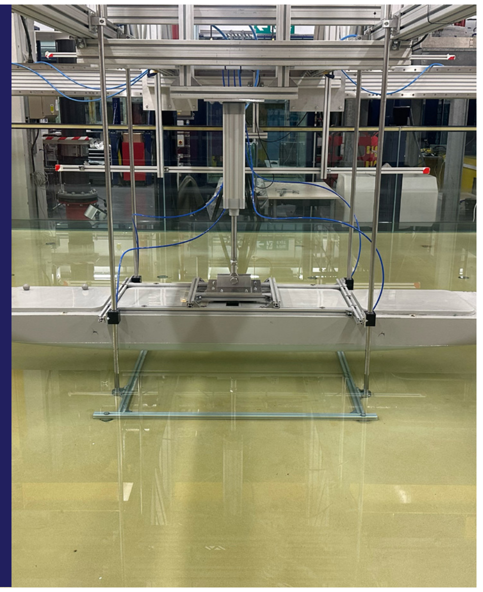
To design and develop a mechanical and technically feasible Tidal Gravity Generator, test and define the optimum energy harvesting system, understand and validate the energy potential of the technology, and establish its technical suitability for its operation in a port or harbour environment.

## How did it go?

The project and work packages were completed successfully as planned, with key stages of design development completed, including conceptual and detailed designs, risk analysis, lab validation and prototype testing. A UK patent application was submitted, environmental feasibility and legal and regulatory research reports prepared, commercial, technical and competitor research completed. Initial contacts were made with manufacturers, and cost estimates prepared for two commercial deployment formats, providing commercial insight for future development and market entry.

## The next steps

We will complete a review of this study and prepare an innovation development plan to identify design weaknesses, lessons learnt and areas where we could further develop the tidal generator design, improve power output performance and commercial feasibility. With a lab validated new technology and R&D partners needed to move forward we aim to raise funding to make critical design improvements and complete development work in collaboration with specialist manufacturers.



# Shoreside Power from Optimised Hydrogen Lifecycle (SPOHL)

## Objective
To explore the feasibility of and produce lab-scale demonstrations of various technologies that can be deployed in a hydrogen lifecycle to support port energy demands through cold-ironing facilities.

## What was the aim?
A primary focus was engine development, including development of a high pressure injector. The project also focused on developing understanding of hydrogen infrastructure requirements, including Energy Vector Analyser (EVA) MOF Hydrogen Storage and renewable electricity conversion to Hydrogen.

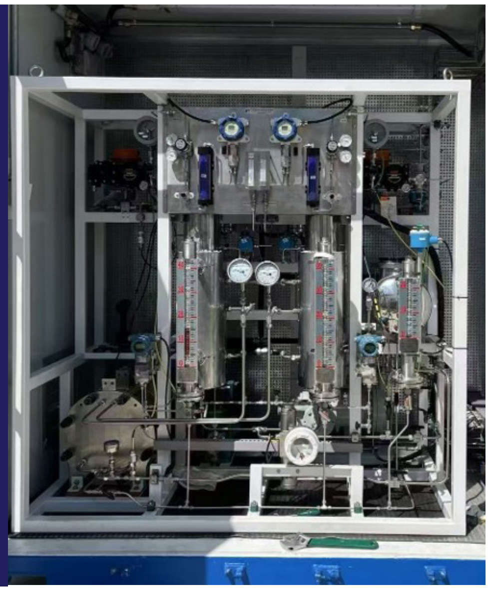
## How did it go?
The project was successful, with both engine development and infrastructure streams completed. The Carnot engine was redesigned and modified to accommodate the higher-pressure (160 bar) hydrogen injector, the MOF hydrogen storage was developed, built and tested, and hydrogen conversion was demonstrated with high efficiency. In demonstration, the EVA was effective, but is not yet sufficiently fast for commercial deployment.

**Lead:** Carnot

**carnotengines.com**

**Partners:** Brunel University London, Carisbrooke Shipping, Clean Air Power GT, Cranfield University, Freeport East, Hydrogen Waves, Rux Energy UK, Swanbarton, The Manufacturing Technology Centre

## The next steps
The team will continue to build on the success of the project. Carnot will be working with Clean Air Power in upcoming projects to test and scale the engine and amount of hydrogen consumed. Rux will continue to develop their hydrogen storage technology and production capacity looking towards commercial deployment, and Swanbarton and Brunel will continue to develop the EVA, to streamline the back-end code and usability looking toward commercial deployment in 2026.







# Free-Piston Engine Generator for Cold-Ironing in UK Ports

## Objective
To demonstrate the feasibility of a mobile, fuel-flexible Free-Piston Engine Generator (FPEG) as a clean shore power source for UK ports.

## What was the aim?
The aim was to develop a 120kW free-piston engine generator with high fuel flexibility and demonstrate its technical viability for cold ironing applications. The project focused on reducing emissions from berthed vessels and providing a scalable, mobile alternative to costly grid-based infrastructure.

## How did it go?
The team successfully designed, assembled and commissioned the FPEG prototype with testing now underway and likely to continue for many months. We have also completed detailed simulations across multiple fuels, and prepared the control system architecture for modular deployment. Industrial partners validated the port-side integration pathway. The project confirmed TRL 6 was achieved, and emissions modelling showed significant reduction potential.

**Lead:** H2CHP

**h2chp.co.uk**

**Partners:** Durham University, PD Teesport, pH3 Capital

## The next steps
The project will now transition into an operational demonstration, scaling the generator to 250kW (achieved by increasing from two to four FPEG cylinders) and integrating with real port infrastructure. Key regulatory pathways will be formalised and vessel interfacing trials completed. The full demonstration will enable TRL 7 validation and unlock commercial deployment opportunities in UK and international ports

# NI/GB Green Maritime Corridor

**Lead:** B9 Energy Storage

**b9energy.co.uk**

**Partners:** DFDS Logistics, DFDS Seaways, JG Maritime Solutions, Larne Harbour, Mutual Energy, Teesside University

## Objective

To assess the feasibility of a zero emission green shipping corridor between Northern Ireland and Northwest England, powered by renewable green methanol, integrating hydrogen fuel cells and onboard carbon capture and recycling.

## What was the aim?

To define, evaluate, and demonstrate a zero-emission maritime energy system and corridor between Northern Ireland and Great Britain. This included using green hydrogen to synthesise methanol, transporting it to ships, reforming it onboard into hydrogen for power generation, and capturing the resulting $CO_2$ for reuse in a Carbon Loop.

## How did it go?

The project successfully delivered a detailed feasibility study, system design, techno-economic model, regulatory review, and real-world trial at Larne Harbour. The trial validated methanol reforming and hydrogen fuel cell integration for electric vehicle charging, proving concept viability. While some technical challenges remain, the core concept of renewable methanol as a maritime fuel with a Carbon Loop was validated.

## The next steps

Next steps include scaling the system for onboard marine deployment and completing full end-to-end demonstration using green methanol and closed-loop $CO_2$ capture. Stakeholder engagement will focus on securing policy alignment, regulatory certification, and investment for commercial deployment. B9 Energy Storage and partners will continue developing the larger scale Ulster Hydrogen Valley and exploring international collaborations to deliver zero-emission shipping solutions.




# Clean Maritime Demonstration Competition 5:

# International Green Corridors Fund

# Greening the Irish Sea – The Central Corridor

## Objective
To assess the feasibility of transitioning the Holyhead–Dublin maritime route into a Green Shipping Corridor using methanol-fuelled ferries and onshore power supply.

## What was the aim?
To develop a robust, practical plan to decarbonise the high-traffic Holyhead–Dublin ferry corridor. It assessed technical, economic, regulatory, and environmental aspects of switching to methanol fuel and onshore power. The study compared alternative fuels, retrofitting options, and infrastructure requirements, providing a replicable roadmap for green maritime transition.

## How did it go?
The study confirmed that methanol is the most feasible fuel option, enabling 70–80% emissions reductions compared to fossil fuels. Onshore Power Supply (OPS) further enhances decarbonisation and aligns with EU regulations. The corridor can deliver meaningful environmental benefits, though economic support is needed to close the cost gap versus business-as-usual.

**Lead:** Stena Line Ports

**ricardo.com**

**Partners:** Dublin Port Company, EDF Energy R&D UK Centre, Irish Ferries, Maynooth University, Ricardo-AEA, Stena Line bv

Stena Line

RICARDO

Maynooth University
National University of Ireland Maynooth

Irish Ferries

eDF ENERGY

CALAFORT ÁTHA CLIATH
DUBLIN PORT

## The next steps
Next steps could include securing funding to retrofit vessels and deploy OPS and methanol bunkering infrastructure, particularly at Holyhead. Key actions involve engaging with regulatory bodies, advancing fuel procurement strategies, and coordinating retrofit and infrastructure timelines. The project consortium will also explore opportunities to replicate this model on other short-sea RoPax routes in the UK and Europe.







# Green North Sea Shipping Corridor

## Objective
To assess the feasibility of establishing a Green Shipping Corridor between the Port of Tyne (UK) and the Port of Ijmuiden (Netherlands), focusing on methanol as the preferred alternative fuel and the use of Onshore Power Supply (OPS) to reduce emissions.

## What was the aim?
To identify and evaluate the technical, economic, regulatory, and environmental implications of decarbonising ferry operations on the Tyne–IJmuiden route. It considered vessel readiness, port infrastructure, fuel sourcing pathways, and emissions reduction potential, as well as the additional economic cost a green corridor would have over business-as-usual operation.

## How did it go?
The study found that methanol represents a viable long-term fuel solution for the corridor, offering substantial well-to-wake emissions reductions, up to 80% in the most favourable scenarios using e-methanol. OPS was shown to provide significant additional savings during berthing. The analysis highlighted the strategic fit of both ports for early adoption, although infrastructure development will require targeted investment and coordination. The corridor demonstrates high potential for near-term implementation, with long-term value dependent on policy support and fuel availability.

**Lead:** Port of Tyne Authority

**ricardo.com**

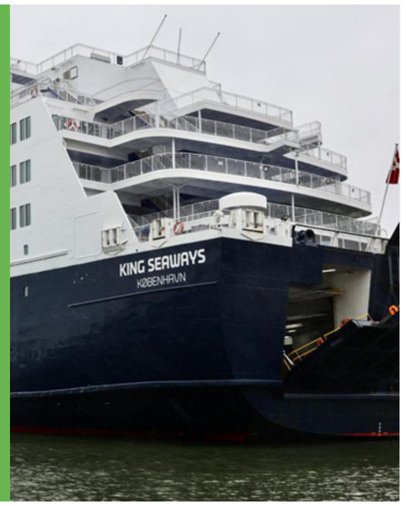
**Partners:** Ricardo-AEA

PORT OF TYNE

RICARDO

Zeehaven IJmuiden NV

## The next steps
Key actions include finalising vessel design and construction, fuel supply options, and identifying funding mechanisms to support OPS deployment and methanol bunkering infrastructure. Stakeholder coordination across port authorities, ferry operators, and fuel providers will be essential. Lessons learned will inform future corridor development across the North Sea region and support national decarbonisation objectives.



# Smart Shipping Acceleration Fund

## New Tools to Support Just In Time Arrivals at Ports, Reducing Costs and GHG Emissions

### Objective
To develop machine learning models to predict vessel turnaround times and optimise port workforce allocation, reducing emissions, delays, and costs at UK ports.

### What was the aim?
To analyse historical vessel and labour data to build predictive models that estimate vessel turnaround times. This would support Just-In-Time (JIT) port operations by enabling better workforce planning and operational efficiency. The model would be integrated into Ensemble's Athena platform to provide smarter scheduling capabilities at ABP and other UK ports.

### How did it go?
We successfully cleaned and merged complex vessel and labour datasets, trained machine learning models (CatBoost), and validated a prototype capable of explaining 70% of the variance in turnaround times. The project demonstrated that turnaround is driven primarily by cargo type, vessel size, and workforce deployment. Key insights are now being embedded into Athena for real-time operational use.

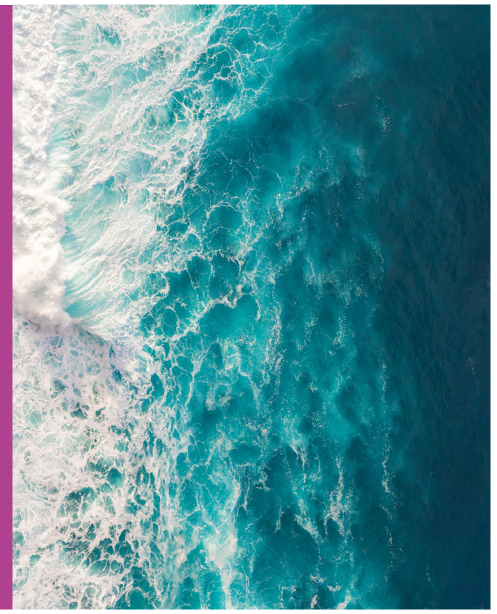
**Lead:** Ensemble Analytics

**ensembleanalytics.co.uk**

**Partners:** Associated British Ports

### The next steps
We will deploy the model within the Athena platform at other ABP ports, and extend testing with Bristol Port. This will include real-time validation, continuous retraining with new data, and the development of an interface for 3rd-party labour providers.

Commercial rollout is expected in 2025, supporting wider JIT adoption. We are also planning to license predictive insights to JIT and route-optimisation providers.



# Project Sunflower

## Objective

To assess the technical, operational, and regulatory feasibility of deploying autonomous terminal tractors (ATTs) in regional ports and determine the potential emission savings and other benefits.

## What was the aim?

To evaluate the potential of ATTs in a regional port environment to reduce GHG emissions reduction by retrofitting existing vehicles, assess infrastructure and system readiness, and identify regulatory, operational, and safety considerations. In the course of evaluating the outcomes of GHG emissions, the study sought to identify the key criteria for full autonomous deployment while laying the groundwork for future commercial trials, insurance engagement, and full integration with Belfast Container Terminal.

## How did it go?

The feasibility study identified key technical specification required of terminal tractors to efficiently deploy autonomous solutions as well as identifying key infrastructure and operational requirements. Time constraints prevented full integration with port systems and live trials, however the project delivered a clear deployment blueprint, regulatory and insurance considerations, and confirmed strong potential for autonomous operations in ports. It set the foundation for future project phase.

**Lead:** Belfast Harbour Commissioners

**belfast-harbour.co.uk**

**Partners:** Aidrivers, Belfast Container Terminal (BCT)

## The next steps

The next steps include selecting newer terminal tractors for improved system integration, initiating live trials at Belfast Container Terminal with full system integration. This will involve validating autonomous operations during off-peak hours without safety drivers, refining insurance and regulatory pathways, and engaging with stakeholders for deployment planning.





# Clean Water Charging System (CWCH)

## Objective

To develop an efficient, low-emission hydrogen-based energy solution for poor-grid electric vessel charging and other port power needs.

## What was the aim?

To develop a decentralised power solution utilising hydrogen to boost available electrical power with higher efficiency, lower cost, and a reduced footprint compared to conventional hydrogen fuel cells. The solution is designed to enable electrification in rural ports where upgrading grid infrastructure is uneconomical and where additional investment in rapid charging infrastructure would otherwise be unviable.

## How did it go?

The project successfully developed and validated a method for enabling vessel charging in rural ports, delivering insights into technical feasibility, economic viability, emissions reduction, and regulatory compliance. The solution's cost and efficiency benefits have been safeguarded through a pending patent, and the project secured interest from ports for future demonstrations. These outcomes confirm the technical readiness and commercial potential of the system for near-term deployment.

**Lead:** Hixal

**hixal.net**

**Partners:** O.S. Energy (UK), University Of Warwick

## The next steps

Next steps include the build and testing of a full-scale prototype, using the validated designs developed during this project. Testing will refine the software controls and validate performance against regulatory and safety requirements. Demonstration plans at St George's Pier and Rochester are underway, alongside industry collaboration for manufacturing scale-up. These will pave the way for commercial rollout and early adoption across the UK's rural port network.

# Green Haven Digital Twin (GHDT)

**Lead:** Entopy

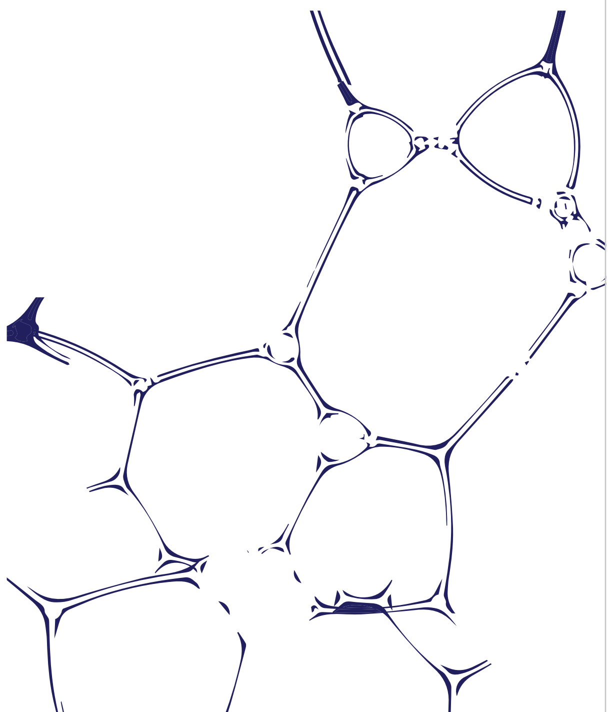
**entopy.com**

**Partners:** Harwich Haven Authority

## Objective
To deliver predictive and simulative intelligence to stakeholders involved in the operation of berthing vessels at the Port of Felixstowe to identify and mitigate future constraints to reduce port congestion.

## What was the aim?
To extend current Digital Twin to include aspects of the port terminal operation and berth plan, and to test dynamic communications with vessel operators to optimise vessel arrival time. This would help prove the technology's capability to increase vessel arrivals, increasing revenues for the port and its partners; improve service levels offered to vessel operators, including reducing vessel waiting times; and optimise vessel steaming speeds to reduce greenhouse gas emissions.

## How did it go?
The project was successful and the Partners were able to achieve both objectives. The Digital Twin has been developed extensively with a controlled release allowing Partner access throughout the trial. This has allowed extensive testing of model accuracy, feedback and development. The feasibility assessment for dynamic vessel communications has been limited due to commercial sensitivities, however the trial has allowed the Partners to ascertain the potential impact which will inform further development and support a future demonstrator.









# Smart Renewable Energy Generation, Recharging and Maintenance Technology (SMARTGEN)

**Lead:** Taurus Engineering

**tauruseng.co.uk**

**Partners:** Aceon Battery Solar Technology, Newcastle University, Offshore Renewable Energy Catapult, University Of Liverpool

## Objective
To assess the feasibility of a modular wave-powered electric charging system using second-life batteries for coastal vessel electrification across marinas and green corridors.

## What was the aim?
To evaluate the technical and commercial feasibility of a clean, off-grid charging solution powered by wave energy and second-life batteries to support the decarbonisation of small and medium vessels by enabling affordable, scalable electrification at marina locations. The study included simulation, environmental modelling, and partial physical deployment to validate system design, integration pathways, and lifecycle performance under realistic coastal conditions.

## How did it go?
The project exceeded feasibility-stage expectations by successfully deploying a partial system at South Shields Marina, allowing early data capture and real-world validation. Extensive modelling was completed on wave capture, energy conversion, and life cycle emissions. Field installations, camera monitoring, and network-connected systems were set up, and significant industry interest has emerged.

## The next steps
The consortium plans to advance to a full demonstration phase, refining the SMARTGEN system for scale-up and deployment at other UK coastal sites. Partner discussions are underway with UK marina operators, international stakeholders, and port infrastructure firms to gain interest in the SMARTGEN technology more widely and demonstrate environmental and economic benefits in live vessel applications.

# IntelliSense.io: decarbonising ports with POP – a digital twin Port Optimisation Platform for dryside operations

**Lead:** Intellisense.io

**IntelliSense.io**

**Partners:** Associated British Ports

## Objective

To develop and demonstrate a digital twin Port Optimisation Platform to reduce energy consumption and emissions in dryside port operations using Artificial Intelligence (AI).

## What was the aim?

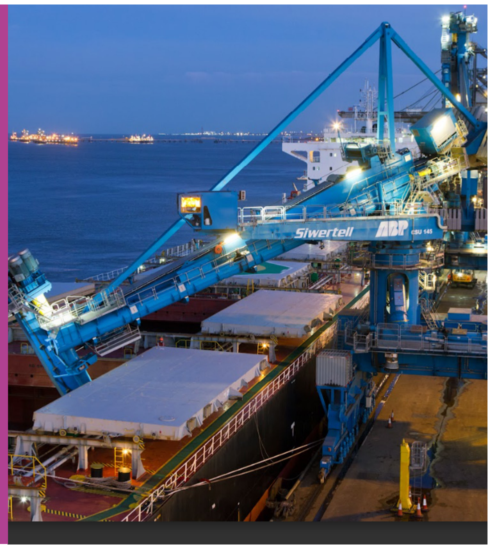
To integrate AI into port operations at the Humber International Terminal to optimise dryside processes and reduce the carbon footprint of port activities through data-driven insights and smart technologies. This involved creating a digital twin to simulate and analyse operations, identify energy-saving opportunities, and develop proof-of-concept applications.

## How did it go?

The project successfully developed a digital twin of the port and built key proof-of-concept applications, including 'Smart Shutdown' and 'Staff Planning' to optimise operations. Significant progress was made in advancing the technology and commercial readiness of the Port Digital Twin and Smart Berthing initiatives. The project also provided valuable insights into potential emissions reductions and economic benefits through detailed analysis and modelling.

## The next steps

Further development will focus on integrating the digital twin with more port systems and expanding its scope to include areas like energy-aware planning, material tracking, and predictive maintenance. A demonstration project for 'Smart Berthing' with UK regulatory bodies is also recommended. These steps aim to move the technology to full operational deployment and replicate its success at other ports.








# Marine Terminal Energy Independence – Solar / Hydrogen Feasibility Study

**Lead:** Scotline Terminal

**scotline.co.uk/transit**

**Partners:** Rhizome Energy, University Of Kent

## Objective

To evaluate energy independence on a marine terminal using renewable energy stored as hydrogen through a techno-economic feasibility study.

## What was the aim?

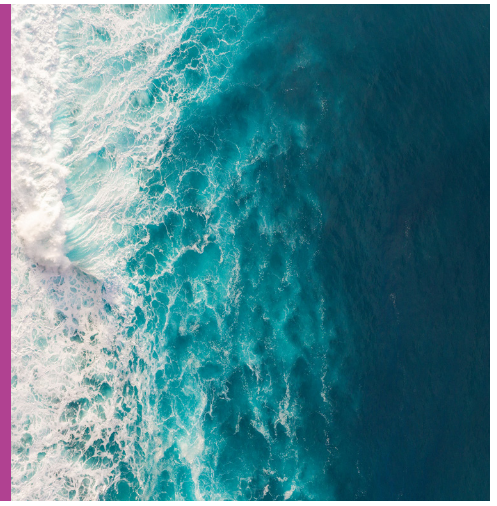
Ports often struggle with limited grid based electrical supplies and rapidly increasing energy demand associated with decarbonisation. We planned to develop a generic tool that compares granular energy demand profiles of any marine terminal (or other manufacturing location) with potential energy yield from onsite renewables. The tool can then scope a customised and optimised semi-independent microgrid using combination hydrogen / battery as a storage capacity to meet facility demand.

## How did it go?

All data relating to energy demand and supply were collected and the optimisation tool was developed and implemented within a user-friendly and interactive decision support software. Results allowed the identification of multiple viable decarbonisation pathways by implementing hydrogen powered machinery within the current business-as-usual energy costs.

## The next steps

Using the tool to generate workable solutions for multiple locations, it was quickly established that emission optimised (full renewable) solutions are unlikely to be adopted without external funding. Partial solutions are competitive and regular review of calculations will allow facilities to maximise available investment and / or local funding initiatives to generate emissions reductions.



# Project BlueWater: Multi-use drones for emissions monitoring, logistics delivery & data collection in ports

## Objective
Bluewater focused on automated drones for sustainable logistics, surveillance, and emissions monitoring to reduce emissions in port environments whilst also creating efficiencies and improving safety.

**Lead:** Skyports

**skyportsdroneservices.com**

**Partners:** Consortiq

## What was the aim?
To reduce emissions from fossil-fuel dependent activities in the port environment by utilising electric drones for deliveries, emissions monitoring and data collection. To meet the project goals, the project was divided into three core project phases namely: emissions monitoring, delivery operations and survey demonstrations.

## How did it go?
Project Bluewater was a successful project. We were able to showcase the proof of concept for drone operations within port environments. The drone inspection demonstration in Portsmouth successfully showcased the benefits of aerial inspection through the collection of images highlighting berth and roof damage. Moreover, the feasibility study depicted possible future capabilities of emissions monitoring, inspection and deliveries.

## The next steps
A follow-on project will build on the feasibility study created within the original Bluewater project. The next phase will take forward the potential of electric and hybrid drones to support safer, cleaner, and more efficient maritime operations. Bluewater 2 will display live demonstrations for real customers, in preparation for future tenders and commercialisation opportunities.







# An optimised control system for dual-fuel delivery infrastructure for low carbon vessels

## Overview
In the transition to low-carbon shipping, multiple low-carbon fuels are currently being developed. It is likely that different fuels will be used by ships depending on operational requirements, such as voyage duration and specific cargo. This poses difficulties for port operators developing onsite infrastructure which can service the demands of vessels with different fuel types, representing very case specific investments.

**Lead:** Hydrostar Europe

**hydrostar-eu.com**

**Partners:** Devonport Royal Dockyard, Emerald Green Power

This Smart Shipping project will build on previous work to develop a sophisticated smart control system which will optimise infrastructure operation for the dual-fuel delivery system at individual ports, but also for whole regions by integrating the infrastructure operation of multiple ports as a connected ecosystem. Integrating multiple ports will provide vessel operators with confidence that they can access low-carbon fuels throughout their voyages, whilst achieving decarbonisation and air quality improvements.

This will be achieved by implementing advanced digital twin models and simulation models, and with these create new AI algorithms and machine learning patterns which utilise data from ports themselves, incoming vessels, meteorological institutions and other sources which utilise data from ports themselves, incoming vessels, meteorological institutions and other sources. At individual ports, knowledge of incoming vessels and the energy availability onsite will determine how the control system operates onsite infrastructure, being demand led to produce optimal ratios of hydrogen and electricity to supply incoming vessels.

# Smart Efficient Automated Scheduling (SEAS)

**Lead:** Purple Sector

**purplesector.tech**

**Partners:** Harwich Haven Authority

## Objective

To demonstrate that emissions from pilot boats could be reduced by optimising their operational schedule using a digital twin and mathematical modelling.

## What was the aim?

For PurpleSector and HHA to collaborate on building a proof of concept schedule optimiser to automatically generate a pilot boat schedule optimised to minimise distance travelled and emissions. The aim was then to run the optimizer against historical data of ship arrivals / departures from HHA managed ports to prove a fuel / $CO_2$ saving.

## How did it go?

Rules governing pilots and pilot boat operations, and the current process for pilot boat schedule creation were shared by HHA's Vessel Transfer Service (VTS) Team. A schedule optimiser was successfully built that prepared a pilot boat schedule for the day optimised to give the lowest distance travelled / lowest emissions. Across sample days the optimiser gave a peak distance and emissions saving of 22% and an average of 13% when compared with historic data.

## The next steps

PurpleSector and HHA will collaborate on developing the schedule optimiser from a proof of concept to allow the running pre-deployment trials in a live working environment. If pre-deployment is successful, the infrastructure required to support production software will then be prepared and the software itself will undergo a substantial upgrade to automate more of the key functions, build a functional user interface and ensure that it is sufficiently robust and reliable.





# Creating a ground-truth in-water ocean data monitoring solution for smart shipping route selection

**Lead:** Oshen

**oshendata.com**

**Partners:** City College Plymouth, Plymouth Marine Laboratory

## Objective

To deploy and validate micro-vessels collecting real-time ocean data to improve forecast accuracy and enable fuel-saving route optimisation for low-emission shipping.

## What was the aim?

To prove that low-cost, autonomous micro-vessels could deliver accurate in-ocean weather data to improve shipping route forecasts. By integrating this real-time data with route optimisation platforms, the goal was to demonstrate a 5–10% reduction in fuel use across green shipping corridors. The consortium aimed to test, validate, and deploy a small fleet in real-world conditions and compare its data quality against industry standards.

## How did it go?

A new fleet was built and deployed 20 nautical miles offshore, capturing high-quality weather data. Comparative analysis showed strong alignment to a moored buoy, validating the data quality. Sea trials exceeded previous activity levels, and design changes improved vessel performance. Despite challenges, all key milestones were met, including integration progress with SGS and fuel modelling based on the new data, with the estimated fuel saving over 5%.

## The next steps

Oshen will scale up manufacturing, pursue licensing deals, and expand U.S. market activity following demos with NOAA and the US Navy. Further work includes refining fuel saving models, improving software pipelines, securing partnerships, and to publish the white paper resulting from this work. The aim is to commercialise the data platform and grow adoption across key transatlantic green corridors.

# EcoRoutePlanner: Dynamic Daily Route Planning and Scheduling for Crew Transfer Vessels in Offshore Wind

## Objective

To develop a novel digital toolset optimising Crew Transfer Vessel (CTV) operations for offshore wind farms, improving efficiency and reducing emissions using real-world data.

**Lead:** Njord Offshore

**njordoffshore.com**

**Partners:** University Of Essex

## What was the aim?

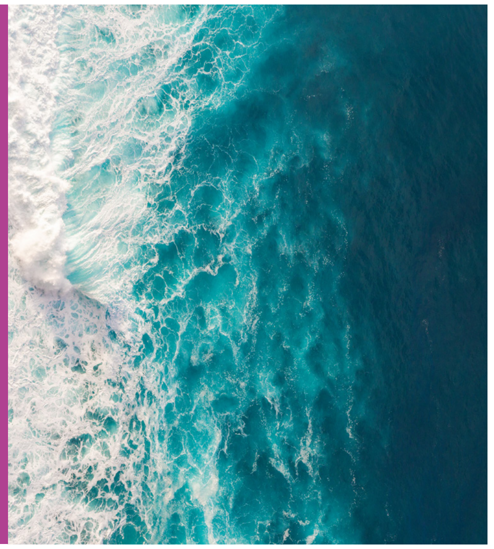
To create a system using advanced optimisation algorithms for dynamic CTV route planning. By integrating real-time data, it sought to enhance transit safety, fuel efficiency, and operational effectiveness. The project targeted a 10% reduction in fuel consumption/emissions, minimised turbine downtime, and overall increased efficiency compared to static planning methods.

## How did it go?

The project successfully implemented the tool, integrating data from ports and turbines globally. A front-end interface was developed and has been shared with partners. Preliminary results are promising, indicating a potential reduction in fuel consumption and greenhouse gas emissions of 10% to 5%. It also indicates a potential decrease of 8% in the trip duration.

## The next steps

We are planning a next-stage project that involves large-scale demonstration trials on operational Njord CTVs data collection/analysis, system integration with real-time data and dynamically integrating potential charter's change of plans. Key outcomes will be a validated system demonstrator targeting a further decrease in fuel to potentially reach 25% fuel/emission plus establishing a pathway towards a commercial SaaS product.







# Amphibian LARS&DMS: Launch, Recovery and Debris Management Systems to accelerate use of robotic vessel cleaning

## Objective

To investigate the feasibility of building and demonstrating a safe Launch-and-Retrieval System (LARS) and Debris Management System (DMS) for Innvotek's Amphibian robotic platform.

**Lead:** Innvotek

**innvotek.com**

**Partners:** Aberdeen Harbour Board, Offshore Renewable Energy Catapult

## What was the aim?

Effective LARS and DMS will allow ship and maritime asset maintenance companies to offer all-in-one cleaning and detailed inspection services to ship owners, 4 times quicker and at 40% less cost than current dive-led inspections. This will promote regular cleaning and inspections of ship hulls, reducing fuel used and hence GHG emissions.

## How did it go?

There were challenges in establishing a robust Bill of Materials for the Amphibian, LARS and DMS designs, and changes were needed to enable a two-stage demonstration. However these were overcome and all milestones and deliverables were completed successfully.

Interaction between partners and other stakeholders in the supply chain has provided valuable insights into all aspects of development and deployment of Amphibian LARS&DMS.

## The next steps

This project will be taken forward toward commercialisation, building on two main outcomes of the project to develop a full-scale demonstration, and further developing the Comprehensive Business Plan and Investment Strategy by working with IUK Business growth on accelerator and GBIP programmes to get the company investment-ready.

# Collaborative Autonomy for Subsea Intervention (CASI)

**Lead:** Robosys Automation

**robosysautomation.com**

**Partners:** Acua Ocean, Offshore Renewable Energy Catapult

## Objective

To assess the feasibility and software and hardware design requirements for integrating and operating a Remotely Operated Vehicle from the moonpool of USV PIONEER.

## What was the aim?

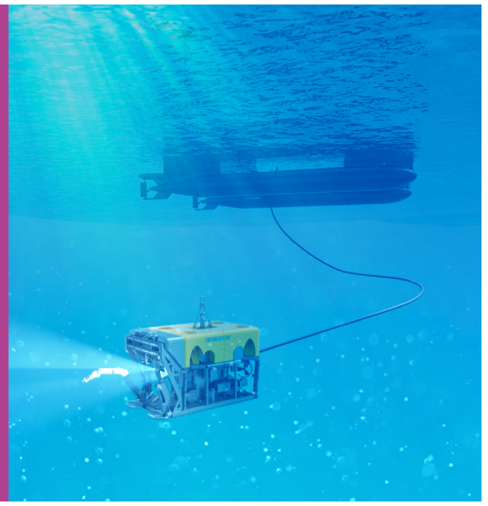
To assess how to replace existing larger crewed vessels with smaller Multi-UxV (uncrewed autonomous vehicle) systems and novel deployment methods, enabling collaborative autonomy for surface and subsea intervention. This included path optimisation for enhancing safety and commercial availability, the launch and recovery system (LARS) of a ROV from a USV, and USV station keeping for subsea intervention.

## How did it go?

ACUA defined the design needs for a modular LARS for work-class ROVs, including bow thrusters, ballasting, and electrical system changes. Robosys designed and simulated new algorithms and enhanced its software for improved path planning and mission behaviors. OREC created a ROV specification catalogue to inform LARS design, and delivered a market assessment and an LCA analysis on carbon offsetting.

## The next steps

To take the initial design work completed by Robosys and ACUA surrounding the software and hardware requirements, and to develop, manufacture, integrate and demonstrate the full USV-ROV nested robotics system through an industrial research project. This would bring the system to a point where it is ready for commercial demonstration and exploitation.







# O.S.I.R.I.S. – Offshore Inspection and Renewable Infrastructure Servicing

**Lead:** Bettering Our Worlds (Bow)

**usebow.com**

**Partners:** ACUA Ocean, Offshore Renewable Energy Catapult

## Objective

Project OSIRIS focused on revolutionising the inspection and maintenance of offshore renewable energy infrastructure through the deployment of advanced nested robotic systems and ACUA's hydrogen-powered autonomous vessel, USV PIONEER.

## What was the aim?

Project OSIRIS focussed on understanding the technical, regulatory and economic feasibility through demonstrating the operational capabilities of the nested robotic systems and their integration with the hydrogen-powered vessel in a simulated environment. The project also undertook a regulatory compliance review and a cost-benefit analysis comparing traditional inspection methods with our innovative approach, highlighting potential savings and efficiency gains.

## How did it go?

The feasibility study showed the potential to operate multiple robotic solutions in a maritime environment, both surface, sub-surface and aerial in a simulated environment and in a variety of seastates and weather conditions. The supporting customer discovery and OEM engagement broadened market understanding and enabled the development of a commercial and technical roadmap.

## The next steps

To explore further development of the software integration beyond a simulated environment and to develop, manufacture, integrate and demonstrate the full USV-ROV-UAV nested robotics software control system through an industrial research project. This would bring the system to a point where it is ready to deploy during a commercial demonstration.

# Safer, Smarter Ships – Strategies and innovations for vessels using low flash point fuels

## Objective
To integrate physical designs and software inventions allowing more efficient storage of hydrogen. It created radical new designs of value for generations to come.

## What was the aim?
To design patentable innovations which deliver accurate and efficient safety control systems that can be deployed in ships. The project proves that cryogenic hydrogen can safely be stored below deck and sophisticated safety measures reduce the risks without adding unnecessary complexity to ship construction techniques. Combining applied physics, computer science and naval architecture with advanced production knowledge, the project has advanced understanding to the point where rapid deployment is now possible.

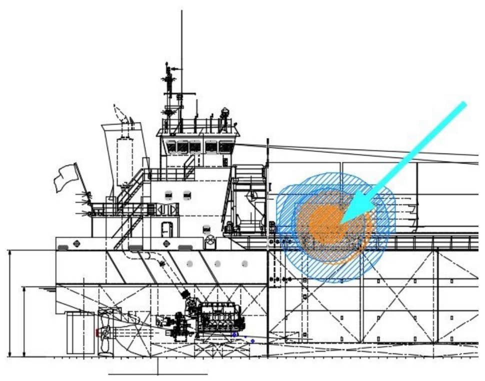
## How did it go?
The project has exceeded expectations. The team have created a number of radical design iterations, some of which are undergoing patent review and application. Respective and complementary skills and a willingness to share knowledge and workload among the consortium has delivered startlingly rapid advances.

**Lead:** Ecomar Propulsion

**ecomarpropulsion.com**

**Partners:** Aluminium Marine Consultants, Rockabill Marine Design, University Of Southampton, University Of Strathclyde

## The next steps
The project has reduced uncertainties such that it is now clear how cryogenic hydrogen can be deployed as a viable fuel in many types of commercial vessels. It is also clear that moderate changes to ship structures, revised gas evacuation processes using natural buoyancy and advanced software controls can reduce risk and increase operational range without compromising normal duties of commercial vessels.









# Offshore Charging Simulations and Training for Safety and Efficiency of SOV Electrical Charging Operations

## Objective
To address market challenges around vessel decarbonisation including safety, training and regulation development, and the interoperability of infrastructure with hybrid vessel solutions.

## What was the aim?
To investigate the feasibility of safely implementing offshore mooring and charging of different models of hybrid Service Operation Vessels (SOV), and to produce a simulation package for training of personnel.

## How did it go?
The project was a success in a very short time frame and delivered the fundamental objectives it set out to. The consortium team had good cooperation and understanding among all the partners and delivered both a feasibility report in partnership with Lloyds Register, and a specification for a training simulation package for safe mooring and charging operations.

**Lead:** North Star Shipping (Aberdeen)

**northstarshipping.co.uk**

**Partners:** Aberdeen Harbour Board, Flotation Energy, London Marine Consultants, Newcastle University, Offshore Renewable Energy Catapult, Tyne Coast College

## The next steps
Follow on steps include developing the simulation package into a virtual model to explore how crews interact with offshore floating structures, mooring systems and offshore charging systems. This would then lead onto physical demonstrations of offshore charging systems.

# Smart Shipping Safety and Cyber Assurance

## Objective
To identify potential cyber and safety vulnerabilities with current small boat electric propulsion technologies and develop tools/techniques to assess and address these vulnerabilities going forward.

**Lead:** Rad Propulsion

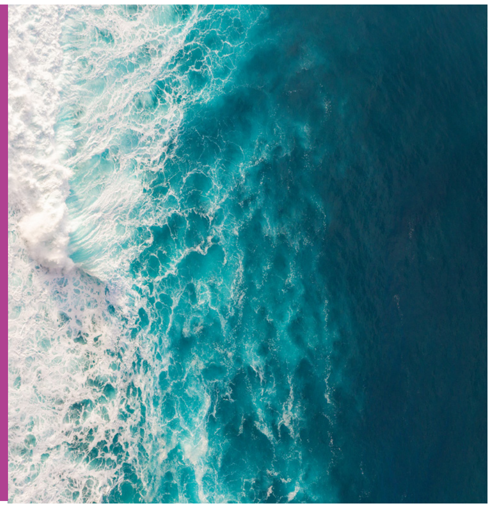
**radpropulsion.com**

**Partners:** Drisq, University Of Plymouth

## What was the aim?
To assess the potential cyber and safety assurance vulnerabilities of a representative real world electric propulsion system. The aim being to prove to commercial operators that such systems can be trusted in critical tasks whilst ensuring safety to other water users, the public and the environment. To achieve this, cyber security testing at the University of Plymouth's Cyber Ship Lab was carried out and benchmarked against accepted software safety practices used in the aerospace industry.

## How did it go?
The project successfully achieved all its objectives and not only benchmarked the level of cyber security and safety assurance of a representative system but also developed tools, techniques and a roadmap outlining the steps necessary to achieve high levels of cyber and safety assurance in similar products going forward. The cyber security testing did not identify any significant vulnerabilities but did manage to identify several areas where security enhancements were possible.

## The next steps
The purpose of this short feasibility study was to identify potential vulnerabilities. Therefore, the next step is to undertake a follow-on demonstration project to validate and demonstrate how the lessons learned, and the tools/techniques outlined in this feasibility study can be used to improve cyber resilience and safety assurance in such systems.







# Future-Proof Fleet – Managing Risks arising from the industries drive towards Decarbonisation

## Objective
To integrate internal and external data sources for real-time maritime risk assessment using ML and NLP to predict and manage risks linked to emerging technologies.

**Lead:** Hilo Maritime Risk Management

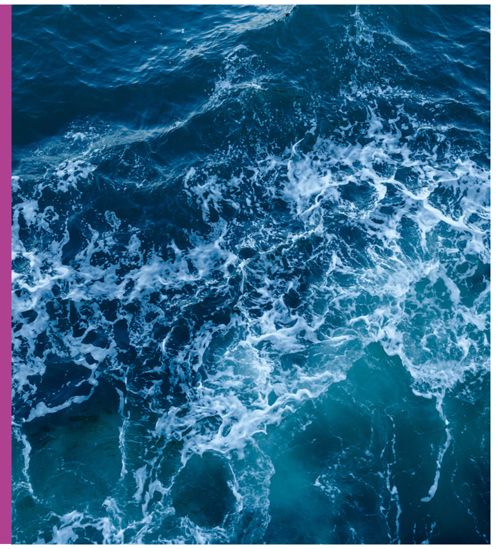
**hilomrm.com**

**Partners:** Effortless Technologies

## What was the aim?
HiLo has established industry trust by securely sharing sensitive safety, inspection, and defect data in exchange for actionable risk analytics. The project aimed to acquire remaining inspection and defect datasets and integrate onboard equipment data to identify risks earlier than ever before. By combining multiple data streams and leveraging advanced analytics, HiLo sought to transform maritime safety through predictive insights and early-warning capabilities.

## How did it go?
The project was highly successful, demonstrating strong potential for commercialization and impact. Early successes include identifying equipment defects through MAGPIE analytical models. A beta version of MAGPIE was also developed for shipboard use, enabling real-time risk detection and improving operational decision-making.

## The next steps
HiLo will continue engaging with current and potential clients to expand its data ecosystem and enhance model accuracy. It will also strengthen partnerships with key industry stakeholders and technology providers to scale the platform and maximize global impact. To support platform growth, advanced R&D, and international expansion, HiLo plans to initiate a new fundraising round.



# BOSS LEVEL (Battery Optimisation Sensor Systems with Local Environment and Vessel Engineering Learnings)

## Objective

BOSSLEVEL explores onboard sensor and data networks with AI-based analytics to optimise battery energy storage systems (BESS) on electric and hybrid vessels, supporting maritime decarbonisation.

## What was the aim?

To assess the feasibility of an on-board sensor and data acquisition network for real-time battery monitoring and optimisation. As maritime propulsion shifts towards electrification and alternative fuels, understanding battery health is critical for efficiency, cost savings, and emissions reduction. By leveraging expertise from electric vehicle (EV) technologies, BOSSLEVEL sought to improve battery longevity, enhance vessel autonomy, and support ship-port energy integration, ensuring sustainable and data-driven maritime operations.

## How did it go?

BOSSLEVEL successfully defined requirements for an IoT-enabled battery monitoring system, developed advanced analytics for state-of-health estimation, and assessed regulatory compliance for onboard data networks. Sensor trials on Brittany Ferries and HydroSurv vessels validated the feasibility of real-time battery performance monitoring. This showed how data-driven insights can improve battery management, and support shore-based charging strategies. Findings indicate significant adoption potential across the maritime sector, with clear economic benefits in reducing battery degradation and enhancing vessel efficiency.

**Lead:** Barter For Things

**barterforthings.co.uk**

**Partners:** Houlder, Hydrosurv Unmanned Survey (UK), Marine South East, Swanbarton, University Of Portsmouth





# PATROL – Propeller with Adjustable Thrust for Reducing Operational Losses

## Objective

To ascertain maritime vessel operational efficiency gains by utilising a concept Adjustable Thrust Propeller (ATP) compared to a conventional Fixed Pitch Propeller (FPP).

## What was the aim?

To investigate, develop and undertake proof of concept analysis of the ATP that was fitted to an azimuth (rotating) POD drive. Sectors of the maritime industry where vessels must endure varying loads during their duty cycles were targeted, such as water taxis, crew transfer vessels and fishing trawlers. The goal was to ascertain the feasibility of the ATP, powered by electric drive with an optimized control system.

## How did it go?

The project consortium brought together leading Maritime and Automotive industry experience with renowned academic support. TPIL led the mechanical component design of the concept, feeding in performance simulation data to WMG for the control system. iNetic supplied the required electrical drive data to the control system.

**Lead:** Teignbridge Propellers International

**teignbridge.co.uk**

**Partners:** iNetic, University Of Warwick

## The next steps

This feasibility study project has shown substantial (~+15%) theoretical efficiency gains. The theory now needs to be proven, requiring a prototype ATP system to be manufactured using TPILs existing inhouse manufacturing capability, with electrical drive and control system support from iNetic and WMG respectively. A suitable test vessel will be required for sea trials of the ATP system, this being either TPIL's purpose-built test vessel HRV1, or an external vessel owner/operator.

# Self-Learning Wing Trim Optimisation for AirWing Wind Propulsion System

## Objective
To assess the feasibility of AI-driven, self-learning control for optimising the trim of GT's AirWing wind propulsion system to reduce maritime emissions.

## What was the aim?
To explore the technical and economic viability of integrating AI and adaptive control systems into GT's AirWing propulsion technology. This involved evaluating self-learning algorithms to optimise the aerodynamic performance of the wing in real time, enhancing thrust and fuel efficiency. By leveraging cutting-edge AI techniques, the project supports decarbonisation in the shipping sector, particularly for vessels with limited deck space where traditional wind propulsion systems are less viable.

## How did it go?
The project delivered high-fidelity aerodynamic models, control algorithm simulations, and a roadmap for deployment. It also engaged regulators to shape the future compliance framework for AI in maritime. Initial results showed both Extremum Seeking Control (ESC) and RL controllers outperforming offline optimisation, with ESC achieving 86.6% and RL 97.5% of optimal EEDI performance. Both controllers adapted well to wind variability and system changes.

**Lead:** GT Green Technologies

**gtgreentechnologies.com**

**Partners:** Carisbrooke Shipping, University Of Bath

GT WINGS

CARISBROOKE SHIPPING

UNIVERSITY OF BATH

## The next steps
The consortium will next test the AI-enhanced AirWing on a 124m UK-owned cargo vessel to validate real-world performance and emissions savings. The consortium is also planning a more ambitious project focused on developing a more granular control system—including fan power modulation—and integrating it with weather routing tools to create a holistic decision-support system for operational optimisation and commercial evaluation.





# WindWingsHub: Towards building next generation of decision support systems for wind assisted vessels

## Objective
To develop WindWingsHub, a digital decision-support platform that accelerates the adoption and optimises the operational performance of WindWings-equipped vessels.

## What was the aim?
To address barriers to widespread adoption of wind-assisted propulsion by developing a digital platform enabling real-time optimisation, analytics, and strategic decision support. By integrating technical and operational data, WindWingsHub empowers vessel operators and corporate stakeholders to maximise the benefits of WindWings technology, supporting emission reductions, regulatory compliance, and commercial competitiveness.

## How did it go?
Early results show significant potential for improving vessel operational efficiency and user feedback indicates the platform simplifies WindWings integration into fleet operations, making the technology more accessible and scalable. The project has validated WindWingsHub's role as a catalyst for broader adoption of wind propulsion technologies across the commercial shipping sector.

**Lead:** BAR Technologies

**bartechnologies.uk**

**Partners:** Union Maritime

UNION MARITIME

BAR TECHNOLOGIES

## The next steps
The next phase focuses on commercial deployment of WindWingsHub as part of the WindWings package offering. Planned activities include scaling up the platform's integration across Union Maritime's fleet. BAR Technologies will also pursue strategic partnerships to expand the platform's reach, supporting the maritime sector's transition towards net-zero shipping through data-driven optimisation of wind propulsion technologies.

# ElectroNautPredict

## Objective

To explore developing an algorithm for accurate range prediction to support embedded hardware in battery-electric vessels.

## What was the aim?

The ElectroNautPredict feasibility project will explore developing an algorithm for accurate range prediction to support embedded hardware in battery-electric vessels.

This project aims to address this challenge by creating a software & hardware solution that will collect data from multiple sensors and model vessel expected range based on current and future operating conditions

## How did it go?

Data collection and model training have been conducted in the Taw Torridge Estuary, however, progress was impacted by bad weather, requiring an increased frequency of meetings.

Milestones such as vessel readiness and information collection for future plans were completed, and development of the xCU Ethernet interface and range prediction model is ongoing.

**Lead:** EVParts UK

**evparts.co.uk**

**Partners:** Tope Ocean, Torridge District Council, University Of Exeter

## The next steps

The team are planning to trial ElectroNaut Predict system on the Bournemouth, Christchurch and Poole Council (BCP, harbour master's vessel. Following, the next phase of development will focus on model training and refinement, and collecting more data to support evaluation of the Range Prediction Model as well as exploration of model applicability and other user types.







# AI-assisted power system optimization for green methanol/ hydrogen Service Operation Vessels

## Objective

To use Artificial Intelligence (AI) to determine optimised powertrains designs for Service Operation Vessels (SOV) to achieve a shipowner's objectives for reduced emissions and cost.

## What was the aim?

To understand how AI can be used for powertrain optimisations and what its benefits and limitations are within a ship design project, alongside using published technology data and experimental data to produce validated digital model an input to the AI tool.

## How did it go?

The project suffered a setback with the withdrawal of a consortium partner, which delayed access to vessel operational data. Despite this, the remaining consortium parties worked closely together, frequently in parallel, to successfully achieve the project objective. Access to industry data allowed University of Birmingham significant advances in their AI Tool.

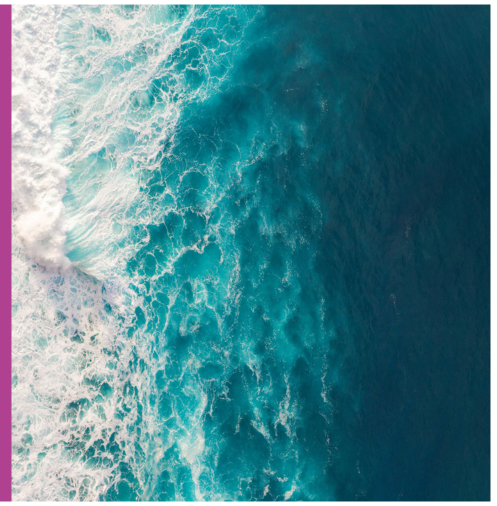
**Lead:** Longitude Consulting Engineers

**longitude-engineering.com**

**Partners:** Chartwell Marine, DNV UK, Steamology Motion, University Of Birmingham

## The next steps

The next steps are to apply the AI tool to the powering analysis of a new SOV design project. Using the lesson learnt, LE understand the required inputs and level of technical involvement required to train the tool. LE also see the value in expanding the capability of the AI tool to cover power-distribution and aspects identified in the feasibility study such as ship arrangement and stability.



# SESSF, Smart Electrification of Short Straits Ferries

## Objective
To develop a decision support tool for designing and operating e-ferries, reducing emissions on the Short Straits routes.

**Lead:** AVL Powertrain UK

**avl.com**

**Partners:** DFDS A/S, University Of Kent

## What was the aim?
To develop a digital and data-driven decision support tool to optimise the design and operation of e-ferries, reducing emissions on the Short Straits routes. The project analysed existing fleet data and created simulation models to investigate e-ferry designs, and battery charge/discharge cycles to inform development. This tool will support vessel operators, in deploying e-ferries, enhancing sustainability and operational efficiency.

## How did it go?
The project achieved its scope in creating a tool to support DFDS's transition to zero-emission battery electric ships, enhancing sustainability and operational efficiency in cross-Channel transport. The partners collaborated effectively, analysing fleet data, investigating e-ferry designs, optimising battery cycles, and conducting a techno-economic analysis to develop a digital decision support tool for simulating electric ferry design and operation on the Short Straits routes.

## The next steps
The next steps involve further developing the decision support tool to incorporate additional operational scenarios and detailed electric powertrain designs. Partners will continue to refine the tool's capabilities, and collaborate with stakeholders to ensure the tool's applicability to similar routes and markets, supporting DFDS's strategic deployment of electric ferries and advancing sustainable maritime technology.






# Marine to Electric Power – SeNZe-Tech™ the Smart Way to Clear The Hurdles

## Objective
To develop a novel, data-lead, sensor-enabled and AI-algorithm drivetrain control system that enables maritime operators to adapt vessels to zero carbon whilst better optimising whole power and propulsion performance.

**Lead:** Duodrive

**duodrive.com**

**Partners:** Ad Hoc Marine Designs, Cardiff University, Green Lizard Technologies, MTE Power, Teesside University

## What was the aim?
To create an intelligent vessel control system uniquely able to optimise power vs thrust for the greatest efficiency, fuel & emissions reduction whilst usable by a wide range of fuel, vessel and propulsor configurations. The solution enables smart, predictive maintenance regimes that keep systems running cleaner, further minimise emissions, cut operating costs and reduce downtime.

## How did it go?
The team have achieved significant progress, and have developed a workable overall approach that gives a new level of whole-system visibility and understanding of real-time powertrain and propulsion performance, and can simulate the operations of a variety of vessel types. to enable true 'well-to-wake' evaluation to quantify advantages to vessel owners.

## The next steps
To convert the simulated system architecture we have developed into a viable operation & control system product with an on-board vessel interface and control capability and the telemetry to transmit and use vessel data in real time for business information and operations. A bridge to commercialisation will be a real-world implementation aboard a vessel.

# COMLink Design tool (Conceptual, Operational Modelling Linked Design Tool)

## Objective

To develop a modelling tool that predicts ship resistance in waves accurately during concept design, improving efficiency, reliability, and sustainability of future vessels.

**Lead:** Houlder

**houlderltd.com**

**Partners:** Siem Shipping UK, University Of Southampton

## What was the aim?

To address the limitations of current ship design methods by developing a surrogate model that accurately predicts added resistance in waves. By integrating realistic operational conditions into early-stage design through the COMLink Tool, the goal was to enhance decision-making, reduce risk of underperformance, and minimize design changes later.

## How did it go?

The project progressed well, with operational data from Siem Shipping providing key operational conditions, while the University of Southampton contributed high-fidelity simulation data and surrogate modelling. A prototype of the COMLink Tool was demonstrated successfully on car carrier designs. The approach shows strong promise in transforming early ship design processes, optimised for real-world conditions.

## The next steps

The next phase involves refining the surrogate model with extended datasets and broader vessel types, enhancing accuracy and usability. Plans are underway to integrate the COMLink Tool into commercial design workflows and explore collaboration with additional operators. Further development will strengthen confidence in predictions and will ensure the methodology benefits wider maritime innovation.






# Energy saving technology for vessels with controllable pitch propulsion

## Objective

To develop a novel, cost-efficient, and easy-to-install Energy Saving Technology (EST) for vessels equipped with Controllable Pitch Propellers (CPP).

**Lead:** Cybermarine

**cybermarine.uk**

**Partners:** O.S. Energy (UK)

## What was the aim?

Unlike conventional propellers where pitch is fixed, CPPs allow both pitch and RPM to vary which is called as the combinator mode. However, due to the complexity of operating in this mode, many captains fix the pitch and vary RPM, leading to high fuel consumption. The aim was to develop an application that calculates the optimal RPM and pitch combination to minimise fuel use without compromising speed, thus supporting emissions reduction, improving fuel efficiency, and operational savings.

## How did it go?

The application has been successfully developed with a user-friendly interface, tested, and deployed on the pilot vessel. Due to the complexity of digitising signals from the CPP system, it was installed in offline mode instead of the anticipated online mode. Manual and semi-automated functions have been enabled, and offline testing has shown the system to be working satisfactorily. Full real-time optimisation will progress once signal digitisation is completed.

## The next steps

Once signal digitisation is complete, live vessel data will be connected for real-time optimisation. The system will then be validated in live operations using AI mode. Based on the pilot vessel results, we plan to aggressively market this product to expand its deployment across other vessels with CPPs. The application will also be presented at maritime expos and conferences to support engagement and adoption in other regions.

# Intelligent Net Zero Design: Smart digital tools for optimizing powertrains on wind assisted ships

## Objective
To generate smart digital tools to aid efficient design and operation of next generation powertrains on Wind Propulsion Technology (WPT) equipped vessels.

## What was the aim?
To develop an intelligent design sizing and optimisation tool for fuel cell and battery-based powertrains on WPT equipped vessels, that would factor in actual vessel operation – a key element for WPT vessels due to their highly variable power demands. This required generating a comprehensive virtual model of the entire energy delivery system, vessel performance and energy demands relative to environment across a vessel lifetime.

## How did it go?
The tool development was highly successful, with several insights derived that would unlikely be self-evident in a traditional approach, or without integrated full lifetime operational consideration. The output from the tool shows economic challenges remain in the use of expensive and low energy density sustainable fuel options, even when energy efficiency is put foremost, but there remains significant opportunity for improvements, which can now be efficiently and accurately assessed.

**Lead:** Spaera

**spaera.eco**

**Partners:** Scotline, Seabird Technologies, University College London

## The next steps
Spaera will focus on further developing the feature set and integration of the developed design tool, as well as analysing further scenarios enabled by the tool, in order to identify optimum use cases for early adoption. In tandem this effort will help refine a shipyard ready design proposal for a next generation net zero vessel, efficiently powered by a sustainable fuel based fuel cell and battery powertrain system and WPT.

Funded by
UK Government

Department
for Transport

UKRI Innovate UK

/innovateuk