SEAI RD&D 2021

EIRE PROJECT

DT-EIRE-102 – Project Summary Report

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Contents

Revision History

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Figures

Reference Documents / Deliverables

Reference / No.	Title	Report / Document Reference
WP1 D1	Project Kick-off Report	DT-EIRE-101 Project Kick-off Report
WP1 D2	Project Summary Report	DT-EIRE-123 Project Summary Report
WP1 D3	Monthly Project Reports (12)	DT-EIRE-102-113 SEAI EIRE Project Month # Report
WP2 D1	Customer Engagement Report	DT-EIRE-201 Customer Engagement Report
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WP4 D1	Design Basis Report	DT-EIRE-401 Design Basis Report
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WP4 D1	Detailed Design Report	DT-EIRE-501 Detailed Design Report
WP6 D1	Initial Dissemination Plan	DT-EIRE-601 Initial Dissemination Plan
WP6 D2	Communications and Dissemination Report	DT-EIRE-602 Communications and Dissemination Report
M 101	Kick-off Meeting Slides	DT-EIRE-P101 Daretech-EIRE Kick-off Meeting Slides
DB 001	User Groups Database	DT-EIRE-DB001 User Groups Database
DB 002	Supply Chain Database	DT-EIRE-DB002 Supply Chain Database
DR 001	Mechanical & Electrical Drawing Register	DT-EIRE-DR001 Drawing Register
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1. Executive Summary

This report summarises project activities carried out by Daretech which have been completed in June 2023 on the EIRE project, a research, development, and demonstration (RD&D) project as part of SEAI's 2021 funding call which seeks to develop our hybrid system technology through a phase of detailed design to provide a range of standardised products. Daretech have developed hybrid systems for customers in the aquaculture field, however a specific product development phase is now needed to develop a suitable system for utilisation in ports and on quaysides to service the large range of power requirements that can be expected when considering the wide class of vessels for which the technology can be beneficial (Approx. range 20 – 200 kWh).The main objectives of this project were:

1. Gather power consumption data from marine users to represent the range of vessels in the Irish fleet.
2. Generate User Requirement Specification for Hybrid Systems.
3. Generate a Basis of Design for Modular Hybrid Power System.
4. Undertake Detailed Electrical Equipment Selection & Mechanical Packaging Design.
5. Delivery of a market ready product by project completion.
6. Raise awareness about the outcomes of the project and the business to maximise company profile, reputation, and sales.

Daretech engaged extensively with stakeholders in the marine community to develop a comprehensive understanding of technical needs. This included a phase of user group definition and data collection which provided a platform to develop a basis of design and a user requirements specification. This, in turn, fed into a detailed design phase that developed a standardised range of scalable, modular hybrid power systems with a first 85kWh commercial unit being built and due for deployment in the coming months.

A summary of work undertaken in each project work package is provided in section 3 of this report with more detailed information available in the referenced documents, while an overview of dissemination activities undertaken are presented in section 5. Section 4 provides some context as to the impact of this project, its relevance to, and ability to meet requirements for the reduction of carbon emissions in the marine sector. Conclusions and recommendations are also outlined in section 6.

The project has allowed Daretech to develop and validate a detailed design for a range of hybrid systems that services the need of a variety of marine users. It has refined the design based on feedback from stakeholders in the sector and focussed attention on the development of commercial relationships as a route to market and develop sales in Ireland and the EU.

2. Introduction

2.1. Overview

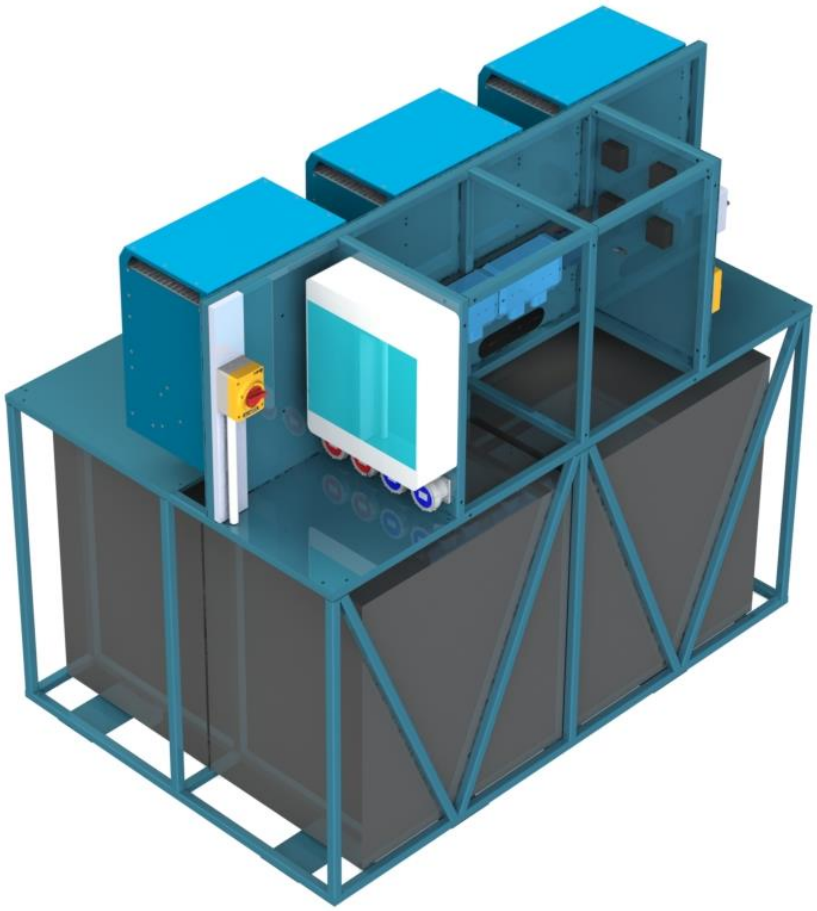

Figure 1: 85kWh Hybrid Power System

This report is intended to provide a summary of work undertaken throughout the EIRE project, an SEAI funded project under the RD&D programme. The project commenced in May 2022 and was completed in June 2023. This report will provide some context for the project and a brief summary of each work package and the key outputs and deliverables from each. They are as follows:

- WP 1 – Project Management
- WP 2 – Stakeholder Engagement
- WP 3 – User Requirements
- WP 4 – Basis of Design and Validation
- WP 5 – Detailed Design
- WP 6 - Communications and Dissemination

Deliverables and a summary of work package outcomes for each are outlined in the following sections.

2.2. Project Context

Electrical supply for marine vessels and platforms is extensively provided by on-board diesel generators which, because of operational requirements, are difficult to size appropriately for efficient operation. This results in typical operation of the diesel generator below 30% capacity. Marine vessels were shown to spend up to 70% of their working life at quayside. Running a generator at low power versus high power is less efficient in terms of fuel used per kWh of electricity produced. Reduction in fuel consumption is desirable both for cost and emissions reduction. Minimising the running hours of the diesel generator is attractive to operators and can significantly reduce emissions due to the large number of suitable vessels.

Daretech's hybrid system brings the advantages of energy storage and renewable energy to the marine sector. The system is a scalable, modular hybrid energy system that Daretech are developing for marine users that do not have access to shore power. Use of this technology allows the vessel owner to both reduce their base-load power related emissions by up to 70% while reducing fuel consumption and extending periods between servicing for diesel generators. The hybrid system has been specifically designed for the marine environment and provides a robust and user-friendly solution. Field trials have resulted in a reduction of 90% of diesel generator running hours. The intent of this project is to bring the technology through a phase of detailed design to develop a modular, scalable system that can suit a wide range of marine applications.

2.3. Innovation / Novelty – Beyond State-of-the-Art

There are three key innovations inherent in this project and the application of hybrid system technology to marine vessels and structures. They are as follows:

- **A 3-phase renewable solution for marine vessels**

There are currently limited renewable technology solutions on the market that have the capacity to provide the required 3-phase power for commercial marine vessels. Integrating with a hybrid system allows renewable power (wind, solar PV etc.) to be distributed to 3 phase systems on the vessels.

- **Integration of renewable energy**

Integration of the renewable energy generation to the vessels electrical system is undertaken with the use of advanced marine certified battery technology – This allows efficient integration while also increasing the operational efficiency of the existing power generation method.

Integration of the hybrid power system into the vessels electrical distribution system is accomplished through automatic synchronisation with the diesel generator. 3-phase power is provided through the inverter charger modules, the number of which can be increased based on specific requirements. Battery storage allows any excess power to be captured and used at a later stage. Throughout the project we have integrated our test rig successfully on a vessel with a modest solar PV input to demonstrate this capability.

- **Rapid analysis and system modelling**

Our ability to rapidly analyse vessel power usage and recommend an optimised modular & scaled solution and quantify the impacts using in house proprietary algorithms. Ongoing system management and optimisation allows operation at peak efficiency with ever changing operational profiles.

The project, through the data collection phase, has allowed Daretech to refine our system specification and economic models for potential customers to provide an early estimate of the required system size based on requirements and the payback period and return on investment for that system. Importantly, this allows us, at an early stage, to offer the end users transparent data on system size options and their respective payback periods to allow an informed decision to be made.

A range of system specifications have been developed based on user requirements with storage capacity from 26 to 160kWh available, instantaneous power up to 45kVA in a standardised support frame and enclosure options based on requirements.

3. Work Package Summary

3.1. WP 1 – Project Management

The project was delivered as outlined in the original application with respect to technical and commercial deliverables. Throughout project activities close schedule and budget control were implemented through bi-weekly meetings and monthly summary reports. This allowed the project team to ensure that work was progressing as intended and, where relevant, mitigation measures were taken to correct any issues encountered. Reference documents for this work package are outlined in the table below.

No.	Title	Report Reference
WP1 D1	Project Kick-off Report	DT-EIRE-101 Project Kick-off Report
WP1 D2	Project Summary Report	DT-EIRE-123 Project Summary Report
WP1 D3	Monthly Project Reports (12)	DT-EIRE-102-113 SEAI EIRE Project Month # Report

3.2. WP 2 – Stakeholder Engagement

The stakeholder engagement work package included engagement with potential customers to define the requirements for system design, component, and service providers to develop the supply chain and other stakeholders to develop an understanding of funding supports and market forces that will drive sales at product launch. User groups for hybrid systems were defined and categorised based on their use case. Detailed information is provided on this engagement in deliverable 2.1 with a scaling plan and business plan delivered as deliverables 2.2 and 2.3 respectively. Reference documents for this work package are outlined in the table below.

No.	Title	Report Reference
WP2 D1	Customer Engagement Report	DT-EIRE-201 Customer Engagement Report
WP2 D2	Scaling Plan	DT-EIRE-202 Scaling Plan
WP2 D3	Business Plan	DT-EIRE-203 Business Plan

3.3. WP 3 – User Requirements

Building on the stakeholder engagement work package, detailed user requirements were defined based on feedback from customers and a data collection phase from real operational cases. Case studies, both desktop and through the installation of a power meter and demonstration unit, refined the technical specifications for the system range. A user requirements matrix was developed that was used in WP 4

to develop a design basis for a range of hybrid systems. Reference documents for this work package are outlined in the table below.

No.	Title	Report Reference
WP3 D1	Customer Feedback Reports	DT-EIRE-201 Customer Engagement Report
WP3 D2	Requirements Matrix	DT-EIRE-302 User Requirements Matrix

3.4. WP 4 – Basis of Design and Validation

Based on work undertaken in work packages 2 and 3, a design basis has been developed for a range of hybrid power systems which seek to provide a standardised solution for varying user requirements as outlined in D3.2. This design basis has been reviewed and finalised based on feedback from end users and a validation of this design basis was undertaken, taking Daretech's demonstrator unit and operating in real conditions to examine its electrical performance and ease of electrical and mechanical integration. A summary of this work is provided in deliverables 4.2 and 4.2.

No.	Title	Report Reference
WP4 D1	Design Basis Report	DT-EIRE-401 Design Basis Report
WP4 D2	Validation of Design Basis	DT-EIRE-402 Validation of Design Basis Report

3.5. WP 5 – Detailed Design

Building on the design basis developed in work package 4 and incorporating lessons learned in the validation of design, a detailed design phase was undertaken. This included the development of detailed electrical drawings - wiring diagrams and single line diagrams for power and control of the hybrid systems for a range of system specifications. Wiring configurations for batteries were analysed and optimised with respect to system performance and ease of assembly over the course of a workshop with electrical installers. Mechanical drawings for the system's structural frame were also developed in consultation with fabricators and installers and options for housing considered and developed based on varying user requirements. A detailed design report summarises the work carried out here and has been provided as deliverable 4.1.

No.	Title	Report Reference
WP4 D1	Detailed Design Report	DT-EIRE-501 Detailed Design Report

3.6. WP 6 – Communications and Dissemination

A dissemination plan was submitted at the early stages of the project to outline the approach to dissemination activities. This is presented in deliverable 6.1 and a follow up communications and dissemination report, deliverable 6.2 has been provided to track the progress of these dissemination activities. This included a summary of communications tools used throughout the project and the project meetings and conferences attended with a variety of stakeholders. A dissemination tracker provides detail on activities carried out through the project web page and social media channels as well as events and media / promotional news activities.

No.	Title	Report Reference
WP6 D1	Initial Dissemination Plan	DT-EIRE-601 Initial Dissemination Plan
WP6 D2	Communications and Dissemination Report	DT-EIRE-602 Communications and Dissemination Report

4. Relevance and Impact

4.1. Relevance to the needs of the Irish Energy Sector and to SEAI

In March 2021 the Irish Government approved a revised Climate Action Bill which includes specific targets on reducing carbon emissions. The bill places on a statutory basis a 'national climate objective', which commits to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally sustainable, and climate-neutral economy. There is due to be a reduction of 51% in the total amount of greenhouse gas emissions within 10 years – this represents a significant front-loading of the plan and therefore action must be taken now.

Daretech's core focus is on the development and implementation of sustainable solutions for the production of electricity in marine applications. With an EU view to increasing the use of its marine space, and hence vessel traffic, consideration must be given to the reduction of vessel emissions to fulfil its climate and emissions targets. Sectors of particular interest to Daretech's products are aquaculture, coastal tourism, ocean energy and seabed mining where sustainable growth is targeted, and markets exist for our products in order to meet the targets stated.

4.2. Impact

The targeted customers for the system are commercial vessel owners and marine operators in the fishing and marine services sectors. They are vessel owners and operators of vessels with:

- Length Overall (LOA) between 4 and 80 meters.
- A standby electrical load of <40kW or a standby load which is <20% of generator capacity.
- Marine structures and shoreside applications

The needs of target customers for the system are primarily cost reduction. Customers require new technology to be economically attractive (payback period of <3 years) with minimal operation by the crew. Vessel owners however must now adapt their vessels to reduce emissions or face penalties in the form of carbon taxes or high berthing fees in ports (up to 40% fee reduction for low emissions) for non-compliance with standards. Daretech's solution must be commercially available at this time, therefore time is of the essence with getting a certified & proven solution to market.

The advantage of the system is the ability to incorporate a modular and suitably scaled hybrid renewable generation and energy efficiency solution into a vessel's energy mix. This implementation will increase the competitiveness by reducing operating costs directly through reduced fuel usage and equipment service cost and will also futureproof against incoming regulations and punitive measures around emissions levels from vessels in port. The modular and scalable nature of the technology allows Daretech to cater for the wide range of specific vessel requirements and architectures.

Based on engagement with the sector, the assumptions made at project application stage have been confirmed with a generally greater focus now on fuel and cost reduction as a result of increased costs.

Daretech spent time in the initial stages of the project defining and categorising user groups that will primarily benefit from the installation of hybrid systems and identifying the system specifications most suitable to each group. An example, fishing vessels between 20 and 30m in length is shown in figure 2 below, with port locations referenced. This has been repeated for all vessels and structures that Daretech have identified as of interest and a comprehensive database has been developed.

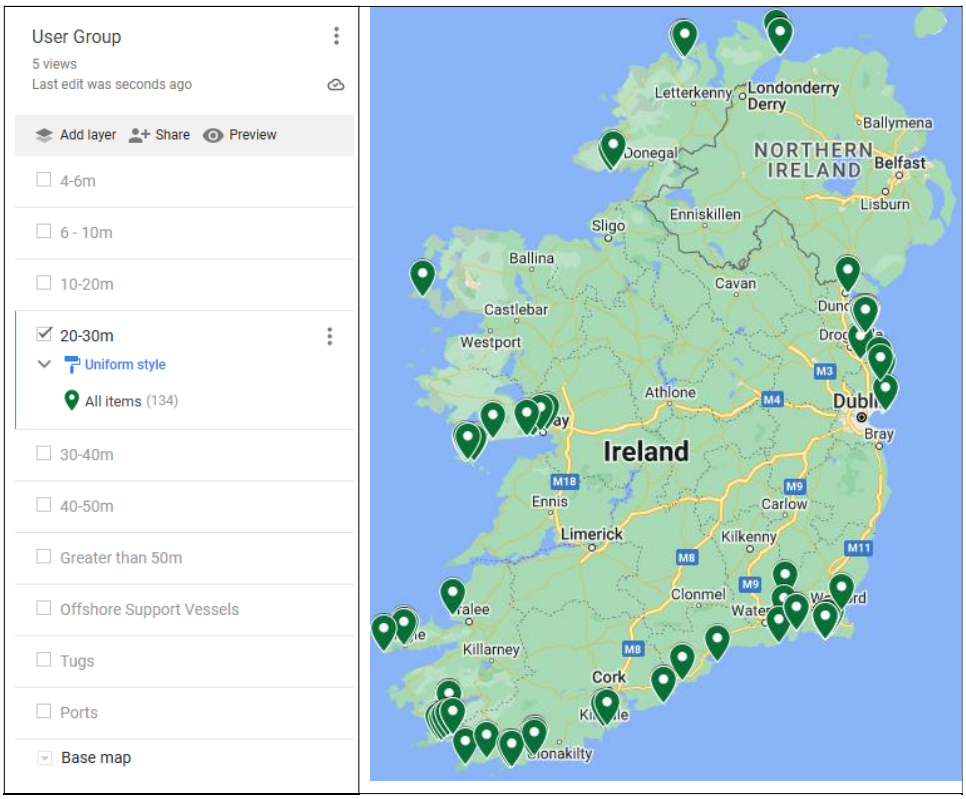

Figure 2: Sample user group - fishing vessels between 20 and 30m

This was followed up during the stakeholder engagement and requirements specification work packages (3 & 4) where a considerable amount of vessel electrical data has been gathered through the installation of power meters and the integration of Daretech's test rig on sites. An example of this data is shown in figure 3.

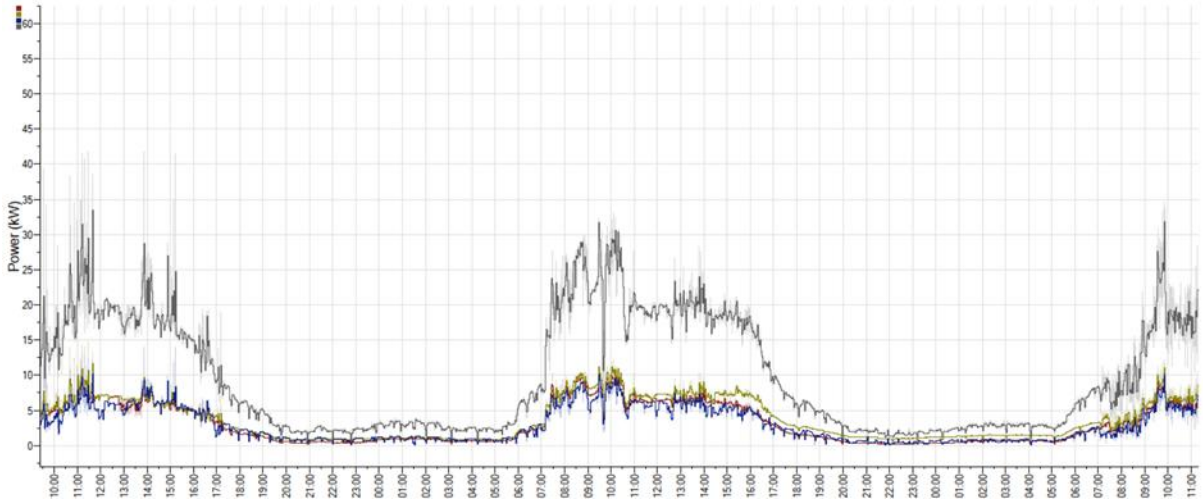

Figure 3: Sample data gathered from a fishing vessel.

This data has proved invaluable in specifying and standardising system sizes and has further complimented data which has been gathered prior to project commencement. These system designs were then developed throughout Work Package 5 to arrive at a standardised system design for customers. The data also allows us to provide the end user with an accurate estimate of capital costs and return on investment over the lifetime of the system. Examples of the outputs from economic modelling is described in DT-EIRE-201 Customer Engagement Report.

5. Dissemination Activities

#	Activity	Objective	Level / Target Audience	Impact	Notes on Implementation
1	**Project webpage:** A dedicated page on the Daretech website, available at; https://daretech.ie/projects/project-eire# This will be the main portal for the dissemination of project related material.	To raise awareness of project details, activities and results and promote the technology to potential users and other stakeholders.	**Public** - Potential customers and other stakeholders.	Raise general awareness of the project and technology for potential customers. **Milestone related updates to page – visits to be analysed based on promotional material releases.**	A project specific webpage has been established and promoted via the Daretech LinkedIn page. https://daretech.ie/projects/project-eire Data gathered during the data collection activities has been published on the web page, and a tracker in place to analyse and track downloads. The data is highlighted during public engagement activities undertaken in #6, 7 below.
2	**Social Media Platforms:** Project promotion through Twitter and LinkedIn with regular thematic blogs to raise awareness of activities and results.	Regular promotion through relevant channels to provide progress updates on project.	**Public** - All relevant stakeholders and potential customers.	Generate a following for the project from stakeholders and actively update on milestones. **Use analytics to quantify and optimise reach to relevant stakeholders**	• Monthly tweet / LinkedIn Update • Analytics from the company's social channel are provided as follows. During the course of the project the companies LinkedIn page posted 6 project specific updates, and 6 updates of a more general product nature. The 6 project specific updates had a combined impression value of 987, averaging 165 per post – each post an average click through rate of 8%. Overall, the visitor activity on the page was up more than 70% when compared to the previous 12 months. The profile of visitors to the webpage are below in Note #4 with approximately 42% of the identifiable 77% of visitors within our target category.
3	**Dissemination Material:** Project brochures and other digital content circulated at relevant conferences and events.	To catch the attention of attendees at relevant conferences, trade shows and other events.	**Public** - Attendees at the above events.	Drive traffic to project webpage and information through engagement. **Use of QR codes or similar, to quantify impact and optimise reach.**	Company branding for tradeshows has been updated to include a reference to the EIRE project. A QR code on the banner links directly to the web page. Company website updated with technical specifications for standardised system sizes.

					This was used at events listed in number 6 below, where relevant. See project note See project note #1 in section 3, below.
4	**Promotional News Activity:** Generate promotional news activity at product launch through articles in sectoral publications, local, national, and international media channels.	To generate awareness of project and provide an overview of activities, results, and relevancy to different industry sectors.	**Public** - All relevant stakeholders	Media channels at product launch. See list of media / websites / publications in Appendix B. **2 channels targeted to cover launch**	• Publication on The Skipper website and February Print Edition https://theskipper.ie/daretech-a-game-changer-in-cutting-costs-emissions/ • Publication on MIIN website https://marine-ireland.ie/node/1002 • Publication in MIIN January Newsletter • A post project activity is planned for October 2023 upon commissioning of a new Daretech system at an aquaculture site in Galway. We will inform the project officer in SEAI when details become available.
5	**Key Industry Stakeholders** Liaise with local, regional, and national development agencies	Raise awareness of technology applications & advantages with a view to promotion of technology and applications through their resources and networks.	**Stakeholder Information** - Industry and Regulatory bodies in the sector (BIM, SEAI, IMDO, MIIN, Marine Institute, etc.)	Promotion of technology through agencies, networks, and approval for support mechanisms where applicable. **Generate secondary promotion through these stakeholders**	• Attendance at stakeholder meeting in Achill (See project note #2 in section 3, below) • GRIPP project (See project note #3 in section 3, below) • Site visits – Details can be provided on request.
6	**Dissemination at Conferences / Trade shows / Events** Project results dissemination	Targeted dissemination of product promotional material and project results to marine trade show attendees or conferences.	**Public** – Potential end users. See list of conferences in Appendix A. Minimum attendance at 4 events.	Quantifiable lead development **Engage with 20 relevant stakeholders at min. 4 conferences / trade shows. Present minimum 2 papers / project updates**	Daretech exhibited at the following conferences during the project timeline and exceeded targets for stakeholder engagement. • Skippers Expo – February 2023 • World Maritime Day – March 2023 • NOR Shipping - June 2023 • MIIN – attended various MIIN organised events throughout the project timelines and awaiting an opportunity to present at relevant industry showcase.
7	**Customers / End users** Engagement to highlight technology suitability and provide information on project / technology	Direct meetings to discuss adaptation of technology and steps to implementation.	**Stakeholder Information / Confidential** - Vessel owners, shipyards, ports, aquaculture sites.	Data collection and sharing, drive sales and disseminate project news. **Minimum 20 users over project duration**	• Refer to DT-EIRE-201 Customer Engagement Report. • Conducted 8 desktop case studies. • Undertook 1 design validation trial (of which over 50 people observed during 10-week trial)

8	**Project Data** Daretech website & other open-source archives	To provide data from project testing and reach key user groups as defined in work package 2.	**Stakeholder Information** - All relevant stakeholders	Drive interest in system operation and key performance metrics. **Project data made available publicly.**	During the project period, Daretech undertook 3 data collection deployments from a broad selection of marine users. These details of these case studies are provided in DT-EIRE—201 Customer Engagement Report. All data collected from field trials has been made freely available through the project webpage, available at: https://daretech.ie/projects/project-eire

6. Conclusions and Recommendations

Work undertaken throughout the project allowed the development of a range of standardised hybrid power systems that are suitable for a wide range of user's - vessels, marine structures, and quayside applications of varying capacity. The consultation phase provided an invaluable level of detail in the system design and validation of this design through on-site testing has developed confidence in the ability of the system to meet user requirements. Detailed design, with input from manufacturers, equipment suppliers and installation contractors has identified and addressed some unforeseen issues in electrical and mechanical integration and a first commercial unit is being built and deployed in the coming months. Extensive dissemination of project activities, as outlined in section 5 above has raised awareness of the project, the technology, and its ability to reduce emissions in the marine sector. An updated business plan has focused attention on route to market and the work has been undertaken on the development of new sales channels to address Irish and EU markets.

Key recommendations that have been noted from project activities include some detail around practical system integration which have been incorporated and summarised in the detailed design report. Supply chains and routes to market have also been developed with a focus on the importance of developing commercial partnerships that have existing access to various market segments.