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Issue **2**



Welcome to the 2nd edition of the HARPOONERS project newsletter!

Dear Reader,

We are delighted to welcome you to the second issue of the HARPOONERS project newsletter. As the project continues to move forward, this edition brings updates on recent activities, progress achieved, and upcoming steps in our joint effort to develop innovative solutions for ship electrification. Through the collaboration of a strong consortium of leading partners across Europe, HARPOONERS is contributing to the decarbonisation of the maritime sector under the Horizon Europe programme. We invite you to explore the latest news and stay connected with the project's evolution.

Stay tuned at <https://harpooners.eu/>

With best wishes,

The HARPOONERS project team.

1) THE HARPOONERS PROJECT

Driving the future of electric maritime transport

HARPOONERS is a pioneering European project dedicated to developing high-voltage, modular, and lightweight battery storage systems for maritime and inland waterborne transport.

By introducing a modular and flexible AC battery system, the project aims to revolutionize vessel electrification, eliminating combustion engines (zero-emission operations) in smaller ships and enhancing energy efficiency in larger vessels.

From innovation to real-world impact

HARPOONERS is not just about research—it's about real-world application. The project will develop, test, and validate its high-voltage battery systems in actual maritime and inland waterborne environments, ensuring their efficiency, scalability, and compliance with safety standards. By bridging innovation and industry needs, HARPOONERS is shaping the future of zero-emission, high-efficiency maritime transport.

HARPOONERS is structured around three main innovation pillars:

- High-Voltage Powertrain Development
- Sustainability
- Digitalization & Safety

Expected results:

- Development of a next-generation high-voltage battery system tailored for maritime and inland waterway applications.
- Development of a cyber-secure and intelligent connected digital twin platform for monitoring and optimization of maritime electric powertrains.
- Advancement in certification frameworks and safety standards to facilitate widespread adoption of new battery technologies.
- Acceleration of commercial deployment through techno-economic analysis and exploitation strategies.

A step-by-step innovation plan

To achieve its ambitious goals, HARPOONERS is structured into eight Work Packages (WPs), each addressing a crucial aspect of the project:

- WP1 - Project coordination and management
- WP2 - System requirements and specifications definition
- WP3 - Novel powertrain development for high-voltage maritime and inland applications
- WP4 - Safety lifecycle and identification of certification requirements
- WP5 - Digital twin technologies and cloud-based real-time monitoring
- WP6 - System integration, testing, and validation
- WP7 - Accelerating commercial exploitation, techno-economic analysis, and deployment plans
- WP8 - Innovation management, recommendations, and dissemination

2) TECHNICAL PROGRESS AND DELIVERABLES

Over the past months, we have made significant progress on various Work Packages. Below are some of the key updates:

WP2 System requirements and specifications definition - Finished

WP1 to WP8 Progress

We have been progressing on WP3 to WP8:

- We are working on the formation of an Expert Forum with the objectives of providing recommendations and supporting on the dissemination activities
- We have been working on the novel powertrain development for high-voltage maritime and inland applications and first Models are already finished and first simulations developed. In addition, the Power Electronics Architecture is also designed, low level Control Algorithms developed and PE prototype is in manufacturing process. The Initial Cooling definition model is already done, the battery controller and PE ECU requirements are defined and the Communication protocol is in its initial definition. Finally, Power Electronics losses model and Battery model are finished.
- We are also working on the Safety Plan and Safety Life Cycle. The HAZID Terms of Reference (ToR) based on FMEA, FTA, single line and block diagrams are developed and the first HAZID workshop has just taken place.
- Regarding the WP5 - Digital twin technologies and cloud-based real-time Monitoring, the dataset from testbenches and models are finalized, a prototype cloud platform is ready and Rule-based and ML-based cyber intrusions are tested, and Edge-cloud linked.
- Dissemination and liaison activities: We keep on working on the Communication and dissemination activities (press, social media, Events).

Liaison activities:

- HARPOONERS has been presented as part of MARLEN initiative.
- HARPOONERS and eWAVE are planning a joint GA in Istanbul in March / April 2027

3) HARPOONERS EVENTS

- HARPOONERS Holds Its 1st General Assembly in Bilbao

The HARPOONERS consortium successfully held its **General Assembly on 29-30 October at TECNALIA Research & Innovation's headquarters in Zamudio (Bilbao, Spain)**, bringing together partners from across Europe for two days of collaboration, reflection and strategic planning.

The meeting provided an excellent opportunity to review the project's progress, align on technical and organisational developments, and define the next steps towards advancing sustainable maritime technologies. Discussions focused on innovation in electric propulsion systems, energy efficiency, and solutions supporting the decarbonisation of maritime transport.

Throughout the two days, consortium partners actively exchanged insights on cleaner technologies, smarter vessels and the contribution of electrification to healthier oceans. The sessions highlighted the strong collaborative spirit of the project and reinforced HARPOONERS' shared commitment to delivering impactful, industry ready solutions under the Horizon Europe programme.

Hosted in the dynamic innovation environment of Bilbao, the General Assembly marked another important milestone for HARPOONERS, strengthening coordination within the consortium and building momentum towards a more sustainable future for maritime transport.



- HARPOONERS Showcased at Europort Exhibition 2025

The HARPOONERS project was actively disseminated at **Europort Exhibition 2025**, one of the most important and international events in the global maritime sector, held in **Rotterdam (the Netherlands)** from **3 to 6 June 2025**.

HARPOONERS was represented by **Ángel Santurtun (FMV - Basque Maritime Cluster)**, who delivered oral presentations introducing the project's objectives, scope and key technological developments. Over the course of the exhibition, **two presentations per day** were carried out—one in the morning and one in the afternoon—allowing continuous engagement with visitors and stakeholders.

In addition, a dedicated **HARPOONERS roll up** was displayed at the FMV booth, helping to attract attendees and increase the project's visibility. Visitors to the booth, as well as other exhibition participants, were informed about the scheduled presentations, held daily at **11:00 and 16:00**, and invited to learn more about the project.

The audience consisted mainly of representatives from the maritime industry, including shipyards, marine equipment manufacturers, research and development centres and other key actors, with around **40 attendees** participating across the sessions. This provided an excellent opportunity to raise awareness of HARPOONERS and discuss current challenges and future solutions for maritime electrification.

Participation in Europort 2025 further strengthened HARPOONERS' outreach to industry and research stakeholders and reinforced its position within the European and international maritime innovation ecosystem.

• HARPOONERS Presented at the Business2Sea Event in Porto

The HARPOONERS project was presented at **Business2Sea**, a key event bringing together industry, policymakers and academia, held at the **Porto Cruise Terminal in Porto, Portugal**.

During the event, **TECNALIA** represented the project, introducing the research activities being carried out within HARPOONERS and highlighting its contribution to advancing maritime electrification. The presentation focused on ongoing efforts to develop innovative solutions that support cleaner, more efficient and sustainable shipping.

Business2Sea provided an excellent platform to engage with a diverse audience and discuss current challenges and future opportunities for electrification in the maritime sector. The interaction with stakeholders from different backgrounds enabled valuable exchange on technological developments, regulatory perspectives and market needs.

Participation in this event further strengthened HARPOONERS' visibility and reinforced its role in shaping the next generation of electric and hybrid solutions for maritime transport under the Horizon Europe programme.



• HARPOONERS Presented at the CINEA Workshop on Energy Transition and Maritime Decarbonisation

The Horizon Europe-funded HARPOONERS project was recently presented at the high level workshop **"CINEA Feedback to Policy - Energy Transition of the Fisheries Sector & Maritime Decarbonisation"**, organised by the European Climate, Infrastructure and Environment Executive Agency (CINEA).

Led by **TECNALIA Research & Innovation** and with the participation of the Basque Maritime Cluster, HARPOONERS was showcased by **Dr. Estibaliz Delgado (TECNALIA)**, who introduced the project's vision and its contribution to a cleaner and more efficient maritime and fisheries sector.

The event gathered European institutions, national authorities, research centres, industry stakeholders and innovative projects, providing a valuable forum to exchange insights and strengthen collaboration on maritime decarbonisation.

During the session, HARPOONERS highlighted its work on technological and operational solutions aimed at reducing emissions, improving energy efficiency and accelerating the deployment of sustainable systems across fleets and maritime operations. The workshop also offered an excellent opportunity to present the project's first achievements, engage with policymakers and funding bodies, identify synergies with complementary initiatives, and reinforce HARPOONERS' position within the EU maritime innovation ecosystem.

Participation in this event represents an important step in increasing the project's visibility and consolidates HARPOONERS as a reference initiative in the decarbonisation of the maritime and fisheries sectors.



• Presentation at the Process Systems Engineering Group at NTNU, Trondheim

On 9 March 2026, the HARPOONERS project was showcased at the Process Systems Engineering Group seminar at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway, through a technical presentation delivered by Rambabu Kandepu (Corvus Energy).

The presentation addressed one of the key challenges in battery based maritime electrification: the accurate monitoring and control of **lithium ion battery systems**, which are inherently nonlinear, time varying and partially observable. Critical internal states—such as **state of charge (SOC)**, **state of health (SOH)** and **internal resistance**—cannot be measured directly, making reliable state estimation essential for battery safety, performance and lifetime management.

The session focused on **control oriented modelling and state estimation methods** with direct relevance for **real time Battery Management Systems (BMS)**. Equivalent circuit models and state space formulations were introduced, followed by **Kalman filter based estimation techniques** designed to operate under real maritime conditions.

Special attention was given to **observability challenges** arising from changing operating conditions and battery ageing, which can significantly impact estimation accuracy over a system's lifetime. In this context, battery models were presented as fundamental components of **digital twins**, enabling closed loop learning by combining laboratory characterisation with real world operational data.

This contribution reinforces HARPOONERS' commitment to advancing reliable, industry ready solutions for large scale deployment of electric and hybrid powertrains, supporting safer operations and accelerating the decarbonisation of maritime transport.



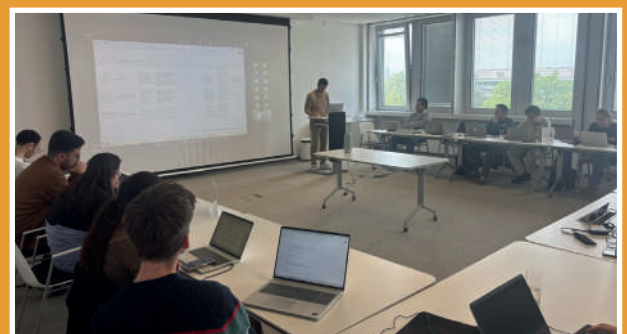
• HARPOONERS Holds Its 2nd General Assembly in Vienna

The HARPOONERS project consortium successfully held its **General Assembly meeting** last 15 and 16th of April, 226 in Vienna, bringing together partners to review progress and align on the next steps of the project.

The meeting provided an important opportunity for consortium members to **exchange updates on ongoing activities**, assess results achieved so far, and discuss upcoming milestones. Strategic discussions focused on strengthening collaboration across work packages, ensuring alignment with project objectives, and reinforcing the overall impact of HARPOONERS.

In addition to the technical and managerial sessions, the General Assembly fostered **knowledge sharing and cooperation among partners**, reinforcing the consortium's commitment to innovation and excellence. The open dialogue, constructive feedback, and meaningful exchanges will contribute to the successful implementation of the project in the coming months.

The HARPOONERS consortium would like to thank all partners for their active participation and engagement during the meeting, as well as the hosts in Vienna for their support. The insights and agreements reached during the General Assembly mark an important step forward as the project continues to advance its objectives.



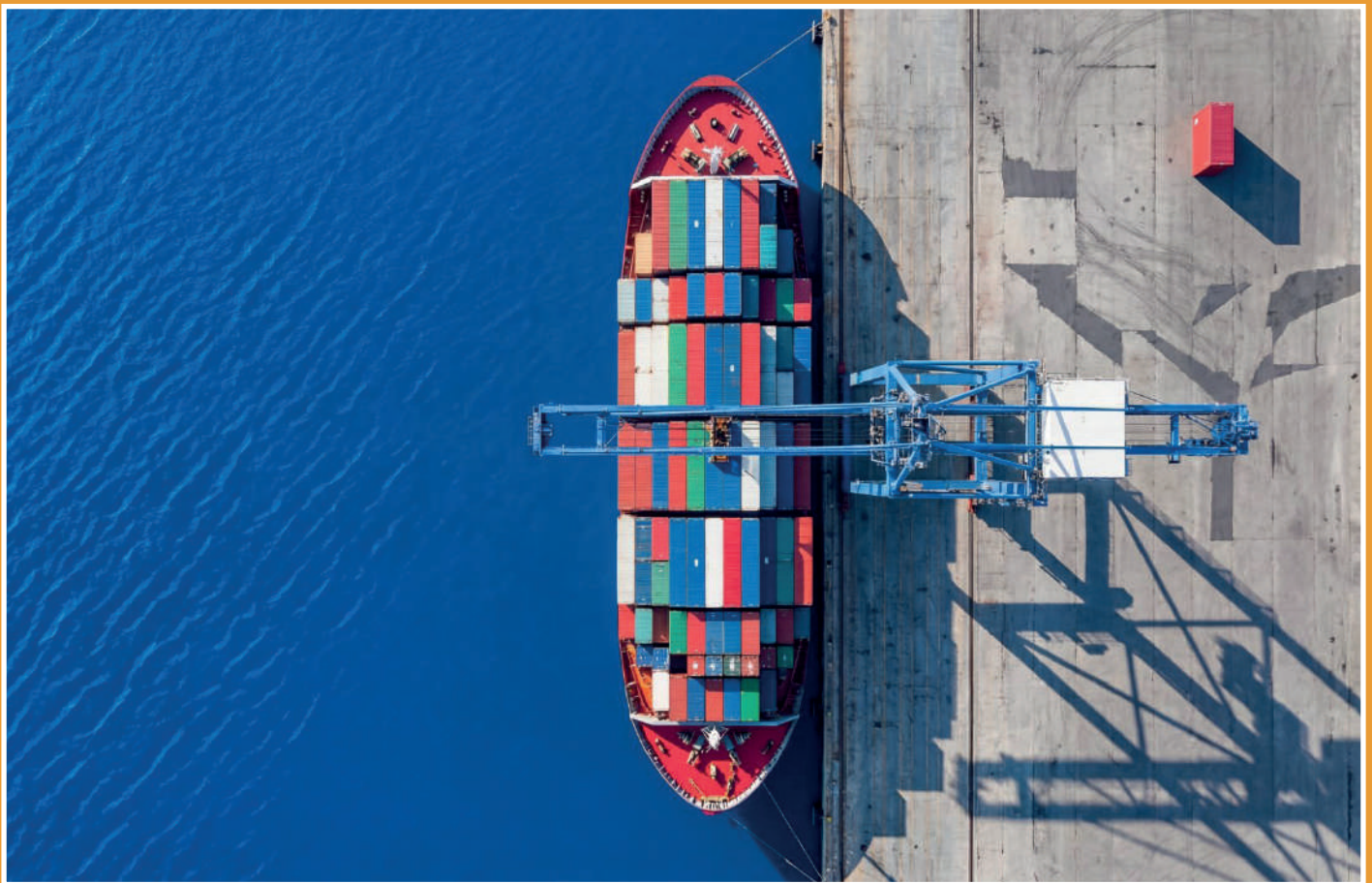
- **WEBINAR: NEW DEVELOPMENTS IN POWER CONVERSION SYSTEMS FOR MARITIME TRANSPORT**

On 13 May, TECNALIA Research & Innovation, in collaboration with Power Electronics, will host a technical webinar showcasing the latest developments in power conversion systems for maritime applications, using the Horizon Europe-funded HARPOONERS project as a real-world success case.

The webinar will present how high power battery energy storage systems (BESS) and modular multilevel power converters, such as Cascaded H Bridge (CHB) architectures, can enhance energy efficiency, smooth peak demand, and enable zero emission port operations—even for long distance vessels.

Led by TECNALIA, the HARPOONERS project is developing next generation high voltage, lightweight and modular electric powertrains with strong industrial potential, supporting the decarbonisation of the maritime sector.

Free online technical webinar – [Registration available:](#)



4) COLLABORATION WITH OTHER PROJECTS

HARPOONERS Strengthens EU Synergies through Collaboration with the MarLEN Network

The HARPOONERS project continues to expand its European collaboration network through a new synergy with the **MarLEN (Maritime Low Emission Network)** initiative, established under **Work Package 8**, dedicated to innovation management, Key Exploitable Results (KERs), and dissemination and exploitation activities.

This collaboration supports HARPOONERS' strategic objective of overcoming fragmentation in research and innovation by fostering coordination and long term synergies with complementary European maritime initiatives, thus enhancing the potential for replication and impact across the EU.

MarLEN is a 54 month Horizon Europe project bringing together **14 ministries, funding bodies and research organisations from 10 European countries**, with the shared goal of accelerating the decarbonisation of waterborne transport. The initiative aligns closely with the **Zero Emission Waterborne Transport (ZEWI) partnership**, promoting cooperation between national and regional research programmes.

Through this synergy, HARPOONERS and MarLEN will work together on mutual promotion activities, structured knowledge exchange of non confidential results and success stories, and joint actions such as workshops and conference events. This collaboration reinforces HARPOONERS' role within the European maritime innovation ecosystem and contributes to building a more connected and impactful path towards zero emission shipping



5) SCIENTIFIC PUBLICATIONS

- Ettore Soldaini, Sachin Kumar Bhoi, Sajib Chakraborty, Omar Hegazy, **"Machine Learning-Based Intrusion Detection System for Wireless IoT Nodes Enabling Resilient Digital Twin Services in Marine Applications"**.
- Eneko Otaola, Edorta Ibarra, Salvador Ceballos, Andrés Sierra Gómez, **"Investigation on power semiconductors for Maritime battery-to-grid CHB power electronics converters"**.

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