D8.6: Stakeholders Analysis, Exploitation Plan and Comprehensive Market Analysis Report

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Co-funded by the European Union

Project data

Document	
Grant agreement n°	101138694
Acronym	BlueBARGE
Project title	Blue Bunkering of Anchored ships with Renewable Generated Electricity
Call	HORIZON-CL5-2023-D5-01
Start date	1st January 2024
Duration	36 months
Project URL	https://bluebarge.eu/

Document Info

Deliverable	
Document reference	D8.6
Due Date of Delivery to EC	31.12.2024
Actual Date of Delivery to EC	20.12.2024
Document type	Report
Dissemination level	PU - Public
Work package	WP8
Lead beneficiary	MAGCIR
Reviewers' Organization	ABS, Columbia Ship Management

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Revision history			
Version	Date	Editor	Summary of Modifications.
V0.1	20.05.2024	Reza Karimpour	Initial version.
V0.2	31.06.2024	Reza Karimpour	Initial version with internal feedbacks from MAGCIRCLE colleagues.
V0.3	10.10.2024	Reza Karimpour	Developed based on extensive literature review and desktop analysis.
V0.4	22.11.2024	Reza Karimpour	Developed based on ten responses from partners to survey questions.
V0.5	28.11.2024	Reza Karimpour	Final tuning and adjustment for peer review version of the document.
V1.0	19.12.2024	Reza Karimpour	Finalising the document based on all comments and feedback received from two peer reviewers, ABS and Columbia Ship Management.

Quality control		
Role	**Approval date**	**Reviewer**
Reviewer	10.12.2024	Philippos Ioulianou (Columbia Ship Management)
Reviewer	10.12.2024	Venetia Lazaratou (ABS)

Acronyms and Abbreviations	
Acronym/Abbreviation	**Meaning**
ABS	American Bureau of Shipping
AC	Alternating Current
AiP	Approval-in-Principle
CINEA	European Climate, Infrastructure and Environment Executive Agency
D	Deliverable
DMP	Data Management Plan
DOI	Digital Object Identifier

EC	European Commission
EAB	External Experts Advisory Board
EMS	Energy Management System
EU	Europe
EU ETS	European Emission Trade Scheme
FTO	Freedom To Operate
GA	Grant Agreement
GHG	Greenhouse gas
GT	Gross Tonnage
HRB	Horizon Results Booster
IMO	International Maritime Organisation
IPR	Intellectual Property Rights
JOA	Joint Ownership Agreement
KERs	Key Exploitable Results
KPI	Key Performance Indicator
KR	Key Results
MAGCIR	MagellanCircle
MMS	Multimarine Services Limited
NDA	Non-Disclosure Agreement
NTNU	Norwegian University of Science and Technology
NTUA	National Technical University of Athens
OPS	Onshore Power Supply
SEN	Sensitive
SSE	ShoreSide Electricity
T	Task
TL	Task Leader
WP	Work Package
WPL	Work Package Leader
V	Volt
VRFB	Vanadium Redox Flow Batteries

Disclaimer

This project has received funding from the European Union's Horizon Europe Funding Program, through the European Climate, Infrastructure and Environment Executive Agency (CINEA) under the powers delegated from the European Commission and under Grant Agreement No 101138694.

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1 - Executive Summary

The BlueBARGE project is a pioneering initiative aimed at delivering sustainable energy solutions for the maritime sector. By developing a modular and scalable power barge, the project is set to significantly reduce greenhouse gas (GHG) emissions and provide clean, renewable energy to offshore platforms and anchored vessels. The project aligns with the European Union's Fit for 55 initiative, addressing decarbonization goals by integrating advanced hybrid energy storage systems, including lithium-ion batteries. A key feature of the BlueBARGE solution is its adaptability and scalability for various maritime applications. The power barge is designed to meet the energy needs of vessels over 5000 gross tons (GT), contributing to GHG reduction and addressing additional environmental concerns, such as noise and vibration mitigation. These features ensure the solution is well-positioned to support the maritime sector's transition to clean energy.

Stakeholder engagement is central to the project's strategy and is developed under Task 8.3. The project identifies and maps key stakeholders, including shipowners, ports, policymakers, and technology providers, to ensure their needs and interests are reflected in the design and commercialization of the BlueBARGE solution. Continuous engagement throughout the project's lifespan is facilitated through targeted workshops, surveys, and live demonstrations, ensuring stakeholder collaboration remains active during and beyond the project.

The Exploitation Plan and Market Analysis, developed under Task 8.4, outlines a clear pathway to commercial success in the maritime industry. This comprehensive plan addresses critical elements such as value proposition, market size, regulatory constraints, and market innovation to create a sustainable business model. The Lean Business Model Canvas serves as a strategic tool to identify Key Exploitable Results (KERs) and align them with market needs and EU regulations, such as the Fit for 55 initiative.

Furthermore, the project places strong emphasis on Intellectual Property Rights (IPR) management and business sustainability, as outlined in Task 8.5. The IPR framework ensures the protection of key technical innovations, including hybrid energy systems, while complying with GDPR and other data protection regulations. This robust framework safeguards the long-term commercialization potential of BlueBARGE, providing a detailed stakeholder analysis, an exploitation plan for the project outputs and a market analysis. By focusing on technological innovation, regulatory compliance, and stakeholder collaboration, BlueBARGE represents a transformative approach to maritime decarbonization. Its modular and scalable design, tailored for diverse energy demands, positions the project as a critical contributor to the maritime sector's transition to clean energy.

The project also emphasizes phased commercialization, with a strategy paving the way for deployment by 2030. Initial pilot deployments will focus on high-potential regions like the Mediterranean and Northern Europe, targeting areas with stringent regulatory requirements and growing demand for clean energy solutions. Through technological advancements, stakeholder engagement, and a commitment to sustainability, BlueBARGE is poised to redefine maritime energy systems.

BlueBARGE project integrates cutting-edge hybrid energy systems, innovative business models, and strategic stakeholder collaboration to deliver a sustainable solution for the maritime industry. By addressing environmental challenges, fostering partnerships, and aligning with regulatory frameworks, BlueBARGE creates a pathway for significant GHG reduction and supports the global transition to clean maritime operations.

This deliverable, D8.6, builds upon the outcomes of Tasks 8.3, 8.4, and 8.5, integrating stakeholder analysis, exploitation strategies, and intellectual property rights (IPR) frameworks into a comprehensive market analysis. Specifically, insights from Task 8.3 provided the foundational stakeholder engagement framework, Task 8.4 informed the exploitation pathways and value proposition alignment, and Task 8.5 ensured the protection of innovative technical solutions through robust IPR management. Together, these tasks create a cohesive approach, contextualizing the findings of D8.6 as part of a broader effort to align project outputs with market and regulatory demands.

2 - Introduction

Background of the BlueBARGE Project

The BlueBARGE project is designed to address the urgent need for decarbonizing the maritime sector by developing a fully integrated, modular power barge solution. This initiative is part of a broader effort to electrify maritime operations and reduce the industry's carbon footprint. The maritime industry contributes approximately 3% of global greenhouse gas (GHG) emissions, driving international decarbonization efforts. BlueBARGE supports these goals by providing clean, renewable energy to moored and anchored vessels, reducing emissions at ports and offshore locations.

The project integrates cutting-edge hybrid energy storage systems, including lithium-ion (Li-ion) batteries and vanadium redox flow batteries (VRFB). Additionally, the potential use of hydrogen fuel cells is being explored to future-proof the system. The primary objective is to deliver shore-side electricity (SSE) to vessels while also ensuring modularity and scalability to adapt to various maritime and onshore applications.

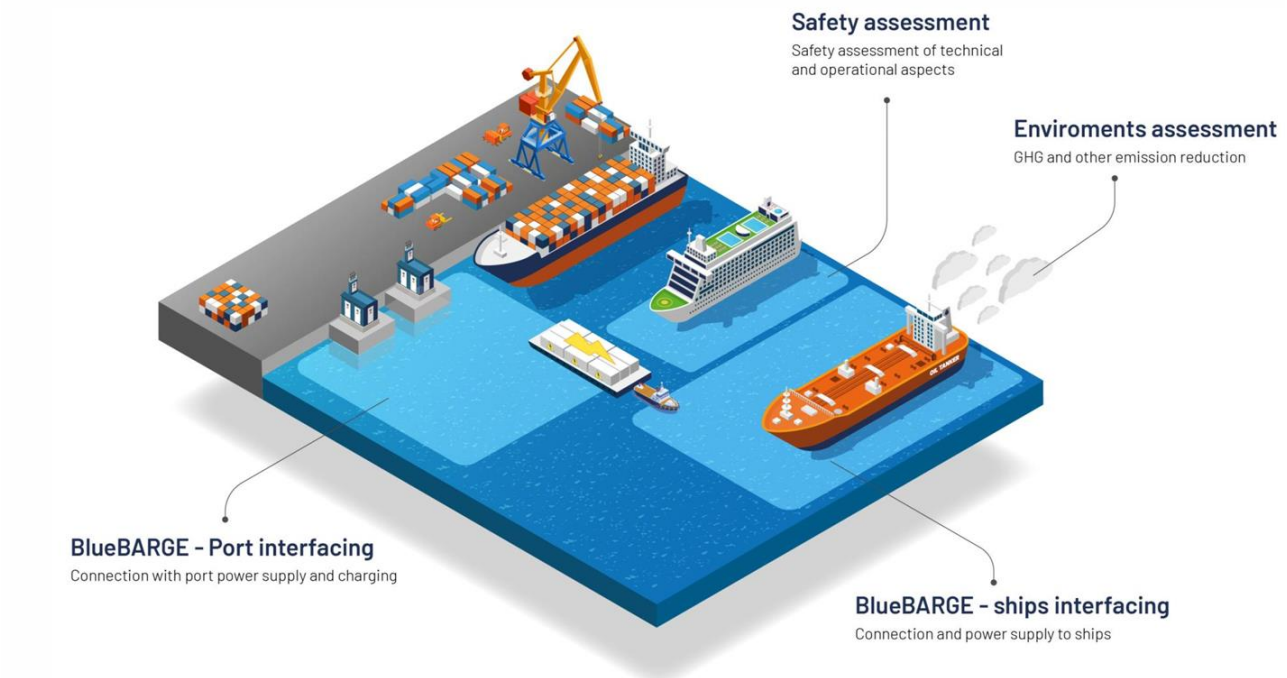


Figure 1 How BlueBARGE works

Work Package 8 (WP8): Engagement, Outreach, and Commercialization

Work Package 8 focuses on engagement, outreach, and commercialization strategies, aligning with the BlueBARGE project's overarching goals. WP8 ensures that the project's achievements are communicated to the public and key stakeholders, while also securing commercial pathways for its technologies. Stakeholder engagement is essential for fine-tuning both the technical and market exploitation plans, ensuring that BlueBARGE's solutions are aligned with regulatory and market needs.

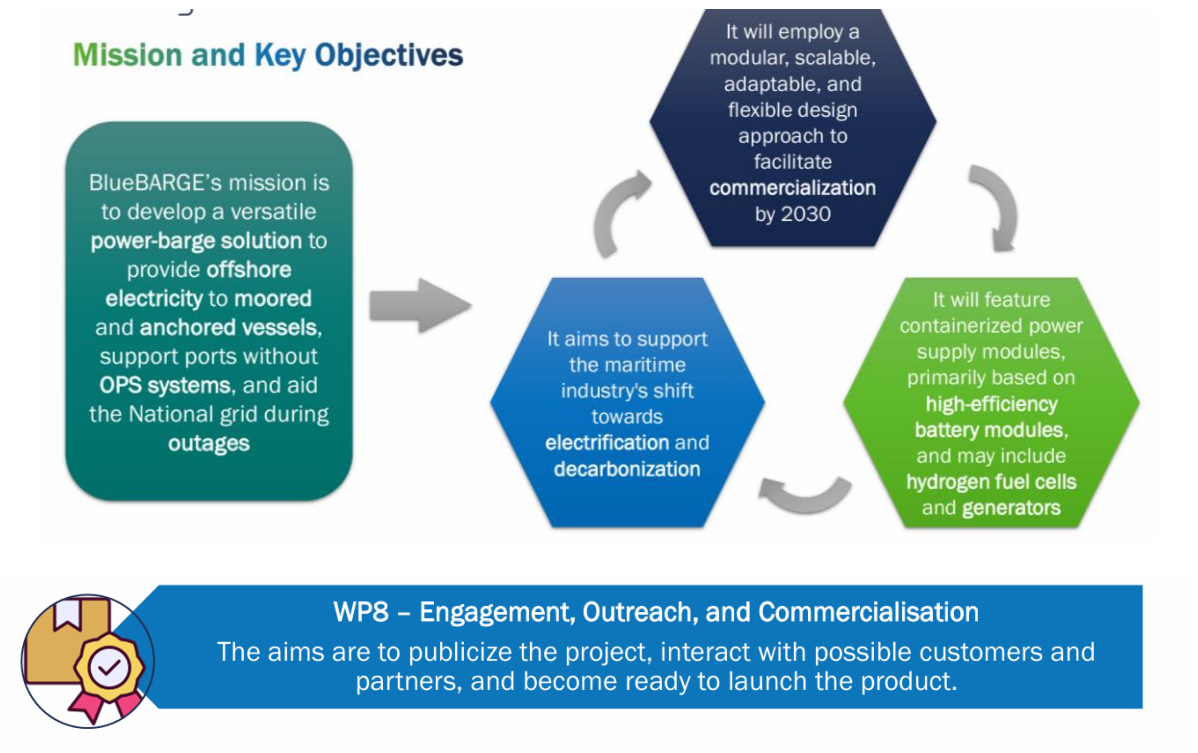


Figure 2 Objectives of WP8 in line with the project overall goal

Stakeholder Analysis and Market Exploitation

Importance of stakeholder analysis

Stakeholder analysis is a key factor in ensuring the BlueBARGE project's technical and commercial success. This process involves identifying and engaging with relevant stakeholders, such as regulatory bodies, energy providers, battery manufacturers, and technology partners. Stakeholder input will inform the project's scalability goals, modular design, and market potential. By aligning with the expectations and requirements of key players, the project ensures its relevance in the market.

Exploitation plan and market analysis

The exploitation plan and market analysis focus on understanding stakeholder needs and market demands. These analyses will guide the commercialization strategy and help ensure that BlueBARGE aligns with EU regulations, including decarbonization targets and compliance with environmental directives such as the EU's Fit for 55 initiative. By addressing regulatory requirements and decarbonization goals, the project aims to drive market adoption and commercial success.

Objectives of task 8.4: stakeholder engagement and exploitation

Task 8.4 plays a crucial role in integrating stakeholder feedback into the project's technical and market strategies. This task ensures that data gathered from stakeholders is used to refine the modular design and technical specifications, facilitating the project's commercial viability. Through continuous engagement, the project will adjust its exploitation plans to remain market-relevant and compliant with EU environmental regulations.

Document intended readership

The document is a public document designed for a diverse audience involved in the development, operation, and commercialization of the BlueBARGE power solution, including:

- Electrical engineers and designers
- Operation and maintenance personnel
- Project managers, supervisors, and technicians
- Regulatory and compliance officers

The BlueBARGE project is a pivotal initiative aimed at reducing GHG emissions in the maritime sector through the development of a modular, scalable power barge. Work Package 8 ensures the project's long-term impact by focusing on stakeholder engagement, outreach, and commercialization. The integration of stakeholder needs into the technical and commercial strategies, along with adherence to EU regulatory frameworks, will drive the project's success, making BlueBARGE a significant contributor to the maritime industry's decarbonization efforts.

3 - Stakeholder Analysis

In any complex project such as BlueBARGE, which aims to bring innovative solutions to the maritime industry, a thorough stakeholder analysis is essential. The Stakeholder Analysis identifies and categorizes key individuals, organizations, and entities that can impact or be impacted by the project's outcomes. This includes both internal and external stakeholders, from consortium partners to regulatory bodies and maritime industry leaders. By engaging stakeholders early in the process, the project ensures transparency, addresses their concerns, and incorporates their feedback into the design and development phases. This analysis will guide interactions with stakeholders throughout the project lifecycle, fostering collaboration and ensuring that the commercial, environmental, and operational aspects of the BlueBARGE solution align with the needs of the maritime industry. The analysis also helps in the identification and management of expectations and risks, contributing to the overall success and sustainability of the project.

3.1 - Stakeholder Mapping

BlueBARGE project emphasizes a comprehensive and strategic approach to stakeholder mapping and engagement, recognizing that diverse stakeholder roles are critical at each phase of the project. These roles range from the design and regulatory compliance stages to commercialization and long-term

sustainability. A well-defined categorization of stakeholders facilitates targeted engagement strategies that align with the project's goals and objectives. Furthermore, it enables the project to address key regulatory, environmental, and operational considerations effectively.

Stakeholder mapping involves identifying and categorizing stakeholders based on their level of influence and interest in the project. It ensures that communication strategies and engagement activities are tailored to meet the needs and expectations of each group. The BlueBARGE project utilizes a strategic framework, drawing on tools such as influence/interest matrices, to systematically evaluate and manage stakeholder relationships.

The BlueBARGE project identifies and categorizes stakeholders into two primary groups based on their influence, level of involvement, and impact on the project's success. This structured approach ensures a comprehensive understanding of their roles and facilitates tailored engagement strategies.

Primary stakeholders: directly involved in project operations

These stakeholders play a critical role in the successful implementation, operation, and adoption of the BlueBARGE solution.

1. **Shipowners and maritime operators**:
    - Core users of the BlueBARGE system, whose participation is essential for integrating clean energy solutions into maritime operations.
    - Key decision-makers for adopting modular technologies like shore-side power and hybrid energy systems.
2. **Ports and terminal operators**:
    - Pivotal in deploying the necessary infrastructure for shore-side power solutions, ensuring the supply of green energy from energy providers, and collaboratively defining the operational framework to align with decarbonization goals.
    - Partners in scaling the system to support sustainable port operations.
3. **Barge operators**:
    - Responsible for operating and maintaining the BlueBARGE solution, ensuring its smooth functioning and operational success.
4. **Technology providers and equipment manufacturers**:
    - Companies such as CORVUS ENERGY, ELKON, and REGBES supply critical components, including energy storage systems, control systems, and power modules.
    - Partners specializing in hybrid energy technologies, such as lithium-ion and vanadium redox flow batteries, enable scalable energy solutions for the maritime sector.
5. **Crews and vessel operators**:
    - As end users of the barge's clean energy solutions, they ensure seamless integration of the technology into daily maritime operations and contribute to its acceptance and effectiveness.
6. **Regulatory authorities**:

- Maritime and environmental authorities at national and international levels ensure compliance with policies like the EU Fit for 55 initiative and IMO GHG regulations.

Secondary stakeholders: indirectly affected or supporting the project

These stakeholders influence the broader regulatory, environmental, and societal context within which BlueBARGE operates.

1. **Public authorities and policymakers**:
   - Local, regional, and national governments develop policy frameworks and funding mechanisms critical for fostering adoption and supporting sustainable initiatives.
2. **Classification societies**:
   - Organizations such as the American Bureau of Shipping (ABS) provide certification and standards to ensure safety, environmental protection, and regulatory compliance.
3. **Academic and research institutions**:
   - Partners like NTUA and AAU contribute through technical validation, performance evaluation, and safety assessments, strengthening the scientific basis of the project.
4. **Environmental NGOs**:
   - Advocate for sustainable practices that enhance visibility and public support for the project.
5. **Renewable energy providers and bunkering services**:
   - Play a critical role in supplying renewable energy and hybrid fueling solutions, such as hydrogen and battery storage, ensuring the project's operational sustainability and alignment with its decarbonization scope. As primary stakeholders, their involvement is essential to fulfilling the project's objectives and maintaining its long-term viability.
6. **Accreditation organizations**:
   - Offer essential support in certifying and validating innovative solutions, fostering trust and credibility.

This categorization ensures that the BlueBARGE project addresses environmental, operational, and regulatory dimensions holistically. Targeted engagement strategies are developed to prioritize stakeholders based on their influence and interest, fostering collaboration to achieve the project's decarbonization objectives.

The BlueBARGE project employs advanced stakeholder mapping tools, such as the Power/Interest Grid, which helps categorize stakeholders based on their influence and interest in the project. High-influence, high-interest stakeholders, such as regulatory bodies and shipowners, are given priority in engagement efforts. On the other hand, secondary stakeholders, such as public authorities and equipment manufacturers, are engaged in ways that ensure they remain informed and supportive without requiring intensive management.

In line with GDPR (General Data Protection Regulation) compliance, the project implements strict guidelines for managing stakeholder data. This ensures that all stakeholder interactions and data

collection activities adhere to privacy and security standards, safeguarding sensitive information related to project development and commercialization (European Union, 2016).

By engaging with these stakeholders through structured and transparent processes, BlueBARGE ensures that its solutions are not only technically sound but also aligned with market expectations and regulatory requirements. This comprehensive stakeholder mapping strategy is central to the project's success and long-term sustainability.

3.2 - Stakeholder Engagement Strategies

The BlueBARGE project adopts a phased approach to stakeholder engagement, ensuring consistent involvement throughout the project's lifecycle. This strategy is designed to accommodate the evolving needs of stakeholders and maintain open lines of communication from the initial project stages through to post-demonstration and commercialization phases. By engaging with stakeholders at every phase, the project ensures their input is continuously integrated into decision-making processes, enhancing the project's relevance and long-term impact. A comprehensive literature review, combined with the analysis of responses from project partners to survey questions, has informed the development of a phased stakeholder engagement strategy. This approach ensures the incorporation of best practices and partner insights into the design and execution of targeted engagement activities. The following table outlines the key activities and objectives for each phase, emphasizing the importance of iterative collaboration, continuous feedback, and alignment with industry needs. Table 1 provides a clear and concise overview of the phased engagement strategy, emphasizing key activities and objectives for each phase.

Table 1 Phased Engagement Approach

Phase	*Key Activities*	*Objective*
Initial Phase: (relationship building)	- Workshops and Presentations: Introduce project objectives and preliminary designs. - Collect feedback to guide future activities.	Build strong relationships with key stakeholders, including regulatory bodies, shipowners, port authorities, and energy providers. Establish a collaborative foundation by ensuring stakeholders are well-informed about the project's goals and potential benefits. For energy providers, highlight the opportunity to commercialize green energy by supplying vessels, creating a mutually beneficial partnership that supports project success and advances sustainability objectives.
Mid-Project Phase: (iterative collaboration)	- Interactive Workshops: Conduct periodic updates and collaborative sessions aligned with WP8 outreach activities. - Live Demonstrations and Surveys: Test solutions in real-world scenarios and gather real-time responses.	Refine technical and operational aspects of the project by incorporating stakeholder feedback and ensuring practical and regulatory alignment.

Post-Project Phase: (scaling and sustained interaction)	- Follow-Up Workshops and Industry Events: Promote broader adoption and knowledge sharing. - Continuous Feedback Loops: Maintain communication to adapt to market needs.	Focus on scaling solutions, ensuring long-term sustainability and adaptability. Foster knowledge sharing and broader adoption of BlueBARGE technologies.

Key engagement activities

The project incorporates a variety of targeted activities to foster effective collaboration and ensure stakeholder participation. Based on the literature and, more importantly, the responses of the project partners to the survey questions, the key engagement activities may include:

Workshops
- Designed for stakeholders such as technology providers, regulatory bodies, and industry representatives, workshops capture insights to align the project with operational, environmental, and regulatory requirements.

Surveys
- Stakeholder surveys provide real-time feedback, highlighting key use cases for the power barge, such as environmental applications and post-disaster power supply to vessels.

Live Demonstrations
- Real-world demonstrations offer stakeholders hands-on experience, enabling them to evaluate and refine the project's technologies.

Community Building Program
- This initiative fosters collaboration and ongoing engagement with stakeholders through forums, workshops, and online platforms. It keeps stakeholders informed, collects feedback, and promotes opportunities, such as green energy commercialization for energy providers, ensuring alignment with project goals and long-term success.

Transparent Communication
- Open forums and advisory board sessions address stakeholder concerns related to regulatory compliance, technical feasibility, and economic viability, fostering trust and collaboration

These strategies are key to ensuring that the project meets stakeholder expectations while fostering broad awareness and participation. By prioritizing stakeholder input, BlueBARGE is aligned with the industry's operational, environmental, and regulatory needs.

3.3 - Stakeholder Needs and Expectations

The development of the Stakeholder Needs and Expectations framework for the BlueBARGE project is informed by a comprehensive literature review and analysis of survey responses from project partners. This approach integrates best practices with valuable insights from partners, ensuring that the design and execution of the project align closely with stakeholder priorities. By addressing these expectations, the project enhances its relevance and impact within the maritime industry.

As multiple surveys will be conducted throughout the project, it is essential to communicate stakeholder needs and expectations on a regular basis. This communication ensures transparency and allows for any necessary adjustments or shifts to be promptly addressed, keeping the project aligned with stakeholder priorities and evolving requirements.

Key stakeholder needs

Stakeholders expect BlueBARGE to deliver clean, reliable energy solutions that enhance operational efficiency while adhering to stringent environmental regulations, such as the EU Fit for 55 initiative. They prioritize scalable and adaptable systems capable of meeting diverse maritime and onshore energy needs, complemented by competitive pricing to ensure accessibility. These requirements underline the project's commitment to balancing innovation with sustainability and economic viability:

GHG Reduction and Energy Efficiency

Stakeholders prioritize BlueBARGE as a pivotal contributor to maritime decarbonization. They expect the project to deliver clean, reliable energy solutions that significantly enhance operational efficiency. This expectation underscores the importance of integrating advanced hybrid energy systems capable of accommodating a wide range of vessel sizes and energy requirements. Such scalability is essential for the project to meet the diverse needs of the maritime industry and secure its role as a sustainable energy solution.

Regulatory Compliance

Compliance with stringent environmental regulations is another fundamental stakeholder expectation. BlueBARGE aligns closely with EU directives like the Fit for 55 initiative and IMO GHG reduction strategies. By embedding these regulatory frameworks into its design and implementation, the project ensures that its solutions adhere to the highest environmental standards, further reinforcing its credibility and long-term viability in the industry.

Cost-Efficiency and Financial Viability

Economic considerations remain critical to stakeholder acceptance. The adoption of BlueBARGE's innovative solutions depends on their ability to balance technological advancements with competitive pricing models. Stakeholders emphasize the need for affordable yet effective energy solutions that can bridge the gap between innovation and financial feasibility, ensuring the project's accessibility across diverse market segments.

Sustainability and Adaptability

Flexibility and scalability are key attributes expected of the power barge solution. Stakeholders anticipate a design capable of addressing a variety of energy needs, both maritime and onshore. This adaptability not only meets immediate operational demands but also ensures the long-term sustainability of the solution in a rapidly evolving energy landscape.

Identified challenges

BlueBARGE faces challenges in integrating complex technologies, addressing stakeholder skepticism over costs, and adapting to evolving regulations, requiring innovative engineering, trust-building campaigns, and agile collaboration with policymakers.

Figure 3 Identified challenges - Stakeholder needs and expectations

Recommendations for stakeholder engagement

- Tailored engagement activities: Using stakeholder mapping insights, the project team designs targeted strategies to engage regulatory bodies, technology providers, and end users effectively. For stakeholder engagement, examples include workshops which includes regulatory bodies to address compliance with EU ETS or FuelEU Maritime Initiative standards and some technical reviews with technology providers to optimize energy systems like hydrogen fuel cells. For future advancement, targeted strategies could focus on European ports, where zero-emission solutions are in high demand, and offshore platforms needing modular power solutions. These tailored approaches ensure stakeholder relevance, regulatory compliance, and alignment with market needs.
- Proactive communication: Addressing skepticism through transparent financial models that demonstrate cost efficiency and technical reliability is vital for stakeholder buy-in.
- Collaborative platforms: Leveraging advisory board meetings, workshops, and technical reviews maximizes stakeholder involvement and ensures alignment with project objectives.
- Regulatory adaptation: Periodic reviews with policymakers and industry experts allow the project to stay ahead of evolving regulations, ensuring compliance and relevance.

Feedback integration

Stakeholder feedback collected through surveys, workshops, and real-life scenario analyses directly informs the refinement of BlueBARGE's technical and operational solutions. Barge operators, port managers, and shipowners guide the design to ensure alignment with practical and regulatory requirements. This continuous input ensures that the power barge solution is modular, scalable, and capable of addressing diverse market needs.

To conclude in this chapter, the BlueBARGE project's stakeholder analysis highlights its commitment to aligning technological innovation with stakeholder expectations and regulatory requirements. By addressing key needs and challenges through a phased and targeted engagement strategy, the project fosters active participation, builds trust, and enhances its long-term impact. This holistic approach ensures that BlueBARGE is well-positioned as a transformative solution in the maritime energy landscape, paving the way for successful commercialization and adoption in achieving decarbonization goals.

As the foundation of stakeholder needs and expectations has been established, the next step focuses on translating these insights into actionable strategies through the Preliminary Exploitation Plan, ensuring that the project's Key Exploitable Results (KERs) effectively align with market demands and regulatory frameworks.

4 - Preliminary Exploitation Plan

The Preliminary Exploitation Plan serves as a foundational step in translating the innovative outcomes of the BlueBARGE project into tangible commercial success within the maritime sector. This plan outlines strategies to leverage the Key Exploitable Results (KERs) and position them effectively within the market. It includes defining the project's value proposition, identifying target sectors, assessing market size, and

analyzing the regulatory environment. By integrating these elements with the Lean Business Model Canvas, the plan ensures a structured, adaptable pathway for commercialization. Furthermore, it addresses the market's evolving demands, fosters business innovation, and highlights the project's potential to contribute to the decarbonization and electrification of the maritime industry. The exploitation plan thus not only focuses on the project's short-term impacts but also sets the stage for mid-term sustainability, guiding the BlueBARGE solution towards long-term commercial viability and broader industry adoption.

4.1 - Identifying the Key Exploitable Results (KERs)

The Key Exploitable Results (KERs) of the BlueBARGE project represent critical innovations aimed at achieving maritime industry decarbonization. These results form the cornerstone of the project's commercialization strategy by fostering a cleaner and more sustainable maritime energy infrastructure.

Key Results (KRs) vs. Key Exploitable Results (KERs)

Key Results (KRs) are specific, measurable outputs reflecting the project's progress toward its technical, operational, or scientific goals. They are tied to project tasks and assessed through Key Performance Indicators (KPIs) as outlined in the Grant Agreement (GA). For instance, KR1.2 concerns power supply modules developed in WP3 (T3.2 and T3.3), while KR2.3 pertains to the small-scale BlueBARGE prototype developed in WP6 (T6.1 and T6.2).

Key Exploitable Results (KERs), on the other hand, focus on innovations with significant potential for industry adoption, societal benefit, or further research. While based on KRs, KERs extend into application-oriented outputs, emphasizing their commercial and policy relevance. For example, KER1 includes power generation modules derived from KR1.2, KR1.3, and KR5.1, while KER7 relates to commercialization strategies stemming from KR4.3.

Key differences between KRs and KERs:

Aspect	Key Results (KRs)	Key Exploitable Results (KERs)
Focus	Technical or scientific outcomes from project tasks.	Innovations with potential for exploitation or commercialization.
Scope	Project-specific and tied to objectives and KPIs.	Broader scope, focused on market adoption or societal impact.
Origin	Defined in the Grant Agreement and Work Plan.	Identified during the exploitation strategy and derived from KRs.
Purpose	Measure project success and progress.	Highlight results with economic, social, or research value.
Examples	Power supply modules, prototype demonstration results.	Commercialization strategies, best practices for industry.

In summary:

- **KRs** are the *building blocks* of the project—outputs tied to specific tasks and objectives.
- **KERs** are the *value-added innovations*—outputs identified for exploitation and long-term impact.

The relationship can be summarized as: ***KRs → Basis for KERs → Commercial/Practical Impact.***

For BlueBARGE project, initially Key Results are designed in the grant agreement. See Table 2.

Table 2 key elements of the project impact pathway and measures to maximise its impact

EXPECTED RESULTS
KR1.1 List of use cases
KR1.2 Power supply modules
KR1.3 Integration design
KR1.4 Interfaces design
KR1.5 ***BlueBARGE*** design alternatives
KR1.6 ***BlueBARGE*** promoted alternative
KR1.7 ***BlueBARGE*** modularity and scalability analysis
KR2.1 Battery modules
KR2.2 Integrated hybrid battery system
KR2.3 Small-scale ***BlueBARGE*** prototype
KR2.4 ***BlueBARGE*** demonstration results and validation
KR2.5 Recommendations and best practices
KR3.1 Environmental assessment of design alternatives
KR3.2 ***BlueBARGE*** environmental performance
KR3.3 Advanced assessment and optimisation tool
KR4.1 Financial assessment of design alternatives
KR4.2 ***BlueBARGE*** economic performance and CBA
KR4.3 Market analysis, exploitation and commercialisation plan
KR5.1 NTQ Statement of Maturity for battery systems
KR5.2 Safety assessment report
KR5.3 Approval-in-Principle
KR5.4 Technical, operational and safety guidelines

MAGCIR, as the leader of the Exploitation task, has followed a defined path toward the commercialization of the project's results, with the contribution of all project partners (particularly KER owners). This process begins with the identification of exploitable results and potential applications that can be derived from the BlueBARGE project. The project's innovations and outcomes hold significant potential for exploitation, which can be realized through the identification and protection of Key Exploitable Results (KERs) in Table 3, and their connection with the project's Key Results (KRs) which are highlighted in Table 2.

As guided by the European IPR Helpdesk and also mentioned in the grant agreement of this project, KERs are the main outputs of the project with considerable potential for exploitation and are initially presented in Table 3 for the BlueBARGE project.

Table 3 BlueBARGE Key Exploitable Results (KERs) According to The Project Grant Agreement

KERs	Description	Related KR
KER1	***BlueBARGE*** power generation modules and hybrid system	KR1.2, KR1.3, KR5.1
KER2	Advanced assessment and optimisation tool	KR3.3
KER3	Innovative ***BlueBARGE*** solution	KR1.6, KR5.3
KER4	Scalable and modular ***BlueBARGE*** alternatives	KR1.5, KR1.7
KER6	Guidelines for offshore power supply	KR5.4
KER5	Best practices and industry recommendations	KR2.5
KER7	***BlueBARGE*** commercialisation and exploitation strategies	KR4.3

Partners contributions to KERs

In the context of the BlueBARGE project, these KERs encompass a range of technical innovations, advanced tools, and strategies that can be applied to various aspects of the maritime sector, especially in offshore power supply applications. By carefully managing and exploiting these KERs, the project partners can ensure the effective commercialization and market adoption of the BlueBARGE solution, ultimately leading to a significant reduction in GHG emissions and a more sustainable maritime industry.

The following stakeholder-specific contributions, gathered through survey analysis, have been integrated into the KER descriptions to provide a more detailed understanding of the roles and innovations contributed by project partners:

- **ABS**: Contributions to KER1 and KER3 focus on power supply modules and securing Approval-in-Principle (AiP). These insights emphasize the regulatory compliance and scalability pathway essential for commercialization.
- **CORVUS ENERGY**: As the primary contributor to KER1, Corvus Energy focuses on containerized battery systems. This modular battery design serves as a foundational component for scalability and is critical for achieving modularity in energy storage.
- **ELKON ELEKTRIK**: Contributions to KER2 and KER5 involve hybrid energy systems and modular power barge design. The role of electrical design in enabling seamless system integration is vital for the project's success.
- **HYDRUS**: Expertise in barge retrofit design has been incorporated under KER related to modular and scalable retrofits, showcasing innovative design solutions for retrofitting existing barges.
- **Emerging KERs**: The survey identified modular inverter platforms as a potential KER, aligned with voltage interface management and relevant to KER3. This addition supports innovations in energy distribution and management.

Additional KER suggestions from partner feedback

Based on survey responses, the following emerging KERs have been suggested for consideration:

i. **Containerized Hydrogen Fuel Cells**: Proposed as a complementary energy storage solution alongside containerized battery modules. These innovations offer promising opportunities for future scalability and research but are currently explored in desktop studies without integration into the prototype.

ii. **Barge-to-Ship Connection**: Identified as a critical component for ensuring safe and efficient power transfer. This includes modular, semi-/fully automated designs capable of handling different ship types and novel inverter platforms for voltage interface management (400 V to 11 kV AC).

These additional KERs may be refined, expanded, or excluded by the end of the project, depending on the maturity of results and alignment with the project's objectives.

To ensure practical applicability, the identified KERs will be integrated into the Intellectual Property Rights (IPR) management framework. This includes securing patents, establishing joint ownership agreements, and ensuring regulatory compliance. These steps will position the BlueBARGE project for long-term industry success and environmental impact.

By connecting partner contributions and innovative technologies with clearly defined commercial pathways, the BlueBARGE project ensures its KERs are well-positioned for industry adoption, regulatory alignment, and economic viability.

4.2 - IPR Management and Sustainability

Effective IP management in Horizon Europe projects maximizes research value by handling intellectual property rights (IPR), licensing, patents, copyrights, and trade secrets. Key activities include regular IP audits, patent filings, and preparing IP for commercial use through licensing or new product development. In collaborative projects, managing diverse IP contributions is crucial, requiring alignment of partners' goals, cultures, and protection strategies. Clear agreements on IP management and exploitation are essential. A flexible IP approach ensures all partners benefit and complies with the European Commission's rules for "Open Science." Exploitation of results is required for up to four years post-project, with visibility on the Horizon Results Platform. Joint ownership agreements ensure proper management and compliance with the GA, protecting both innovations and partners' IP. This strategy also supports innovation planning and Go-To-Market activities.

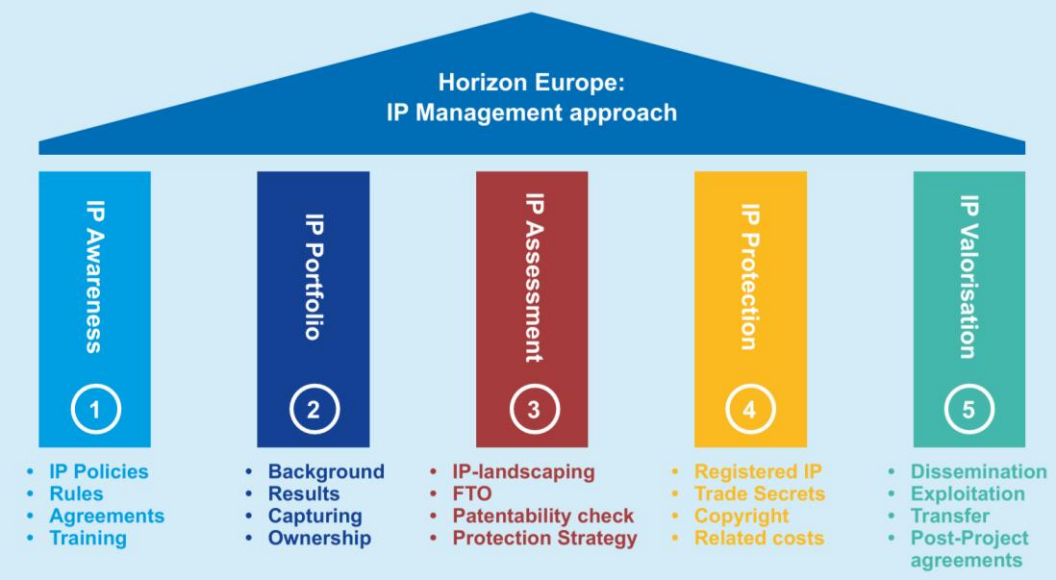


Figure 4 Five Pillars of IP Management in Horizon Europe Projects

Source: Publications Office of the European Union (2022).

As illustrated in *Figure 4* ,the "Five Pillars of IP Management" framework highlights key IP challenges at various project stages, vital for growth and commercialization beyond the project's end. By integrating industry-aligned strategies and ensuring GDPR compliance, the BlueBARGE project safeguards its innovations while fostering sustainability in the maritime industry. Strategic partnerships, market analysis, and knowledge management are central to the project's long-term success and sector-specific contributions.

Building on the previous section’s overview of IPR management, the following details BlueBARGE’s specific IPR and sustainability strategies. These include protecting technical innovations, ensuring GDPR compliance, and implementing a comprehensive financial sustainability model. These strategies ensure that BlueBARGE’s solutions remain commercially viable, industry-aligned, and adaptable, while contributing to maritime decarbonization goals.

Key IPR and Sustainability Strategies

The BlueBARGE project's IPR and sustainability strategies are designed to balance innovation protection, regulatory compliance, and long-term market relevance. By safeguarding technical advancements through patent filings and joint ownership agreements, ensuring GDPR-aligned confidentiality measures, and integrating a robust financial sustainability model, the project creates a foundation for impactful commercialization. These efforts are further reinforced by early regulatory validation and partner collaboration, aligning BlueBARGE's solutions with industry needs and decarbonization goals:

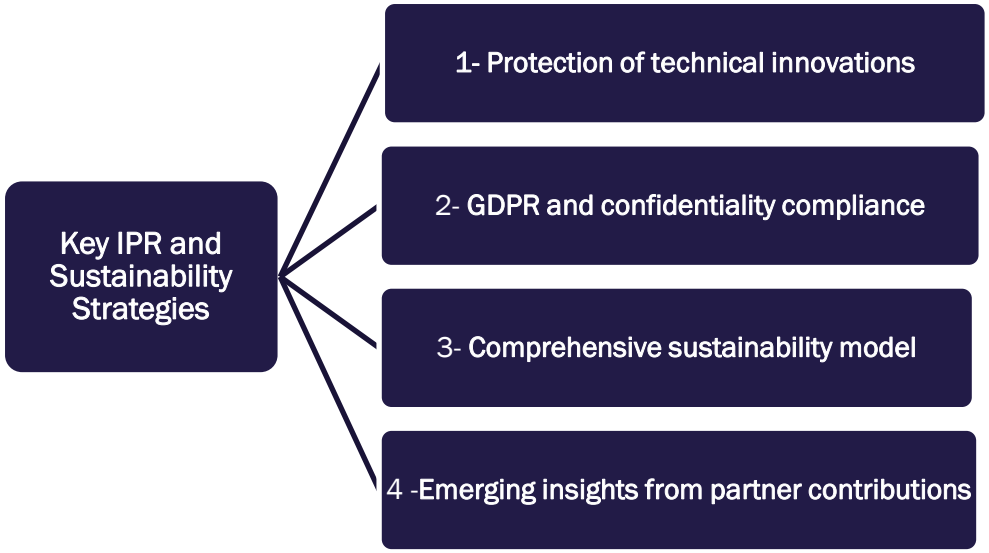


Figure 5 Key IPR and Sustainability Strategies

1. **Protection of technical innovations**

The BlueBARGE project prioritizes the protection of its key technical innovations, including hybrid fuel systems, containerized battery technologies, and energy storage solutions such as lithium-ion batteries and vanadium redox flow batteries (VRFB).

- patent strategies and IP audits: Patent filings, trade secrets, and regular IP audits ensure that these innovations are adequately protected.
- joint ownership agreements: Intellectual property co-developed by multiple consortium partners is managed through joint ownership agreements, ensuring equitable distribution of rights and responsibilities.
- validation and industry alignment: ABS's contributions, particularly the emphasis on Approval-in-Principle (AiP) for designs, underline the critical role of early stakeholder involvement in validating technical innovations. This not only strengthens the IPR framework but also enhances industry alignment, ensuring the project outcomes meet regulatory standards and market needs.

2. **GDPR and confidentiality compliance**

Adherence to GDPR and confidentiality norms is integral to the BlueBARGE project, ensuring secure management of personal, commercial, and technical data.

- commitments from partners: All partners have reinforced their dedication to safety guidelines and regulatory compliance, which bolsters the project's ability to protect sensitive information.
- data protection mechanisms: Non-Disclosure Agreements (NDAs), secure data storage systems, controlled access to sensitive data, and regular audits form the backbone of the project's confidentiality strategy.
- regulatory alignment: By aligning with GDPR and confidentiality protocols, the project mitigates risks associated with data breaches, enabling smooth collaboration and information sharing across consortium partners.

3. **Comprehensive sustainability model**

The BlueBARGE project incorporates a detailed business sustainability model to ensure its financial viability and adaptability to future market demands.

- financial viability: This model addresses capital expenditures (CAPEX), operational expenditures (OPEX), and potential revenue streams, including direct sales, leasing agreements, maintenance contracts, and pay-per-use models.
- strategic partnerships: Collaboration with stakeholders ensures that the solutions remain competitive and relevant while meeting evolving regulatory requirements.
- market adaptability: By integrating industry feedback, such as ABS's AiP focus and partner suggestions for modular and scalable designs, the sustainability model aligns with market expectations and opportunities.
- contribution to decarbonization: The sustainability model highlights the project's role in driving the maritime industry toward decarbonization by providing commercially viable, low-emission solutions.

4. **Emerging insights from partner contributions**

- validation and regulatory integration: ABS's emphasis on regulatory validation through AiP not only strengthens the IPR strategy but also highlights the importance of incorporating regulatory bodies early in the innovation process. This ensures a seamless transition from development to commercialization.
- confidentiality enhancements: Commitments from all partners, particularly from those more involved such as ABS and Multimarine Services, to safety guidelines and confidentiality protocols emphasize the importance of secure data handling in achieving market readiness.

In conclusion, the IPR management and sustainability framework of the BlueBARGE project provides a robust foundation for safeguarding innovations, ensuring regulatory compliance, and achieving long-term commercial success. By integrating partner feedback, emphasizing validation through regulatory bodies like ABS, and maintaining strict confidentiality measures, the project positions itself to deliver transformative solutions for the maritime industry. This strategic approach not only protects BlueBARGE's innovations but also secures their financial viability, regulatory alignment, and industry adoption, ensuring significant contributions to maritime decarbonization efforts.

4.3 - Preliminary Lean Business Model Canvas

The BlueBARGE project provides a flexible, modular, and scalable power barge solution designed to deliver clean energy to both maritime and onshore applications. By addressing critical gaps in the energy needs of ports and vessels, the project aims to significantly reduce greenhouse gas emissions and align with EU environmental standards, with a target for commercialization by 2030.

Key value propositions

The BlueBARGE project introduces a transformative and versatile power barge system, designed to address the pressing environmental and operational challenges in maritime and onshore energy sectors. Its innovative features and solutions cater to diverse use cases, offering the following key value propositions.

Below is the expanded Key Value Propositions section presented in Table 4.

Table 4 BlueBARGE Key Value Proposition

Key Value Proposition	Details
Flexibility and Scalability	- Adaptability: The modular design allows BlueBARGE to adapt seamlessly to various vessel profiles and energy demands. - Large Vessels: Supports large cruise ships and cargo vessels requiring significant power during port stays or anchorage. - Small Vessels: Configurations align with smaller energy needs of ferries and regional vessels. - Future-proof design: Easily scalable to accommodate technological advancements or industry shifts. - Modular approach: Highlighted by partners with emphasis on design flexibility for diverse vessel types.
Environmental Impact	- GHG reduction: Provides clean, renewable energy to reduce CO_2, NO_x, and SO_x emissions by minimizing reliance on diesel generators. - Noise mitigation: Operates quietly, reducing noise pollution in ports and coastal areas, benefiting local ecosystems and communities. - Biodiversity support: Enhances environmental sustainability, particularly in ports near protected marine or coastal zones.
Sustainability	- Lithium-Ion battery systems: High energy density and efficiency for reliable power output. - Vanadium Redox Flow Batteries (VRFB): Long-duration energy storage with extended lifecycle capabilities, ideal for large-scale sustainable applications. - Hydrogen fuel cell compatibility: Future-ready for zero-emission operations as hydrogen technology matures. - Regulatory compliance: Aligns with EU's Fit for 55 regulatory framework and other international decarbonization targets.
Economic and Operational Benefits	- Reduced operational costs: Transitioning from fossil fuel-based systems to clean energy reduces fuel and maintenance expenses. - Enhanced energy efficiency: Optimizes energy utilization, minimizing waste and maximizing cost-effectiveness. - Improved regulatory compliance: Facilitates adherence to stringent environmental regulations, reducing the risk of fines or delays.

Strategic Alignment with Industry Needs	- Filling critical gaps: Addresses the lack of shore-side power infrastructure in many ports. - Diverse applications: Meets operational requirements for powering offshore platforms, recreational vessels, and commercial vessels.

The value propositions outlined above form the foundation of BlueBARGE's innovative power barge solution, emphasizing its flexibility, sustainability, and market alignment. These features seamlessly connect to the Lean Business Model Canvas, which provides a structured framework for addressing customer segments, value propositions, and commercialization strategies. This ensures a clear and actionable pathway for market adoption and long-term success.

Lean Business Model Canvas for BlueBARGE

The Lean Business Model Canvas is a streamlined tool designed for developing, visualizing, and validating innovative business ideas. It focuses on key aspects of a business while minimizing complexity, making it particularly useful for startups and innovation-driven projects. The canvas includes nine essential building blocks. This framework encourages a customer-focused approach, continuous iteration, and rapid testing of ideas to enhance the feasibility and marketability of innovations.

A Lean Business Model Canvas serves as a strategic framework for exploiting the BlueBARGE project, as illustrated in preliminary version of Figure 6, facilitating a focused and adaptable commercialization plan.

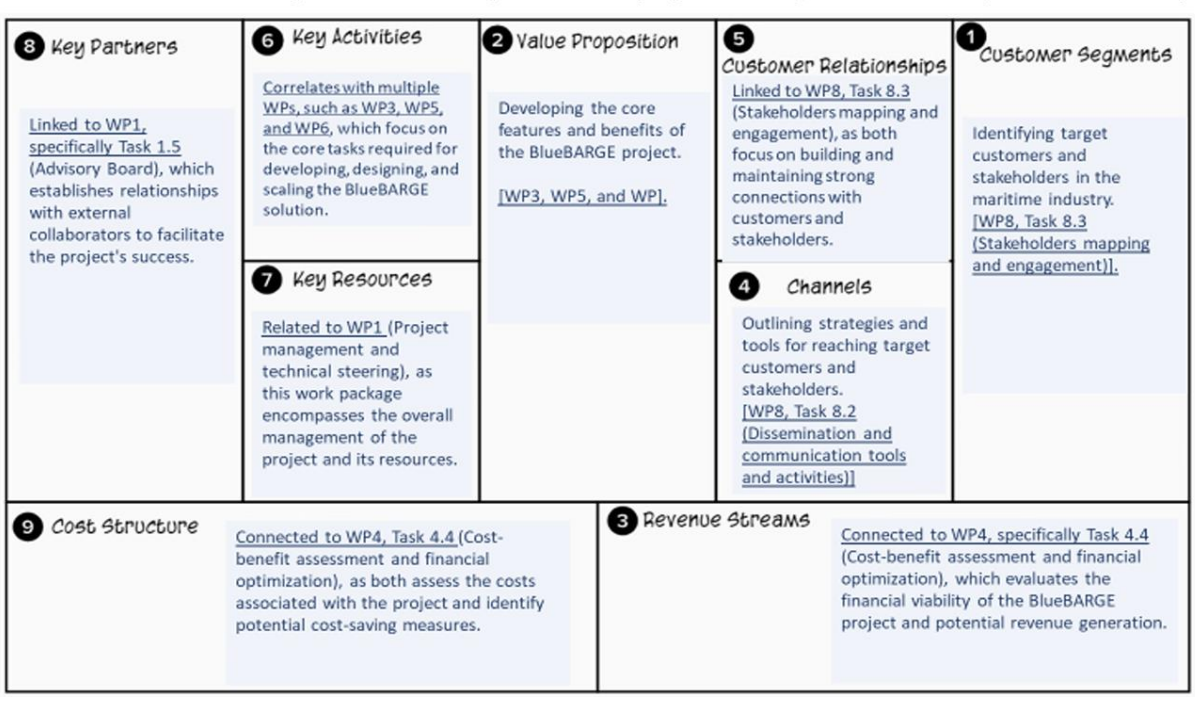


Figure 6 BlueBARGE Lean Business Model Canvas

1. **Customer Segments**

    - commercial shipping operators: large cargo vessels, cruise ships, and ferries requiring clean shore-side power solutions.

- offshore platforms*:* remote platforms needing renewable energy supplies to minimize environmental impact.
- port authorities*:* ports lacking shore power infrastructure, with feedback from Fundación Valenciaport highlighting potential applications for anchorage areas and general-purpose terminals.
- leisure boating sector: small vessels and yachts in ecologically sensitive regions seeking low-emission energy options.
- Renewable Energy providers as they will provide the energy and wish to sell it directly to energy providers or others.

2. **Value Proposition**
   - Decarbonization: Provides renewable energy solutions to reduce emissions.
   - Flexibility and Scalability:
     - Modular design adaptable to various vessel profiles and energy demands.
     - Supports large vessels (e.g., cruise ships and cargo ships) and small vessels (e.g., ferries, regional vessels).
     - Future-proof design allows scalability for technological advancements and industry shifts.
     - Emphasizes design flexibility for diverse vessel types.
   - Environmental Impact:
     - Reduces CO_2, NO_x, and SO_x emissions by minimizing diesel generator reliance.
     - Operates quietly, reducing noise pollution in ports and coastal areas.
     - Supports biodiversity in sensitive ecosystems near ports and coastal zones.
   - Sustainability:
     - Utilizes high-efficiency Lithium-Ion batteries and long-duration Vanadium Redox Flow Batteries (VRFB).
     - Ensures compatibility (with hydrogen fuel cells) for future zero-emission operations.
     - Aligns with EU's Fit for 55 regulatory framework and international decarbonization targets.
   - Economic and Operational Benefits:
     - Lowers operational and maintenance costs compared to fossil fuel systems.
     - Enhances energy efficiency by optimizing utilization and minimizing waste.
     - Facilitates regulatory compliance, reducing risks of fines and delays.
   - Strategic Alignment with Industry Needs:
     - Addresses the lack of shore-side power infrastructure in many ports.
     - Offers versatile solutions for offshore platforms, ports, and recreational vessels.

3. **Revenue Streams**
   - Power-as-a-Service (paas): selling clean energy generated by the barge to ports and ship operators.

- Leasing models: offering modular systems and energy solutions on lease to reduce upfront investment for operators.
- ROI-driven models: insights from REGBES emphasize pay-per-use strategies for flexible and cost-effective adoption.
- Consulting services: providing expertise in infrastructure integration and regulatory compliance.

4. **Channels**
   - Strategic partnerships: collaborations with ports, maritime operators, and energy providers (e.g. TOTAL, ENI).
   - Industry events: showcasing innovations at conferences and trade shows.
   - Digital outreach: utilizing online platforms for stakeholder engagement and promotion.
5. **Customer Relationships**
   - Long-term collaborations: building sustained relationships with maritime operators, port authorities, and offshore platform managers.
   - Customization: tailoring solutions to meet specific energy demands.
   - Continuous support: offering technical support, updates, and regulatory compliance guidance.
6. **Key Activities**
   - Development and optimization: enhancing the hybrid energy system to meet evolving demands.
   - Stakeholder engagement: strengthening relationships with regulators, energy providers, and ship operators.
   - Scaling operations: transitioning from pilot projects to large-scale commercial deployment.
7. **Key Resources**
   - Technical expertise: engineering and project management professionals with expertise in clean energy systems.
   - Hybrid energy systems: leveraging advanced technologies, including batteries and hydrogen fuel cells.
   - Regulatory alignment: ensuring compliance with EU and global maritime regulations.
8. **Key Partnerships**
   - Some partners, ABS and ELKON ELEKTRIK, suggested collaborating with classification societies to ensure regulatory compliance.
   - A project partner, CORVUS ENERGY, also commented: driving technology scalability through modular battery systems.

- Multimarine Services and Danaos Shipping: providing operational feedback to refine designs and ensure market readiness.
- Renewable energy providers: ensuring a consistent supply of clean power for barge operations.

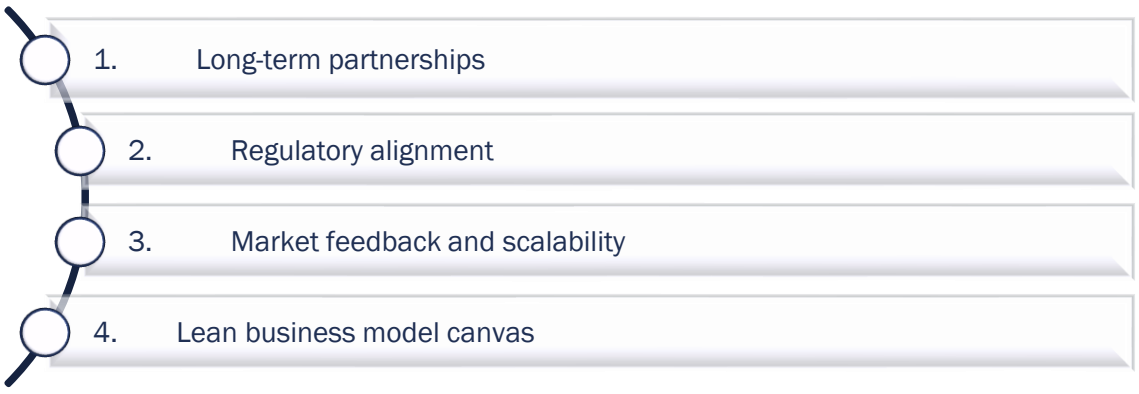
9. **Cost Structure**[1]
   - Technology development: R&D expenses for hybrid systems and modular solutions.
   - Manufacturing costs: production of power barges and supporting technologies.
   - Operational and maintenance costs: long-term expenses for system updates and customer support.
   - Cost-benefit assessments: Task 4.4 of this project analyzes financial optimization strategies to identify cost-saving opportunities.

This Lean Business Model Canvas provides a structured and adaptable roadmap for the commercialization of BlueBARGE, aligning the project with market needs, stakeholder feedback, and sustainability goals. By integrating partner contributions—such as ABS's focus on regulatory compliance and REGBES's commercialization insights—the project is well-positioned to achieve its decarbonization objectives while delivering significant environmental and economic benefits to the maritime industry.

4.4 - Preliminary Exploitation Strategies

The exploitation strategy for the BlueBARGE project is designed to ensure the successful commercialization of its modular, scalable power barge solution by 2030. This strategy leverages long-term partnerships, regulatory alignment, and market responsiveness to establish BlueBARGE as a sustainable and impactful innovation in the maritime industry. The approach aligns closely with EU initiatives, such as *Fit for 55*, which seek to reduce emissions and foster environmental sustainability.

The exploitation plan integrates these strategies into a cohesive framework that balances innovation with practicality. By combining:



[1] Cost structure elements (like R&D, manufacturing, and operational costs) are addressed indirectly as part of the Lean Business Model Canvas and financial sustainability model. However, they are not the primary focus of this section but are integrated into the broader commercialization strategy.

Figure 7 BlueBARGE Key Exploitation Strategies

1. **Long-Term partnerships**

Establishing enduring collaborations with key industry stakeholders—including ports, energy providers, maritime operators, and regulators—is central to the project's exploitation strategy.

Regional focus suggested:

- ELKON ELEKTRIK prioritizes expansion within the Mediterranean region, leveraging its expertise in hybrid energy systems to target this key maritime area.
- MULTIMARINE SERVICES envisions broader scalability across major maritime hubs, ensuring the solution's adaptability to diverse operational contexts.
- Collaboration of shipping companies, energy suppliers to build up jointly BlueBARGEs in various ports to serve regional needs to offset emissions.

By forming these partnerships, the project ensures that its solutions are tailored to regional and global needs, fostering widespread adoption.

2. **Regulatory alignment**

Compliance with EU regulations is integral to the project's exploitation plan, ensuring that BlueBARGE solutions align with the maritime sector's evolving decarbonization requirements.

Feedback provided from partners: ABS and DANAOS SHIPPING emphasized the importance of aligning BlueBARGE with the *EU Emissions Trading System (EU ETS)* and *FuelEU Maritime* regulations. These directives guide the transition to cleaner energy and operational practices within the maritime industry. Columbia Ship Management highlighted the necessity of compliance with EU ETS and FuelEU Maritime regulations, especially as shore connection becomes mandatory from 2030 onwards.

By embedding regulatory compliance into the project's design and deployment phases, BlueBARGE ensures its solutions are market-ready and future-proof.

3. **Market feedback and scalability**

Incorporating real-world insights during the design phase strengthens the project's scalability and market relevance.

Early stakeholder engagement: REGBES highlighted the need for involving stakeholders early in the development process to refine technical concepts and address practical challenges.

This iterative approach not only enhances the project's adaptability but also fosters stakeholder trust and collaboration, ensuring smoother market entry and long-term success.

4. **Lean business model canvas**

As earlier explained in this chapter, the project employs a Lean Business Model Canvas to define key customer segments, value propositions, revenue streams, and commercialization channels. This structured approach ensures that all partners—ranging from technology developers to maritime regulators—have clearly defined roles in the commercialization process. By integrating insights from the business model into the exploitation plan, the project ensures alignment with market needs and financial viability.

In conclusion to this chapter, BlueBARGE exploitation strategy establishes a robust foundation for transforming technological innovations into real-world applications. By prioritizing long-term partnerships, aligning with EU regulations, and integrating market feedback, the project positions itself as a key player in the maritime industry's transition to cleaner energy. The subsequent chapter will expand on detailed market analyses, supporting the strategic roadmap for BlueBARGE's commercialization.

5 - Preliminary Market Analysis

The BlueBARGE project's preliminary market analysis provides a comprehensive overview of the clean energy market within the maritime industry. As global regulatory bodies, especially in Europe, implement increasingly stringent environmental regulations, such as the Fit for 55 initiative (European Commission, 2021), the need for innovative and adaptable solutions like the BlueBARGE power barge is rapidly growing. This section assesses the current market dynamics, identifies the key drivers of growth, and offers a focused regional outlook to better understand the opportunities and challenges facing the project. Moreover, it evaluates the competitive landscape, highlighting BlueBARGE's modularity and scalability advantages while addressing regulatory constraints, particularly within the European Union's policy frameworks.

5.1 - Market Size and Status Assessment

The maritime industry is undergoing a significant transformation, driven by global efforts to decarbonize shipping and port operations. With the sector accounting for approximately 3% of global greenhouse gas (GHG) emissions (European Maritime Safety Agency, 2020), it has become a critical focus for environmental reforms. BlueBARGE is uniquely positioned to capitalize on the increasing demand for clean energy solutions, particularly in regions such as the Mediterranean, Black Sea, and Northern Europe, where regulatory pressures and the adoption of innovative technologies are accelerating.

Key Market Insights:

1. **Market growth**
    - The global maritime decarbonization market is projected to experience double-digit growth rates over the next decade (DNV GL, 2023). Regulatory frameworks such as the International Maritime Organization (IMO) GHG reduction strategy and the EU's *Fit for 55* initiative are shifting clean energy adoption from an optional innovation to a compliance-driven necessity.
    - Insights from *Corvus Energy* highlight the rapid expansion of clean maritime energy solutions globally, with growing investments in hybrid and fully electric-powered vessels. Corvus plays a key role in driving technology adoption and fostering innovation in the sector.
2. **Key market drivers**
    - Environmental regulations: Key policies such as the IMO's GHG reduction strategy and the EU's *Fit for 55* initiative are forcing maritime operators to adopt sustainable solutions. The European Green Deal further enhances these regulations, targeting a 90% reduction in maritime emissions by 2050.

- Technological advancements: Breakthroughs in hybrid energy systems, including hydrogen fuel cells and battery storage technologies, are critical enablers for BlueBARGE. These solutions provide the scalability and flexibility needed to serve diverse vessel types, from large cargo ships to smaller ferries and yachts (*Corvus Energy, 2022*).
- Regional regulations: High demand for low-emission solutions in regions like the Mediterranean and Black Sea, as noted by ELKON ELEKTRIK and MULTIMARINE SERVICES, is driven by the EU *Fit for 55* package and IMO decarbonization targets.

3. **Regional focus**
   - Mediterranean and Black Sea regions: According to ELKON ELEKTRIK and Multimarine Services, these areas demonstrate high demand for innovative energy solutions due to increasing regulatory requirements and their prominence as maritime hubs. Ports and anchorage zones in these regions are rapidly seeking cleaner energy alternatives for cruise terminals, cargo operations, and general-purpose terminals, where there are not enough ports or a grid available with shore connection.
   - Northern Europe: This region remains a leader in the adoption of stringent emission regulations, fostering early adoption of hybrid and electric-powered vessels. BlueBARGE's ability to provide clean, shore-side power aligns well with the needs of ports in this area, contributing significantly to its potential market success.

BlueBARGE market potential

BlueBARGE is positioned to offer clean energy solutions for ports and vessels, with its modular, scalable design catering to diverse vessel types and meeting global and regional environmental standards. By addressing the demand for hybrid energy systems and collaborating with all partners, BlueBARGE is poised for success in the maritime industry. The market for clean maritime energy is growing rapidly, driven by regulatory pressures, technological advancements, and regional demand. With a focus on the Mediterranean, Black Sea, and Northern Europe, BlueBARGE is well-positioned to provide scalable energy solutions, supporting the decarbonization of the maritime industry in a compliance-driven market.

5.2 - Target Sector Definition

The BlueBARGE project is targeting several maritime sectors that face increasing regulatory pressures and urgent needs for decarbonization solutions. These sectors span a wide range of vessel types and operational contexts, ensuring broad market applicability for BlueBARGE's modular, scalable clean energy systems. Insights from partners such as Hydrus, NTUA, and Fundación Valenciaport emphasize the importance of addressing both vessel-specific and port-specific decarbonization challenges to maximize market impact.

Primary target sectors

Offshore Platforms: Offshore platforms in remote locations require sustainable, reliable, and scalable energy solutions to replace traditional diesel-powered generators. BlueBARGE's hybrid energy storage systems, which integrate technologies like lithium-ion batteries and hydrogen fuel cells, offer a zero-emission alternative that significantly reduces the environmental impact of offshore operations (World Bank, 2021). These solutions are particularly suited for regions such as the Mediterranean and the Black Sea, where environmental regulations are tightening.

Commercial Shipping: The commercial shipping sector is one of the largest contributors to maritime emissions, with a significant share generated while vessels are moored and using auxiliary engines for power. BlueBARGE addresses this issue by providing clean shore-side power, enabling vessels to switch off their engines while in port. This reduces GHG emissions, complies with EU Fit for 55 regulations, and supports the IMO's GHG reduction targets (IMO, 2021). Hydrus and NTUA stress the importance of targeting both large vessels, such as cargo ships, containers and cruise liners, and smaller vessels like tugs and ferries to broaden market reach. Columbia Ship Management also highlighted that, in many islands, shore connections are unavailable for charging or emergency purposes, emphasizing the need for versatile and scalable solutions like BlueBARGE.

Leisure Boating: Smaller vessels, including yachts, ferries, and eco-tourism boats, are increasingly under scrutiny due to their operations in environmentally sensitive areas, such as coastal nature reserves and protected marine ecosystems. BlueBARGE's scalable design makes it ideal for this segment, providing low-emission energy solutions that align with regulatory demands and sustainability goals (Corvus Energy, 2022).

Port Applications: Ports play a critical role in decarbonization efforts, serving as hubs for clean energy adoption and emissions reduction. Fundación Valenciaport highlights the strategic importance of solutions like BlueBARGE for achieving net-zero emissions by 2030 in key ports, such as Valencia. By offering modular, shore-side power systems, BlueBARGE enables ports to provide clean energy to a diverse range of vessels, from cargo ships to leisure boats, without the need for permanent infrastructure upgrades.

To conclude, the BlueBARGE project's target sectors span offshore platforms, commercial shipping, leisure boating, and port applications, ensuring broad applicability and market potential. Insights from partners like Hydrus, NTUA, and Fundación Valenciaport underline the importance of targeting diverse vessel types and strategically addressing port-specific decarbonization goals. By focusing on these sectors, BlueBARGE is poised to make a significant impact on the maritime industry's transition to sustainable energy solutions while meeting global regulatory and environmental standards.

5.3 - Competitive Analysis

The maritime clean energy sector is highly competitive, with established players such as Wärtsilä and Corvus Energy leading the market. Despite this, BlueBARGE stands out due to its modular and scalable design, making it uniquely positioned to address the diverse energy needs of the maritime industry. Insights from ABS, Danaos Shipping, and Hydrus underscore the strategic advantages of BlueBARGE in terms of flexibility, cost-effectiveness, and its potential for retrofitting existing vessels. Key Competitive Insights are:

Competitors and market positioning: *Wärtsilä* and *Corvus Energy* are notable competitors, offering advanced hybrid power solutions that cater to the maritime sector. However, their systems often prioritize standardization over flexibility. BlueBARGE's **modularity and scalability** provide a distinct competitive edge by enabling tailored energy solutions for a wide range of applications, including small vessels (such as ferries and tugs) and large ships (such as cargo vessels and cruise liners). ABS and Danaos Shipping emphasize BlueBARGE's ability to adapt to diverse vessel profiles, which enhances its appeal in a market driven by customization and regulatory compliance.

Competitive advantages:

- Modularity and Scalability: BlueBARGE's design allows for seamless deployment across various maritime environments, from offshore platforms to commercial ports. Its ability to scale energy output makes it suitable for both small-scale and large-scale operations, providing a versatility that competitors like Wärtsilä lack.
- Future-Ready Technologies: By integrating hybrid energy systems such as lithium-ion batteries and hydrogen fuel cells, BlueBARGE is positioned to adapt to future advancements in clean energy technologies, ensuring long-term market relevance (Corvus Energy, 2022).
- Cost-Effectiveness: As highlighted by Hydrus, the high cost of alternative fuels poses a significant barrier for many maritime operators. BlueBARGE mitigates this challenge by offering a cost-effective solution that is particularly attractive for retrofitting existing vessels, reducing the need for costly infrastructure overhauls.

Barriers to entry and BlueBARGE's mitigation strategies:

- Capital Costs: The high initial investment required for clean energy solutions is a common barrier in the maritime industry. BlueBARGE addresses this by leveraging the expertise and financial backing of its consortium partners, who bring extensive experience in maritime operations and clean energy deployment.
- Regulatory Compliance: Stringent environmental regulations, such as the EU Fit for 55 initiative and IMO GHG reduction targets, create additional entry hurdles. BlueBARGE not only aligns with these regulations but also incorporates compliance as a core component of its design and deployment strategy, ensuring it meets current and future regulatory standards.
- Market Differentiation: Hydrus emphasizes that BlueBARGE's potential for retrofitting existing vessels gives it a unique advantage, particularly in markets that prioritize cost-effective sustainability measures. BlueBARGE's ability to deliver clean, shore-side power at a lower cost than traditional fuel-based alternatives position it as a market disruptor in regions with stringent emissions regulations, such as the Mediterranean and Northern Europe.

In short, BlueBARGE's modular, scalable, and cost-effective design provides a clear advantage over established competitors like Wärtsilä. By focusing on flexibility, regulatory alignment, and affordability, BlueBARGE addresses the maritime industry's most pressing challenges, including decarbonization and compliance with evolving regulations. With its ability to cater to diverse vessel types and its emphasis on retrofitting existing infrastructure, BlueBARGE is well-positioned to lead the transition toward sustainable energy solutions in the maritime sector.

5.4 - Regulatory Constraints Analysis

Navigating the complex and evolving regulatory environment remains one of the most significant challenges in the maritime sector. The BlueBARGE project is specifically designed to align with key regulatory frameworks, ensuring compliance with the ambitious emission reduction targets set by the European Union (EU) and the International Maritime Organization (IMO). By proactively addressing current constraints and anticipating future regulatory shifts, BlueBARGE maintains a competitive edge in the maritime decarbonization market. Key regulatory insights are:

- ☐ **Regulatory alignment**

The EU's *Fit for 55* initiative, which aims to reduce GHG emissions by 55% by 2030, serves as a critical driver for adopting clean energy solutions in the maritime sector.

Figure 8 Fit for 55 initiatives.Source : European Commission

BlueBARGE aligns with this initiative by providing innovative solutions that reduce emissions at ports, offshore locations, and anchorage zones, directly addressing the environmental challenges highlighted in the EU Climate Targets framework (*European Commission, 2021*).

The *IMO GHG Reduction Strategy* further complements these efforts, setting the global stage for clean energy adoption in the maritime sector.

- ☐ **Challenges in national compliance**

Insights from *ABS* and *Fundación Valenciaport* underline specific regulatory challenges, such as the need to comply with national energy laws for electricity distribution. For example, Spain's *Law of the Electrical Sector* imposes stringent requirements for integrating renewable energy into the grid, which may impact the deployment of BlueBARGE in Spanish ports. Columbia Ship Management also noted that this is a problem faced in many European ports, particularly in Southern Europe, further highlighting the importance of adaptable and collaborative solutions. By addressing these national compliance issues through close

collaboration with local authorities and stakeholders, BlueBARGE ensures seamless integration into diverse regulatory landscapes.

- ☐ **Future compliance and flexibility**

Partners such as *Danaos Shipping* and *REGBES* report no significant regulatory constraints for BlueBARGE at present, highlighting the project's readiness for future compliance under both IMO and EU guidelines. The modular and scalable design of BlueBARGE allows it to adapt to evolving regulations, ensuring long-term viability and compatibility with new standards, such as the *FuelEU Maritime Initiative* and the EU *Emissions Trading System (EU ETS)*.

- ☐ **Strategies to navigate regulatory shifts**

BlueBARGE actively engages with regulatory bodies, such as ABS and Fundación Valenciaport, to stay ahead of policy changes and incorporate these insights into its design and commercialization strategies. This proactive approach not only reduces compliance risks but also positions BlueBARGE as a leader in regulatory foresight, strengthening its appeal to potential customers and partners. As *REGBES* emphasizes, early alignment with IMO and EU guidelines provides a strong foundation for navigating future regulatory landscapes.

BlueBARGE's approach to regulatory compliance ensures it can navigate both international and national frameworks, aligning with initiatives like Fit for 55 and the IMO GHG Reduction Strategy, as well as addressing national regulations like Spain's Law of the Electrical Sector. Its modular, scalable design positions it as a key solution in the maritime industry's shift to clean energy. The next chapter will explore how these alignments drive market innovation and support BlueBARGE's commercialization.

In conclusion to this chapter, the preliminary market analysis has outlined the current opportunities and challenges within the maritime clean energy sector, emphasizing the market's growing demand for innovative and scalable solutions like BlueBARGE. By addressing key regulatory constraints, assessing competitive dynamics, and identifying target sectors, this analysis establishes a strong foundation for exploring how BlueBARGE can capitalize on these insights to drive market adoption. Building on this market understanding, the following chapter delves into the project's approach to leveraging technological advancements, fostering innovation, and developing pathways for scaling and commercialization. These strategies will ensure BlueBARGE not only meets current market needs but also positions itself as a transformative solution in the maritime industry's decarbonization journey.

6 - Preliminary Market and Business Innovation Development

The BlueBARGE project is poised to leverage market opportunities in the maritime industry through innovative hybrid energy systems, combining lithium-ion and vanadium redox flow batteries with hydrogen fuel cells. These technologies offer scalable energy solutions and open doors for partnerships with energy providers, regulators, and developers. The project explores pathways for scaling, focusing on applications like powering anchored ships and emergency scenarios, with full commercialization by 2030. This strategy supports maritime decarbonization and the long-term success of BlueBARGE in the clean energy market.

6.1 - Opportunities for Innovation

The BlueBARGE project is uniquely positioned to leverage key opportunities for innovation in hybrid power systems, modular design, and sustainable energy solutions for the maritime sector. By integrating advanced technologies and aligning with market needs, BlueBARGE sets a new benchmark for clean, scalable, and adaptable energy systems. These innovations not only address the energy and decarbonization demands of the maritime industry but also contribute to broader sustainability goals by enabling seamless integration across diverse applications.

Key innovation areas in the BlueBARGE project mainly focus on hybrid power systems, modular retrofit design, and adaptable business models that address maritime energy needs. These innovations emphasize scalability, sustainability, and efficiency, enabling seamless integration across diverse applications. By leveraging advanced energy storage technologies, retrofit solutions, and flexible deployment strategies, BlueBARGE positions itself as a transformative force in the decarbonization of the maritime industry.

Key innovation areas include:

1. **Hybrid power systems**

BlueBARGE's hybrid power system is its primary innovation, combining lithium-ion (Li-ion) batteries, vanadium redox flow batteries (VRFB), and probably hydrogen fuel cells.

Insights from *Corvus Energy* emphasize the scalability and flexibility of Li-ion battery systems, making them ideal for varying vessel sizes, from small yachts to large cargo ships. The hybrid system is designed to support future integration of hydrogen technologies, ensuring long-term adaptability to evolving energy demands.

These technologies provide enhanced safety, extended energy storage capabilities, and adaptability for remote and fluctuating operations, addressing challenges faced by vessels operating in isolated regions (*Corvus Energy, 2022*).

2. **Modular retrofit design**

Expertise from *Hydrus* highlights the importance of modular retrofit capabilities. BlueBARGE's design allows for easy retrofitting of existing vessels, enabling operators to adopt sustainable technologies without requiring costly infrastructure overhauls.

This feature expands the project's applicability to a broader market, particularly in regions where older vessels dominate the fleet. Modular retrofit design supports rapid deployment and scalability, making the solution accessible to diverse stakeholders.

3. **Market potential**

The deployment of uniform standards across EU member states, as highlighted by ELKON, is a critical enabler for hybrid energy systems. BlueBARGE can act as a bridge to standardization, simplifying the integration of clean energy technologies across regions with varying regulatory requirements.

Inputs from AAU and NTUA stress the growing demand for mobile energy solutions that offer on-demand green power for ports, anchorage zones, and isolated locations. BlueBARGE's portable, scalable design directly addresses this need, offering a practical alternative to fixed infrastructure.

4. **Business model innovation**

The modular and scalable nature of BlueBARGE's design opens new avenues for business model innovation. By offering energy-as-a-service (EaaS), the project enables sustainable revenue streams through power purchase agreements, leasing models, and on-demand energy solutions.

This adaptability allows BlueBARGE to cater to a wide range of stakeholders, including ports, maritime operators, offshore platforms, and energy providers, making it a versatile and commercially attractive solution (*DNV GL, 2023*).

5. **Market opportunities**

BlueBARGE's hybrid power system provides a significant opportunity for market expansion in remote areas, such as isolated islands, offshore platforms, and ports lacking shore-side power infrastructure.

Its ability to supply clean energy to moored vessels directly supports the decarbonization goals of the International Maritime Organization (IMO) by reducing emissions associated with auxiliary engine use while in port (*IMO, 2021*).

6. **Collaborative partnerships**

The project presents a range of opportunities for partnerships with battery manufacturers, renewable energy providers, and maritime regulators. Collaborations with ports shipowners and energy providers will be critical for scaling deployment across diverse maritime regions, while partnerships with technology providers will drive continued innovation in energy storage and power generation systems.

Partnerships with regulators, including ELKON and FUNDACIÓN VALENCIAPORT, will enhance BlueBARGE's ability to align with regional and international energy policies, promoting seamless adoption.

In short, BlueBARGE project capitalizes on technological advancements, modular designs, and innovative business models to address the evolving energy demands of the maritime sector. Insights from partners like CORVUS ENERGY, HYDRUS, ELKON, and NTUA highlight its potential to lead the way in providing scalable, cost-effective, and sustainable energy solutions. By bridging gaps in standardization, addressing retrofit needs, and fostering strategic partnerships, BlueBARGE is well-positioned to transform the maritime industry and drive the global transition to clean energy.

6.2 - Scaling and Commercialization Pathways

The BlueBARGE project outlines a clear roadmap to achieve commercial viability by 2030 through phased implementation, strategic partnerships, and alignment with policies like the EU Emissions Trading System and Fit for 55 initiative. Key strategies include:

1. **Scaling strategies**: The modular design enables adaptation for diverse maritime applications, including offshore platforms, commercial shipping, and isolated regions. Gradual scaling from pilot projects to large-scale deployments ensures operational reliability and meets varying energy demands, with regional hubs streamlining efforts in high-demand areas like the Mediterranean and Northern Europe.
2. **Commercialization roadmap**:
    - **2024–2026**: Pilot deployments in real-world settings focus on technical refinement and stakeholder feedback in high-potential regions like the Mediterranean and focus on the western Mediterranean due to more cruise traffic.

- **2026–2030**: Transition to full-scale deployment, prioritizing regions with stringent regulations, and developing regional hubs for efficient scaling.

3. **Strategic partnerships**: Collaborations with stakeholders, including ABS, FUNDACIÓN VALENCIAPORT, and DANAOS SHIPPING, ensure regulatory alignment, technological optimization, and market trust. These partnerships drive innovation, enhance market readiness, and facilitate compliance with evolving policies.
4. **Policy alignment**: By integrating policies like the EU Emissions Trading System and IMO GHG reduction strategies, BlueBARGE ensures regulatory compliance and long-term market acceptance.

This phased, partnership-driven approach positions BlueBARGE as a leader in maritime decarbonization, leveraging modular technology and strategic alignment to meet evolving energy and regulatory demands.

To conclude this chapter, building on the market analysis, this chapter outlines the key innovations BlueBARGE brings to the maritime energy sector, specifically through its hybrid power systems and adaptable business models. The scalable design of the system allows it to serve diverse maritime needs, from small yachts to large commercial ships. By leveraging partnerships and focusing on commercial scaling, BlueBARGE is set to achieve its goal of full-scale deployment by 2030. This chapter paves the way for the final conclusions and recommendations, which will synthesize all insights and provide actionable next steps to ensure BlueBARGE's sustainability and impact.

7 - Conclusion and Recommendations

The BlueBARGE project is a pioneering effort to revolutionize maritime energy through the deployment of a modular, scalable power barge designed to meet the maritime industry's increasing need for decarbonization. By integrating cutting-edge hybrid energy systems—lithium-ion batteries, vanadium redox flow batteries, and hydrogen fuel cells—BlueBARGE provides a transformative solution that addresses operational demands while aligning with stringent regulatory frameworks such as the European Union's Fit for 55 directive and IMO's GHG reduction targets.

The Exploitation Plan and Market Analysis, led under Task 8.4, forms the backbone of the project's commercial strategy. This task has guided the development of a comprehensive commercialization plan that ensures BlueBARGE's success by addressing the key challenges in the related maritime areas while promoting innovation and sustainability.

Key Outcomes of BlueBARGE and Task 8.4

- **Clear value proposition:** BlueBARGE delivers significant environmental and economic benefits, reducing GHG emissions and energy costs while supporting noise and vibration mitigation in maritime operations. The hybrid system's modularity ensures its application across various sectors, from commercial shipping to offshore platforms.
- **Comprehensive market analysis:** Task 8.4 facilitated a detailed assessment of market size, target sectors, and competitive dynamics, highlighting the growing demand for clean maritime energy

solutions. The analysis identified high-potential regions, including the Mediterranean, Black Sea, and Northern Europe, where regulatory pressures and clean energy adoption are accelerating.

- **Strategic exploitation of key results:** By identifying and managing Key Exploitable Results (KERs), the project ensures the alignment of technological innovations with market needs. These include advancements in hybrid energy storage, modular inverter platforms, and retrofit capabilities, all aimed at maximizing scalability and flexibility.
- **Innovation in business models:** The use of the Lean Business Model Canvas underpins a flexible, adaptable commercialization strategy that incorporates power-as-a-service (PaaS), leasing models, and energy-as-a-service (EaaS) frameworks, enabling cost-effective adoption by a wide range of stakeholders.
- **Focus on business sustainability:** Task 8.4 emphasizes developing a preliminary business sustainability model that balances CAPEX and OPEX considerations, ensuring BlueBARGE's financial viability and market competitiveness.

Recommendations for future advancement

To ensure the success of the BlueBARGE project, efforts should focus on optimizing hybrid energy systems for efficiency and cost-effectiveness, with an emphasis on integrating hydrogen fuel cells to align with zero-emission standards. Targeted strategies should prioritize high-potential markets such as European ports and offshore platforms, while tailoring solutions to regional regulatory and operational needs. Stakeholder engagement must continue through robust partnerships with ports, regulators, and technology providers, supported by ongoing feedback from workshops and demonstrations. Regular updates to designs and business models are essential to maintain compliance with evolving standards like the EU ETS and FuelEU Maritime Initiative, while collaboration with policymakers can shape favorable regulations.

Lastly, phased implementation of pilot projects should proceed as planned, demonstrating reliability and scalability. Flexible revenue models, such as pay-per-use and maintenance contracts, will support broader adoption and market penetration, ensuring BlueBARGE's long-term impact and success.

The **BlueBARGE project**, guided by the comprehensive objectives of **Task 8.4**, has established itself as a cornerstone in the maritime sector's transition to sustainability. Its technological innovation, market-focused strategy, and commitment to regulatory compliance position it as a leader in maritime decarbonization. The project not only meets the immediate needs of the maritime industry but also anticipates future challenges, ensuring long-term environmental and commercial success.

By focusing on **scalability, stakeholder collaboration, and business sustainability**, BlueBARGE is set to redefine maritime energy systems. Its hybrid energy solution is not just a technical innovation but a catalyst for a cleaner, more sustainable future, creating lasting value for the maritime industry and the global environment.

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