Funded by the European Union

HORIZON EUROPE PROGRAMME – TOPIC: HORIZON-CL5-2022-D5-01-02

AENEAS

innovAtive ENErgy storage systems onboArd vesselS

Deliverable D6.1: Interim exploitation plan

Primary Author(s)	Cayetano Hoyos | Fundación Centro Tecnológico Soermar (SOERMAR)
Deliverable Type	Report
Dissemination Level	Sensitive
Due Date (Annex I)	30.07.2024 (Month 18)
Pages	50
Document Version	Draft 2.0 (Final)
GA Number	101095902
Project Coordinator	Mohsen Akbarzadeh | Flanders Make (FM) (Mohsen.Akbarzadeh@flandersmake.be)

Contributors	
Name	**Organisation**
Cayetano Hoyos	SOERMAR

Formal Reviewers	
Name	**Organisation**
Lidia Rossi	FMAR
David Freire	FS

Version Log			
Rev #	**Date**	**Author**	**Description**
0.1	02.01.2024	Cayetano Hoyos (SOERMAR)	Draft creation
0.2	15.04.2024	Cayetano Hoyos (SOERMAR)	Second draft version
0.3	17.06.2024	Cayetano Hoyos (SOERMAR)	Third draft version
0.4	12.07.2024	Cayetano Hoyos (SOERMAR)	Fourth draft version complete. Ready for review
1.0	17/07/2024 22/07/2024	Lidia Rossi (ForMare) David Freire (FS)	Quality reviewers
2.0	25/07/2024	Mohsen Akbarzadeh (FM)	Coordinator review and approval, deliverable ready for submission

Project Abstract

AENEAS aims to contribute towards climate-neutral and environmentally friendly water transport through three new next generation clean energy storage solutions. Eventual impact is an increase of the global competitiveness of the EU waterborne transport sector by European technology leadership for energy storage solutions for diverse waterborne applications.

AENEAS will develop three innovative electric Energy Storage Solutions (ESS) for waterborne transport, which are advanced beyond the traditional battery systems, including Solid-state batteries (SSB), Supercapacitors (SC) and a Hybrid system which combines SSB and SC.

The solutions enable (partial or full) electric shipping, taking into account conditions specific ships might encounter, including adverse conditions outside sheltered waters or going upstream on rivers. AENEAS will evaluate them for a range of applications and end uses in short-sea shipping and in-land waterways. At the same time AENEAS will define the pathway for the three ESSs for application in different ship types, achieving a comprehensive understanding of the ESSs and their applicability for diverse waterborne transport.

Table of Contents

Public Summary

The main objective of this deliverable is to establish both the market and technicalities related to the commercialization of AENEAS results, including the IPR strategy, the analysis of the current international status of ESS, research methods to protect different IPR and apply for patents, in order to convert intellectual property rights in products and business models.

Additionally, this deliverable includes a careful patent search in order to identify any prior disclosures, ancillary IPRs, or other relevant data assesing novelty and patentability. Also, an analysis of the project outcomes is being done, exposing the future exploitation possibility along the different exploitation paths, commercial business plans and potential financial models to allow the future commercialization of AENEAS solutions.

1 Introduction

1.1 Rationale of this deliverable

1.1.1 Deliverable objectives

The main objective of this deliverable is to establish both the market and technical issues associated with the commercialization of AENEAS results, including the IPR strategy among partners, the analysis of the current international status of EES, research methods to protect different IPR and apply for patents, and translation of intellectual property rights in products and business models.

Additionally, this deliverable contains a careful worldwide patent search in order to identify any prior disclosures, ancillary IPRs, or other relevant data assesing novelty and patentability. Also, an analysis of the project outcomes is being done, exposing the future exploitation possibility along the different exploitation paths, commercial business plans and potential financial models to allow the future commercialization of AENEAS solutions.

1.1.2 WP6 overview

Deliverable 6.1 is part of a total of six deliverables that will show the results obtained in the development of the four tasks that make up WP6: task 6.1 Life cycle, cost, environmental and safety impact analysis; task 6.2 Feasibility and adequacy for a broad range of waterborne operations; task 6.3 Exploitation and protection of intellectual property and task 6.4 Future deployment of technologies.

The objectives that are intended to be achieved with the work that will be carried out in WP6 are the following:

- Assess environmental benefits, cost competitiveness and safety issues of the technologies proposed for a number of case studies vis-a-vis state-of-art battery systems.
- Define pathways for the AENEAS solutions to contribute to the EU/IMO decarbonisation strategies for waterborne transport and analysis of and recommendations for regulatory requirements.
- Identify & quantify potential markets for the AENEAS solutions and develop exploitation business models.
- Create a roadmap for advancing TRL of two AENEAS ESS solutions towards full-scale demonstrator in 2027 and for upscaling of the three AENEAS solutions to other waterborne vessels and application areas as an alternative to conventional batteries.

1.1.3 Structure of the document

The deliverable is structured in 8 chapters, which includes an overall approach on the exploitation plan, the identification and analysis of different business models through which to exploit the technological solutions developed at AENEAS, as well as a marketing and patent plan.

It should be noted that deliverable D6.1, as a result of the work carried out in task 6.3, is intrinsically related to task 7.3, depend on each other advancements and have the common

strategies to maximize the impact of the Key Exploitable Results (KERs) generated of AENEAS.

All partners have actively contributed by providing inputs in relation to the KER and their intentions regarding their exploitation. Also, AUTH and ISSN have contributed providing the potential of the academic exploitation of AENEAS results, and SOER, FV and FMAR have networked with the different stakeholders, including the Waterborne TP and ZEWT, to receive from the external industry and academia the most relevant inputs to perform the AENEAS exploitation plan.

The deliverable will finally include conclusions and results.

Attainment of the objectives and explanation of deviations

All the objectives of the task have been met and achieved, without any deviation having occurred in both the content and the execution time.

2 AENEAS value proposition

As a previous step to the identification of potential exploitation opportunities, it was necessary to carry out an overview of the project activities, partners involved and their alignment with the main objectives of the European Union.

Once the roles of each partner within AENEAS were determined, an analysis of each partner was performed in order to evaluate the exploitation potential of each of the results, transforming these results into Key Exploitable Results (KERs). In this sense, each KER was associated with one or more partners, depending on both the scope of work of each of them within AENEAS and their exploitation interests in relation to said KER, presented in Section 2.1.

For each identified KER, an overview is provided within Section 2.2, in order to show the expected developments and innovations beyond the State of The Art (SOTA) will be achieved at the end of AENEAS, including the expected TRL.

Finally, Section 2.3 presents the KER characterization methodology that has been selected and that will be applied to all KERs identified throughout the AENEAS project. Likewise, the results will be presented in future versions of this deliverable. This is intended to guarantee a fluid and successful exploitation of the identified results, establishing relevant strategies for their future introduction into the market.

2.1 AENEAS project and main outcomes

The decarbonization of industry and transport is one of the greatest challenges faced by today's society. Despite past efforts to reduce greenhouse gas emissions, in the upcoming years significantly greater technological progress needs to be achieved to allow both sectors to achieve the objectives set by the European Union, in the European Green Deal, and at international level, stablished by the Paris Agreement.

Specifically, the maritime transport sector is one of the main emitters of CO2 in the transport sector in the European Union with a total of 13% of emissions, and 3% of the global value. Likewise, emissions derived from maritime transport are expected to increase by around 20-50% between 2008 and 2050 [1].

For this reason, and to achieve the objectives established for the electrification of the waterborne transport sector, the introduction of new technologies that allow the transition from fossil fuels to the electrification of the fleet are an absolute priority.

In this sense, AENEAS aims to provide solutions associated with the improvement of the overall energy efficiency of ships and the drastic reduction of emissions from the waterborne transport sector, through the development of innovative energy storage systems, which are far beyond the current State Of The Art.

The main ambition and objective of AENEAS is to develop three innovative energy storage systems:

- Solid-state batteries (SSB), for constant load waterborne transport applications, due to its higher energy density, more than the conventional Li-ion batteries. This new generation batteries will allow vessels to navigate longer distances without depending on fossil fuels.
- Supercapacitors (SC), acting as high energy batteries, in order to improve waterborne transport applications for peak shavings and loading peaks, thanks to its high power density.

- Hybrid Energy Storage System (Hybrid ESS), as a combination of solid-state batteries and supercapacitors, for waterborne transport applications requiring high energy and power density energy storage systems.

The development of these technologies will allow the maritime transport sector to be provided with two new technologies based on state-of-the-art energy storage systems, with the aim of promoting the electrification of the sector and leading it towards decarbonization.

In this sense, and to achieve the general objectives, and develop the innovations that AENEAS proposes, the project has been divided into several Work Packages (WPs), each with its individual objectives, whose joint progress allows the correct evolution of AENEAS. The objectives of each WP are described below:

- WP1 “Operational scenario Specification and Requirements”
    - Objective 1: Determine operational profiles, safety and integration requirements of SBB, SC and hybrid SSB/SC for short sea-, inland water transport-, and seagoing vessels.
    - Objective 2: Define 3 use-cases to demonstrate the 3 ESS at TRL 5, based on the requirements and operational profiles.
    - Objective 3: Develop a monitoring and evaluation framework, including different key criteria, for the different ESS to assess their performance during the demonstrations.
- WP2 “Concept design and Optimization”
    - Pre-sizing of energy/power management strategies and architecture using advanced simulation tools.
    - Optimization of the energy/power management strategies and architecture through simulation, using representative mission profile defined in WP1.
    - Evaluate the performances and the gain of the innovative energy storage systems: SC and SSB that are studied in WP3, compared to current technologies.
    - Evaluation of the vessel’s electrical grid with respect to the performance and environmental aspects.
- WP3 “Cell level characterization and model development”
    - Screen, identify and source the best SC candidate cells; provide SSB cells; define and execute standard characterization for samples verification.
    - Define advanced characterization protocols dedicated to SC and SSB electro-thermal model identification, then perform the dedicated tests, including safety behavior.
    - Definition of models and their parameters at SC or SSB level to support module design for specific vessels.
- WP4 “Conceptual module design, prototyping and functional testing”
    - Define a downscaled module/package size for the stand-alone and hybrid ESSs for HIL testing in WP5.
    - Conceptual design of the ESS modules with optimized Balance of Plant (BoP) including electrical, mechanical, and thermal design and BMS.
    - Prototyping and assembly of the monotype and hybrid ESS modules as input for testing at TRL 5 in WP5.
    - Functional testing and validation of the modules under different operational and environmental conditions.
- WP5 “Testing and Validation“
    - Provide real-time simulation models for the components of ship power systems, power converters and integration of the hybrid ESS.

    - Develop Hardware-in-the-loop (HIL) platforms for testing and validation of the concepts and solutions developed (in WP2, WP3 and WP4) according to the specific use cases to ensure realistic simulations.
    - Test the overall operational performance of the developed energy storage systems with a downscaled model to validate the applied control techniques and the design of the energy storage systems.
    - Test the entire ship power system with up-scaled HIL system for energy management performance over the specific operational profiles of the use-cases.
- WP6 “Impact analysis, business models and exploitation”
    - Assess environmental benefits, cost competitiveness and safety issues of the technologies proposed for a number of case studies vis-a-vis state-of-art battery systems.
    - Define pathways for the AENEAS solutions to contribute to the EU/IMO decarbonization strategies for waterborne transport and analysis of and recommendations for regulatory requirements.
    - Identify & quantify potential markets for the AENEAS solutions and develop exploitation business models.
    - Create a roadmap for advancing TRL of two AENEAS ESS solutions towards full-scale demonstrator in 2027 and for upscaling of the three AENEAS solutions to other waterborne vessels and application areas as an alternative to conventional batteries.
- WP7 “Dissemination and Communication“
    - Maximise the dissemination of project results to bring widespread awareness to the broader public through presentations at webinars, technical conferences, scientific publications and the project website.
    - Generate high impact by carrying out customized communication activities towards relevant industries in the batteries and recycling sector along with the relevant policy makers.
    - Promote awareness of world-wide IP and expertise in the field of solid-state batteries, to enlarge the EU knowhow in the field.
    - Liaise with relevant projects and initiatives, also at extra-European level, to ensure knowledge exchange, interoperability of the developed systems as well as wide market penetration.
- WP8 “Project Management and Scientific Coordination”
    - Manage the project in terms of legal, contractual, ethical, financial, and administrative aspects as well as its decision-making processes.
    - Establish appropriate liaison with the European Commission (EC).
    - Assure high quality of the project’s task implementation, deliverables, reporting processes, and outcomes. This will include proper risk management and development of mitigation strategy.

To show the interconnection and relationship between the WPs, a summary diagram is included below.

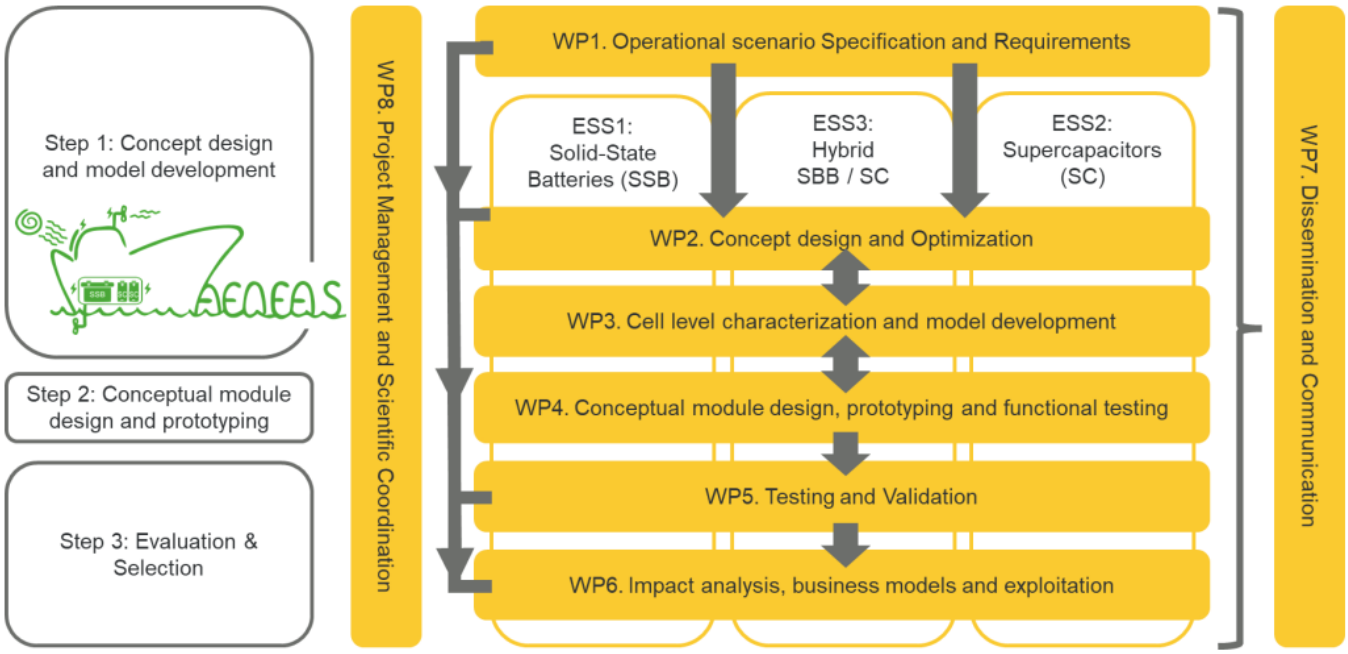


Figure 1: AENEAS work package structure (Pert chart), showing how they inter-relate

2.2 AENEAS innovation and expected results

The first step was the identification of the main results of the Project Results (PRs), which are defined by the European Commission as follows: "*A Project Result is defined as any tangible or intangible output of the action, such as data, knowledge and information whatever their form or nature, whether or not they can be protected*".

The project results, according to the planned work stablished within the Grant Agreement, of AENEAS project are the following:

- Develop of innovative solid-state batteries and supercapacitors, including the hybrid solution combining both Energy Storage Systems (ESS), in order to bring these new technologies in different waterborne transport applications to TRL 5.
- Employ simulation and modelling platforms to develop innovative ESS concepts form marine applications with optimal control and energy management strategies and bringing them to TRL 5.
- Develop modules/packages of SSB and SC with multiple cells and optimized balance of plant.
- Develop innovative SSB, SC and hybrid ESS downscaled testing, validation and upscaling with flexible HL test bench.
- Assess environmental benefits, costs and safety issues of the ESS, and compare them with traditional battery systems.
- Define decarbonization strategies for future maritime applications based on EU/international CO_2 legislations.

Based on the PR description, a Key Exploitable Result (KER) is defined as an identified main interesting result, which has been selected and prioritized due to its high potential to be exploited [2].

Following the previous definition, a preliminary list of KERs was identifed during the proposal presentation, which are summarized in the following picture.

Table 1: KER Owner description

KER number	KER description	Work Package	Owner	Partners involved
1	Component model of SSB	WP2	SIEMENS	FM, CEA, ABEE, SIE, UVA, I2M, GRIM, INLS, AUTH
2	Vessel simulation models	WP2	SIEMENS	FM, CEA, ABEE, SIE, UVA, I2M, GRIM, INLS, AUTH
3	Electro-thermal and safety modelling on SC and SSB	WP3	CEA, ABEE	FM, CEA, ABEE, SIE, UVA
4	Component models of EMS/PMS	WP2	SIEMENS	FM, CEA, ABEE, SIE, UVA, I2M, GRIM, INLS, AUTH
5	Vessel propulsion optimization process	WP2	SIEMENS	FM, CEA, ABEE, SIE, UVA, I2M, GRIM, INLS, AUTH
6	Design and BoP for SC and SSB	WP4	FLANDERS MAKE, ABEE	FM, CEA, ABEE, SIE, UVA
7	ESS sizing, hardware design, assembly and prototyping of the modules	WP4	FLANDERS MAKE	FM, CEA, ABEE, SIE, UVA
8	Hybridization of SSB/SC	WP4	FLANDERS MAKE	FM, CEA, ABEE, SIE, UVA
9	Dynamic modelling and HIL setup design of ship components and power converters	WP5	UNIVERSITY OF VASSA	FM, CEA, ABEE, SIE, UVA, I2M, GRIM, INLS
10	Validated model-based impact assessment of new marine technologies	WP5	UNIVERSITY OF VASSA	FM, CEA, ABEE, SIE, UVA, I2M, GRIM, INLS
11	Lab-scale prototype and multipurpose HIL environment	WP5	UNIVERSITY OF VASSA	FM, CEA, ABEE, SIE, UVA, I2M, GRIM, INLS
12	Trade-off between different energy storage systems (supercapacitors, solid state battery, typical batteries)	WP6	FUNDACION VALENCIA PORT	FM, ABEE, SIE, UVA, I2M, GRIM, INLS, FV, AUTH, SOER, FMAR, ISSN, FS
13	SSB energy storage for constant load waterborne transport operations SC	-	-	ALL

KER number	KER description	Work Package	Owner	Partners involved
	energy storage for peak power. Hybrid energy storage system for high energy and high power			
14	Roadmap to Onboard demonstrators	-	-	ALL

The KER identified in the early stage of the project include:

Component model of SSB: SSB models will be developed and integrated within standard Amesim by SIEMENS. Task 2.1

Vessel simulation models: the vessels simulation models will be run after the component models are developed. Task 2.2 and task 2.4.

Electro-thermal and safety modelling on SC and SSB: Develop a SC and SSB electro-thermal model and it can be used for variety of applications. Task 3.3.

Component models of Energy Management System (EMS)/Power Management System (PMS): For integration of proposed energy storage system in vessel. Task 2.1.

Design and Balance of Plant (BoP) for SC and SSB: Focus on heating solutions, rather than cooling. Task 4.1 and task 4.2.

ESS sizing, hardware design, assembly and prototyping of the modules: Develop prototypes wrt use cases for HIL testing.

Hybridization of SSB/SC: Focus will be compromise between energy and power density. Task 4.1.

Dynamic modelling and Hardware In the Loop (HIL) setup design of ship components and power converters: Delivering accurate real time simulation models of the ship power system including relevant controllers and integrating them with real storage system and power electronics coupled at DC bus. Task 5.1 and task 5.2.

Validated model-based impact assessment of new marine technologies: A full impact analysis of the new ship's ESS will be made with realistic functional parameters and operational strategies. Task 5.3.

Lab-scale prototype and multipurpose HIL environment: Considering ship's ESS (SSB and SC) and power converters (DC/DC and DC/AC converters) a fully functional HIL test bench is created enabling studies of various system designs, reduced scale analysis and suitable upscaling. Task 5.3 and task 5.4.

Trade-off between different energy storage systems (supercapacitors, solid state battery, typical batteries): Focus will be on studying the TCO, safety and performance of the AENEAS ESS systems with traditional batteries. Task 6.1.

SSB energy storage for constant load waterborne transport operations SC energy storage for peak power. Hybrid energy storage system for high energy and high power: Supply of the requirements and specifications to optimize the battery cells for marine

applications. Optimisation of the control strategy and the sizing of the SSB battery pack for marine applications.

Roadmap to Onboard demonstrators: Develop a detailed roadmap to install two on-board demonstrators by 2027.

Exploitable results	Tittle of the Result	Exploitation potential	Field of interest	Organisation contributed to the generation of this result during the project's lifetime	TRL	Expertise needed outside AENEAS consortium
1	Components model of SC and SSB	integration in Simcenter Amesim standard ESS library	System simulation, for many application	**SIE**	7	No
	Components model of SC and SSB	Matlab Simulink/Simscape is used for modelling	Battery energy storage system	ABEE, SIE, UVA	7	No
	Components model of SC and SSB	Further research projects	Electric vessels, Electric vehicles, stationary batteries	I2M, SIE, FM, UVA, ABEE	5	No
2	Vessel simulation models	vessel simulation model in Amesim, can be integrate as demo	System simulation, for many application	SIE	7	No
	Vessel simulation models	Selection of a vessel aligned with the weighted KPIs with a TRL 5	Scientific, maritime sector as a whole (including industry, association and so on)	iSSN	5	No
	Vessel simulation models	Further research projects	Electric vessels	SIE, I2M, FM, CEA, AUTH	5	No
3	Electro-thermal and safety modelling on SC and SSB	SSB electrothermal model, available for many applications	System simulation, for many application	SIE	5	No
	Electro-thermal and safety modelling on Sc and SSB	Low	System simulation, for many application	UVA, SIE, CEA	5	No
	Electro-thermal and safety modelling on SC and SSB	SSB electro-thermal models	Battery energy storage system	ABEE, SIE, UVA	5	No
	Electro-thermal and safety modelling on SC and SSB	Further research projects	Electric vessels, Electric vehicles, stationary batteries	ABEE, SIE, UVA, AUTH, FM, CEA	5	No
4	Component models of EMS/PMS	Prototype models, validated for the AENEAS use-cases	System simulation	SIE	5	No
5	Vessel propulsion optimization process	Optimization process applied to the 3 AENEAS use cases	System simulation	SIE	5	No

Exploitable results	Tittle of the Result	Exploitation potential	Field of interest	Organisation contributed to the generation of this result during the project's lifetime	TRL	Expertise needed outside AENEAS consortium
	Vessel propulsion optimization process	Optimization of EMS and increase efficiency	Battery energy storage system for marine applications	ABEE, FM, CEA	5	No
	Vessel propulsion optimization process	Further research projects	Electric vessels	FM, SIE, I2M, CEA, ABEE, AUTH	5	No
6	Design and BoP for SC and SSB	Further research projects	Electric vessels	FM, SIE, I2M, CEA, ABEE, AUTH	5	No
	Design and BoP for SC and SSB	Battery pack design with thermal management system	Battery energy storage system for marine applications	ABEE, FM, CEA	5	No
7	ESS sizing, hardware design, assembly and prototyping of the modules	project with industrial partners	Maritime applications	CEA Grenoble	5	No
	ESS sizing, hardware design, assembly and prototyping of the modules	Further research projects	Electric vessels	FM, CEA, ABEE, SIE, UVA	5	No
8	Hybridization of SSB/SC	Further research projects	Electric vessels, Electric vehicles, stationary batteries	FM, CEA, ABEE, UVA, SIE, AUTH	5	No
9	Dynamic modelling and HIL setup design of ship components and power converters	project with industrial partners	Maritime applications	CEA Nantes	5	No
	Dynamic modelling and HIL setup design of ship components and power converters	Low	Maritime applications	UVA	5	No
	Dynamic modelling and HIL setup design of ship components and power converters	Further research projects	Electric vessels	ABEE, SIE, UVA, AUTH, FM, CEA	5	No
10	Validated model-based impact assessment of new marine technologies	Project with industrial partners	Maritime applications	CEA Nantes	5	No
	Validated model-based impact assessment of new marine technologies	Medium	Maritime applications	UVA	5	No

Exploitable results	Tittle of the Result	Exploitation potential	Field of interest	Organisation contributed to the generation of this result during the project's lifetime	TRL	Expertise needed outside AENEAS consortium
	Validated model-based impact assessment of new marine technologies	Further research projects	Life cycle and business case analysis of ESS, cost modeling of ESS	CEA, ABEE, FM, SIE, FV, AUTH, ISSN, UVA	5	No
11	Lab-scale prototype and multipurpose HIL environment	Project with industrial partners	Maritime applications	CEA Nantes	4	No
	Lab-scale prototype and multipurpose HIL environment	High	Lab-scale prototype	UVA, CEA	4	No
	Lab-scale prototype and multipurpose HIL environment	Further research projects	Lab-scale prototype	ABEE, SIE, UVA, AUTH, FM, CEA	4	No
12	Trade-off between different energy storage systems (supercapacitors, solid state battery, typical batteries)	Further research projects	Trade-off criteria	AUTH, SIE, FV, ISSN, FM	6	No
13	SSB energy storage for constant load waterborne transport operations SC energy storage for peak power. Hybrid energy storage system for high energy and high power	Further research projects	Sizing SSB vs. SC criteria	FM, CEA, ABEE, UVA, SIE, I2M, AUTH	5	No
14	Roadmap to Onboard demonstrators	Further commercialization	Maritime applications	GRIM, INLS, FS, ISSN, SOER, SIE, I2M, FV, UVA	6	No

2.3 KER characterization methodology

Once the AENEAS related KERs are defined and assigned to each partner, an accurate exploitation strategy is relevant to detail the potential characteristics of each KER, in order to ensure the post project activities and market entry.

The following paragraph tries to describe the KER characterization table, these being the exploitation results that will be used throughout the entire project, and which will be updated as the project progresses. In this sense, the KER characterization table is a tool that allows us to summarize the main characteristics of each KER and provide information on its Exploitation Plan.

The partner who owns the KER must provide useful information to complete the table in the most efficient, realistic, and credible way possible, given that the results will be used to develop both the exploitation plan of the project and of each partner at an individual level. The table has been structured as follows:

- **Novel solution:** this part will include a brief description of the KER, and a comparison with the current State of the Art solutions.
- **Market:** market context in which the KER will be introduced.
- External factors: factors external to the project that could affect KER and its future exploitation.
- **Go to market:** cost for solution implementation, time to get the KER to market, estimated price, etc.
- **IPR management:** Details the background and foreground Ips and the role of the involved partners.
- **Exploitation strategy:** Exploitation means of each partner.

Below is the template for obtaining the above information for each of the KERs identified in AENEAS.

Novel solution	
KER owner	Partner responsible for the identified KER
Description	Short description of the problem the KER aims to solve/ improve
Alternative solution	Description of the State of the Art solutions already present in the market
Unique value proposition	Describe the competitive advantages, the innovative aspects. What does your solution do better, what are the benefits , what distinguishes the KER from the competition/ current solutions
Market	
Target market	Define the targeted customer segments or potential buyers, expected market size of the proposed solution
Competitors	Who are your "competitors" (note: they are the ones offering "alternative solutions")? What are their strengths and weaknesses comparing to you?
Market trends/ public acceptance	Description of market trends and of the hypothetical level of acceptance of the Product/Service by consumers. If applicable include possible risks/reasons why end users might be hesitant in adopting the product/service
External factors	
Requirements	Identification of legal, normative or ethical requirements to implement and commercialize the KER
Go to market	
Cost of implementation	Describe the expected costs for solution implementation
Time to market	Expected time for solution market ability
Foreseen price	Expected selling price of the solution. Revenues: licensing revenues (royalties, service upgrade), spin-off revenues (software development to third parties, subscriptions of the platform, advanced services (upgrades), sale of equipment).

Adequateness of consortium staff	Assess the Adequateness of consortium staff
External experts/ partners to be involved	Include external partners and/or experts involved in the implementation of solution +EES related projects
IPR management	
Background IPR	Include the present status and agreement with other partners involved
Foreground IPR	Include the present status and agreement with other partners involved
Exploitation Strategy	
Exploitation means/potencial	Direct industrial use, technology transfer, license, publication, standard
Partner's contributions	Partner's main contributions in terms of know-how, licesing, patents
Involved partners expectations	Description of partner's expectations
Financing sources	Description of foreseen financing sources after the end of the project

3 Exploitation framework

The correct management of AENEAS's intellectual property is absolutely essential to achieve efficient use of the project results, in order to identify and resolve potential conflicts that may arise between the different AENEAS partners.

AENEAS IPR strategy is defined in the project's Consortium Agreement, before the project starts. Among all the tasks which implies the IPR management, the most important ones are: assessing project's partners prior knowledge (background), their expected contributions to the IP (Results/ foreground information), the overlap of IP among AENEAS partners and plan the consortium's IP strategy.

To develop exploitation agreements, it is recommended to always refer to the prescriptions included in the Consortium Agreement and Grant Agreement, and to consult the Project Coordinator and the Exploitation Manager for any issue concerning IPR protection.

3.1 General exploitation strategy

In general, the overall goal of AENEAS consortium is to achieve the maximum development and use of technologies and solutions developed within the project for a further commercial exploitation of the results, being the intention to ensure the continuation of AENEAS results beyond the end of the project (dissemination of AENEAS results, scientific improvements, research with own funding, acquiring funding for continuation project, technology transfer, find new fields of applications, etc) and how AENEAS will influence in the future.

It should be noted that there is currently no technology equal to what AENEAS is developing in the market, which will contribute to the decarbonization of the maritime transport sector and the electrification of the fleet worldwide through the development of innovative solid-state batteries. and supercapacitors.

In this sense, the interests placed by the partners involved in exploiting the results of AENEAS are several and diverse: training, research, provide services and commercialization. As a result of this, and as mentioned at the beginning of this section, the individual exploitation strategy of each partner will be analyzed within the longer term project's vision.

3.2 Exploitation challenges and aims

This chapter aims to identify the exploitation intentions of each of the partners in the AENEAS consortium. This has been carried out through a BFMULO analysis. The analysis has been developed to determine the involvement of each partner in the Ers identified for the project. These results will serve in the future to establish the bases for the management of Intellectual Property as well as individual exploitation plans.

3.2.1 Results and BFMULO Analysis

In order to develop an appropriate exploitation strategy and plan, it is necessary to determine the level of involvement of the project partners in each of the KERs. A BFMULO matrix including all Ers has been created and all partners have been asked to complete it based on their exploitation intentions. The exploitation intentions are referenced with the letters that characterize this matrix, the meaning of which is explained below:

- **B** = IPR's on background information, information, excluding foreground information, brought to the project from existing knowledge, owned or controlled by project partners in the same or related fields of the work carried out in the research project.
- **F** = IPR's on foreground information, Information including all kind of exploitable results generated by the project partners or 3rd parties working for them in the implementation of the research project. To have an F in an exploitable result it is necessary that a partner has a task(s) in the project related to that very result.
- **M** = Making the products, manufacturing and selling or directly implementing it through own facilities and skills.
- **U** = Using the result, implemented with own knowledge to develop new ranges of products or newer processing. Furthermore, the direct or indirect utilization of foreground in further research activities other than those covered by the project, or for developing, creating and marketing a product or process, or for creating and providing a service.
- **L** = Licensing the result, therefore earning from a negotiation towards third parties outside the Consortium.
- **O** = Other, any other exploitation means (e.g.: consultancy, provide services, etc).

The exploitation intention of each partner that makes up AENEAS has been updated from M6 to M17, with the aim of including in this document the most up-to-date and realistic information possible.

Key Exploitation Result	FM	CEA	ABEE	SIE	I2M	GRIM	INLS	FV	AUTH	SOER	FMAR	ISSN	FS	UVA
1	U	-	BFMU	BFMULO	-	-	-	UO	-	-	U	-	-	-
2	U	-	U	BFMULO	-	-	-	-	-	-	U	B/F/U	-	-
3	U	-	BFMU	BFMU	UO	-	-	UO	F,U	UO	U	-	UO	F,U
4	-	-	U	BFMU	UO	UO	UO	UO	-	UO	U	-	UO	-
5	U	-	BFMU	BFMU	UO	UO	UO	-	-	UO	U	-	UO	-
6	U	-	BFMUL	U	UO	UO	UO	-	-	UO	U	-	UO	-
7	U	BFMUL	U	U	UO	UO	UO	-	-	UO	U	-	UO	-
8	U	-	U	U	UO	UO	UO	-	-	UO	U	-	UO	-
9	U	BFMUL	U	U	UO	-	-	-	F,U	UO	U	-	UO	F,U

Key Exploitation Result	FM	CEA	ABEE	SIE	I2M	GRIM	INLS	FV	AUTH	SOER	FMAR	ISSN	FS	UVA
10	U	BFMUL	U	U	UO	UO	UO	UO	F	UO	U	-	UO	F
11	U	BFMUL	U	U	-	-	-	-	F,M	-	U	-	-	F,M
12	U	-	U	U	UO	UO	UO	-	-	UO	U	-	UO	-
13	U	-	U	U	UO	UO	UO	UO	-	UO	U	B/F/U	UO	-
14	-	-	U	U	UO	UO	UO	UO	-	UO	U	B/F/U	UO	-

3.3 IPR management

The intellectual property of AENEAS project is essential to use the results of the project in the best possible way, as well as to identify and resolve potential conflicts that arise between AENEAS partners.

AENEAS strategy is defined within the Consortium Agreement, which was signed by all partners, before the start of the project. IPR management encompasses a diversity of tasks, the most important and critical being the evaluation of each partner's prior knowledge of the project, knowing their background, the expected contribution to the Intellectual Property of the project, known as foreground, and the possible overlap of Intellectual Property between the project partners in order to establish and plan the intellectual property strategy of the Consortium.

To develop exploitation agreements, it is recommended to always refer to the prescriptions included in the Consortium Agreement and Grant Agreement, and to consult the Project Coordinator and the Exploitation Manager for any issue concerning IPR protection.

3.3.1 IPR background

According to the Grant Agreement (Article 16.1) background is defined as “data, know-how or information (…) that is (…) needed to implement the Action or exploit the results“. Because of this need, Access Rights have to be granted in principle, but partners identified them and agree amongst them on the Background for AENEAS.

In this sense, IP background has to include all IP rights, as well as know-how and business and trade secrets of each partner independent of whether such rights are eligible for IP registration, which is required for the success of the project.

It is very important to ensure any information required for the correct development of AENEAS is accessible to the partners prior to the start of the project, and for this reason, access rights have already been addressed in the AENEAS Consortium Agreement.

Some preliminary Background IPs were identified during the Grant Agreement Preparation and included in the Consortium Agreement. Additionnaly, Partners have been periodically asked about new IP background.

3.4 Partner’s Rights and Obligations

3.4.1 Access rights

Access rights are created in order to use both the background and the results of the project. They have been agreed and detailed in the AENEAS Consortium Agreement. To summarize, during project implementation, Access Rights to Results and Background needed for the

performance of the own work of a Party under the Project shall be granted on a royalty-free basis, unless otherwise agreed for Background in the Consortium Agreement.

In relation to the Access Rights to Results for Exploitation purposes must grant each other access, under fair and reasonable conditions, to results needed for exploiting their results. Also, partners must grant each other access, under fair and reasonable conditions, to background needed for exploiting their results, unless the partner that holds the background has, before acceding to the Agreement, informed the other partners that access to its background is subject to restrictions.

Requests for access must be made — unless agreed otherwise in writing — up to one year after the end of the action.

The following table shows the general conditions in relation to the guarantee of access rights as established in the Consortium Agreement.

Purpose	Access to background	Access to results
Implementation of project	Royalty-free, unless otherwise agreed by partners in the Consortium Agreement.	Royalty-free
Exploitation of project results	The partners must grant each other access, under fair and reasonable conditions, to background needed for exploiting their results, unless the partner that holds the background has, before acceding to the Agreement, informed the other partners that access to its background is subject to restrictions. Requests for access must be made, unless agreed otherwise in writing, up to one year after the end of the action.	

3.4.2 Results and Transfer of Results

The obligations of the partners in relation to the treatment of the results and their transfer are determined and included in the Consortium Agreement, in accordance with the HORIZON EUROPE Participation Rules. As the project is based on collaboration between several partners, each project partner has the right to request access rights to the other partner's background and results as long as it needs them in order to carry out its work under the project or to use its own results. The related information are described in the Grant Agreement and the Consortium Agreement.

3.4.3 Ownership of results

In relation to the ownership of the results, each beneficiary is the owner of what they develop and generate. Given the collaborative nature of the project, it is assumed that developments are not carried out by a single partner of the consortium, but by several partners working together, so in most cases the results obtained by each of the partners cannot be discretized. In this case, all partners who have collaborated in such developments, and results, must enter into a separate joint ownership agreement which stipulates the assignment of rights and the conditions for exercising their ownership.

3.4.4 Obligations to protect the results

Each partner must examine the possibility of protecting the results and protect them, if necessary, for a sufficiently long period of time and with appropriate territorial coverage, if the results of AENEAS were potentially marketable or industrially exploitable, protecting them in a manner reasoned and justified. To do this, all relevant considerations will be taken into

account, including commercial exploitation prospects, legitimate interests of the partners and any other legitimate interest (Article 16 and Annex 5 of the Grant Agreement).

3.4.5 Obligations to exploit results

Each partner must — up to four years after the end of the project— take measures aiming to ensure exploitation of its results (either directly or indirectly, in particular through transfer or licensing) under terms and conditions set up in the Grant Agreement

3.4.6 Obligation to ensure open access to the results

Each project partner must ensure open access (free of charge online access for any user) to all peer-reviewed scientific publications relating to its results under terms and conditions set up in the Grant Agreement.

3.4.7 Consequences of non-compliance

In case that any of the above-mentioned obligations has been breached, the European Commission may apply specific actions to reduce the maximum grant amount proportionally to the seriousness of the breach

3.4.8 Non-disclosure of information

All information received by a partner ("Disclosing Party“) from another project partner ("Recipient“) whether orally, in writing, or in electronic or any other form shall be deemed confidential provided, that such information is clearly marked as confidential. The Disclosing Party disclosing oral information intended as confidential information shall, at the time of disclosure, state that the information is confidential and within fourteen (14) days provide confirmation in writing of its confidential nature.

The Recipient is obliged not to use the Confidential Information otherwise than for the purpose for which it was disclosed for a period of 5 years after the end of the project.

3.5 Proposition of IPR protection options

Preliminary proposals of the IPR protection measures related to the Exploitable results have been considered. The results are presented in the table below. IP proposals are subjected to the potential modifications of the Exploitable results that may arise during the project. Therefore, the updated IP proposals might be provided by the upcoming exploitation plans. Final proposals and the overview of the taken measures will be provided at the end of the project.

No.	Result	Proposed IPR protection
1	Components model of SSB	Patent
2	Vessel simulation models	Patent
3	Electro-thermal and safety modelling on SSB	Patent
4	Component models of EMS/PMS	Patent
5	Vessel propulsion optimization process	Copyright
6	Design and BoP for SSB	Design rights

No.	Result	Proposed IPR protection
7	ESS sizing, hardware design, assembly and prototyping of the modules	Copyright
8	Hybridization of SSB/SC	Patent
9	Dynamic modelling and HIL setup design of ship components and power converters	Copyright
10	Validated model-based impact assessment of new marine technologies	Copyright
11	Lab-scale prototype and multipurpose HIL environment	Copyright
12	Trade-off between different energy storage systems (supercapacitors, solid state battery, typical batteries)	Copyright
13	SSB energy storage for constant load waterborne transport operations SC energy storage for peak power. Hybrid energy storage system for high energy and high power	Patent
14	Roadmap to Onboard demonstrators	Copyright

Protection of the intellectual property rights generated within AENEAS Project can be ensured also by commercial strategies implemented by project partners, such as confidentiality implied for confidential business information, trade secrets and know how.

4 Technology Readiness level Development

Following the definition of the NASA (National Aeronautics and Space Administration), is a method for defining the maturity of a product and its relation to the market, going from the idea (level 1) to the full deployment of the product in the market (level 9). The table below describes each level of TRL.

Table 2: Technology Readiness Level scale. Source: European Commission

level 1	*Basic research*	Principles postulated and observed but no experimental proof available.
Level 2	*technology formulation*	Concept and application have been formulated.
Level 3	*Applied research*	First laboratory tests completed; proof of concept.

Level 4	*Small scale prototype*	Built in a laboratory environment ("ugly" prototype).
level 5	*Large scale prototype*	Tested in intended environment.
level 6	*Prototype system*	Tested in intended environment close to expected performance.
Level 7	*Demonstration system*	Operating in operational environment at pre-commercial scale.
Level 8	*First of a kind commercial system*	Manufacturing issues solved.
Level 9	*Full commercial application*	Technology available for consumers.

The following table summarise the TRL development of each AENEAS KER.

Exploitable results	Tittle of the Result	Involved partners	Expected TRL
1	Components model of SSB	**SIE**	7
	Components model of SSB	ABEE, SIE, UVA	7
	Components model of SSB	I2M, SIE, FM, UVA, ABEE	5
2	Vessel simulation models	SIE	7
	Vessel simulation models	iSSN	5
	Vessel simulation models	SIE, I2M, FM, CEA, AUTH	5
3	Electro-thermal and safety modelling on SSB	SIE	5
	Electro-thermal and safety modelling on SSB	UVA, SIE, CEA	5
	Electro-thermal and safety modelling on SSB	ABEE, SIE, UVA	5
	Electro-thermal and safety modelling on SSB	ABEE, SIE, UVA, AUTH, FM, CEA	5
4	Component models of EMS/PMS	SIE	5
5	Vessel propulsion optimization process	SIE	5
	Vessel propulsion optimization process	ABEE, FM, CEA	5
	Vessel propulsion optimization process	FM, SIE, I2M, CEA, ABEE, AUTH	5

Exploitable results	Tittle of the Result	Involved partners	Expected TRL
6	Design and BoP for SSB	FM, SIE, I2M, CEA, ABEE, AUTH	5
	Design and BoP for SSB	ABEE, FM, CEA	5
7	ESS sizing, hardware design, assembly and prototyping of the modules	CEA Grenoble	5
	ESS sizing, hardware design, assembly and prototyping of the modules	FM, CEA, ABEE, SIE, UVA	7
8	Hybridization of SSB/SC	FM, CEA, ABEE, UVA, SIE, AUTH	7
9	Dynamic modelling and HIL setup design of ship components and power converters	CEA Nantes	5
	Dynamic modelling and HIL setup design of ship components and power converters	UVA	5
	Dynamic modelling and HIL setup design of ship components and power converters	ABEE, SIE, UVA, AUTH, FM, CEA	5
10	Validated model-based impact assessment of new marine technologies	CEA Nantes	5
	Validated model-based impact assessment of new marine technologies	UVA	5
	Validated model-based impact assessment of new marine technologies	CEA, ABEE, FM, SIE, FV, AUTH, ISSN, UVA	5
11	Lab-scale prototype and multipurpose HIL environment	CEA Nantes	4
	Lab-scale prototype and multipurpose HIL environment	UVA, CEA	4
	Lab-scale prototype and multipurpose HIL environment	ABEE, SIE, UVA, AUTH, FM, CEA	4

Exploitable results	Tittle of the Result	Involved partners	Expected TRL
12	Trade-off between different energy storage systems (supercapacitors, solid state battery, typical batteries)	AUTH, SIE, FV, ISSN, FM	5
13	SSB energy storage for constant load waterborne transport operations SC energy storage for peak power. Hybrid energy storage system for high energy and high power	FM, CEA, ABEE, UVA, SIE, I2M, AUTH	5
14	Roadmap to Onboard demonstrators	GRIM, INLS, FS, ISSN, SOER, SIE, I2M, FV, UVA	9

5 Exploitation Plan per partner

The AENEAS project consortium is composed of industrial actors, academic partners and research organizations, as well as shipowners who represent end-users' perspective. The exploitation strategy thus must ensure that all involved parties' interests are taken into account in the exploitation activities. Consequently, the foreground resulting from the AENEAS project will be subjected to two types of exploitation - industrial exploitation and academic/scientific exploitation. While industrial exploitation generally deals with the direct or indirect utilization of the developed foreground for commercial purposes, academic exploitation deals with results utilization in further research activities other than those covered by the project. The following sub-chapters describe how these two kinds of exploitation will be treated within the AENEAS project.

5.1 Industrial exploitation

AENEAS project wants to bring to its industrial partners an innovation and competitive advantage within the waterborne transport sector, the maritime sector and the energy sector, this being the main reason why the industrial partners are mainly interested in commercial exploitation. In this sense, and in order to cover all the technical and technological needs to carry out the correct development of AENEAS, the consortium is made up of entities that cover the entire value chains as well as the entire supply chain, as shown below:

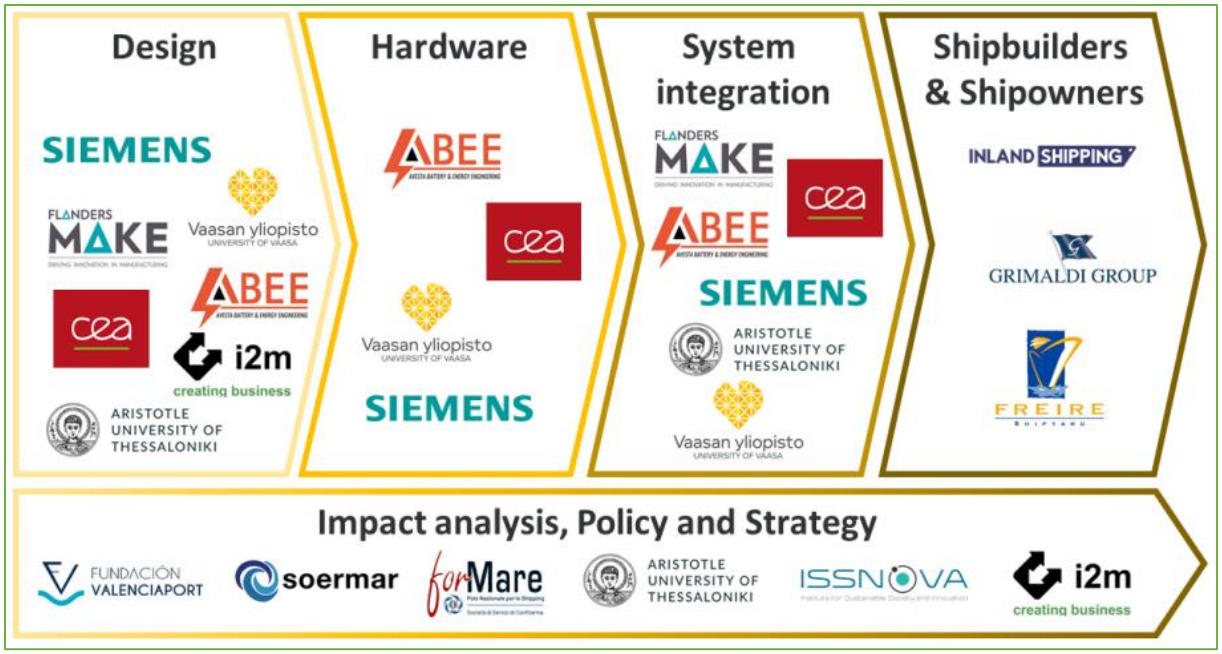


Figure 2: Value chain of AENEAS consortium. *Source: AENEAS Grant Agreement*

5.2 Academic exploitation

, Academic partners and Research Organizations contribute more to exploitable results by providing their knowledge. Their commercial exploitation interests are also oriented in this sense, which are more focused on obtaining know-how knowledge. The main interests of academic partners are often the further development of specific research topics, the participation and organization of seminars and events. Moreover, new knowledge will be used as input in other research projects or even in enhancing products for the market uptake.

5.3 Partners individual exploitation plans

A preliminary analysis of each partner has been carried out, in order to provide a brief description of each partner and their interests, as well as the possible opportunities they have identified for the exploitation of the AENEAS results in which they are located. involved and/or are responsible.

As the project is in the middle of its execution, and the technical work packages are in early stages of development, some details are not fully detailed and will be updated in the final deliverable. The exploitation plans will continue to be updated throughout the project execution period both to ensure the correct communication and dissemination of AENEAS results and to ensure that the results are properly exploited and protected.

5.3.1 FLANDERS MAKE (FM)

Description of project partner:

FM research serves one overall purpose: supporting product and production innovation within the Flemish manufacturing industry. That's the reason FM performs industry-driven, pre-competitive technological research into the vehicles, machines, and factories of tomorrow. As such, FM stimulates the digital transformation of their companies, big and small.

Initially, this research leads to actual applications for companies (innovation leaders) participating in research projects. Next, FM also shares results with the rest of the industry so that innovation followers can make the transition to Industry 4.0 as well.

Role in the project:

- WP2 concept design and optimization – task 2.1 Creation of high-level ESS simulation components and Mission Profiles.
- WP2 concept design and optimization - Task 2.2 Create pre-design simulation models dedicated for concept optimization.
- WP2 concept design and optimization - Task 2.3 Optimization of the vessel architecture and power/energy management strategy.
- WP3 Cell level characterization and model development - Task 3.3 Electro-thermal modelling of SC and SSB.
- WP 4 Conceptual module design, prototyping and functional testing - Task 4.1 ESS module sizing and evaluation of different system design concepts
- WP 4 Conceptual module design, prototyping and functional testing - Task 4.2 Conceptual ESS module design with optimised Balance of Plant (BoP)
- WP 4 Conceptual module design, prototyping and functional testing - Task 4.3 DesignESS modules in hardware and prototyping
- WP 4 Conceptual module design, prototyping and functional testing - Task 4.4 Functional testing and validation of the battery modules
- WP 5 Testing and Validation – Task 5.2 Development of a downscaled real-time HIL platform for testing.
- WP 5 Testing and Validation - Task 5.3 Validation of the entire ship system with downscaled HIL platform.
- WP 6 Impact analysis, business models and exploitation - Task 6.1 Life cycle, cost, environmental and safety impact analysis
- WP 6 Impact analysis, business models and exploitation - Task 6.2 Feasibility and adequacy for a broad range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

Use the results and implement them in their own knowledge to develop new products. Likewise, they will use the knowledge acquired to implement it in new research activities beyond those covered by AENEAS for the development of new products and services.

5.3.2 COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES (CEA)

Description of project partner:

CEA is a major research organisation working in the best interests of the French State, its economy and citizens. Thanks to its strong roots in fundamental research, it is able to provide tangible solutions to meet their needs in four key fields:

- Low-carbon energy (nuclear and renewable).
- Digital technology.
- Technology for medicine of the future.
- Defence and national security.

Role in the project:

- WP1 Operational scenario Specification and Requirements - Task 1.3 Create a monitoring and evaluation frameworks for ESS testing in WP 5
- WP2 concept design and optimization - Task 2.2 Create pre-design simulation models dedicated for concept optimization
- WP2 concept design and optimization - Task 2.3 Optimization of the vessel architecture and power/energy management strategy
- WP2 concept design and optimization – Task 2.4 Verification of the viability of the optimized vessel using Digital Twin
- WP3 Cell level characterization and model development - Task 3.1 Provision and standard characterization of SC and SSB samples
- WP3 Cell level characterization and model development - Task 3.2 Advanced parameters identification of SC and SSB
- WP3 Cell level characterization and model development - Task 3.3 Electro-thermal modelling of SC and SSB
- WP4 Conceptual module design, prototyping and functional testing - Task 4.1 ESS module sizing and evaluation of different system design concepts
- WP4 Conceptual module design, prototyping and functional testing - Task 4.2 Conceptual ESS module design with optimised Balance of Plant (BoP)
- WP4 Conceptual module design, prototyping and functional testing - Task 4.3 Design ESS modules in hardware and prototyping
- WP4 Conceptual module design, prototyping and functional testing - Task 4.4 Functional testing and validation of the battery modules
- WP 5 Testing and Validation – Task 5.2 Development of a downscaled real-time HIL platform for testing
- WP 5 Testing and Validation - Task 5.3 Validation of the entire ship system with downscaled HIL platform
- WP 5 Testing and Validation – Task 5.4 Upscaled evaluation of the ESS performance
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

Use the results to make products and selling them. Also CEA will implement the results in their own knowledge to develop new products. Likewise, CEA will use the knowledge acquired to implement it in new research activities beyond those covered by AENEAS for the development of new products and services. Regarding software development, CEA intends to commercialize it through licenses.

5.3.3 AVESTA BATTERY & ENERGY ENGINEERING (ABEE)

Description of project partner:

ABEE is supporting the industries in the development of tailored made solutions from battery materials to recycling for automotive and stationary applications through the development of dedicated multiscale simulation tools and functions integrated in various platforms.

- Development of next generation battery technologies.
- Recycling of next generation battery technologies.
- Artificial intelligence solutions.
- Advanced multi-scale & modelling expertise.

Role in the project:

- WP1 Operational scenario Specification and Requirements - Task 1.3 Create a monitoring and evaluation frameworks for ESS testing in WP 5
- WP2 concept design and optimization – task 2.1 Creation of high-level ESS simulation components and Mission Profiles
- WP2 concept design and optimization - Task 2.3 Optimization of the vessel architecture and power/energy management strategy
- WP3 Cell level characterization and model development - Task 3.1 Provision and standard characterization of SC and SSB samples
- WP3 Cell level characterization and model development - Task 3.2 Advanced parameters identification of SC and SSB
- WP3 Cell level characterization and model development - Task 3.3 Electro-thermal modelling of SC and SSB
- WP4 Conceptual module design, prototyping and functional testing - Task 4.1 ESS module sizing and evaluation of different system design concepts
- WP4 Conceptual module design, prototyping and functional testing - Task 4.2 Conceptual ESS module design with optimised Balance of Plant (BoP)
- WP4 Conceptual module design, prototyping and functional testing - Task 4.3 Design ESS modules in hardware and prototyping
- WP 5 Testing and Validation – Task 5.2 Development of a downscaled real-time HIL platform for testing
- WP 5 Testing and Validation - Task 5.3 Validation of the entire ship system with downscaled HIL platform
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 6 Impact analysis, business models and exploitation – Task 6.4 Future deployment of technologies
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

ABEE will use the knowledge acquired to implement it in new research activities beyond those covered by AENEAS for the development of new products and services. Regarding software development, ABEE intends to commercialize it through licenses.

5.3.4 SIEMENS INDUSTRY SOFTWARE SAS (SIE)

Description of project partner:

Siemens Digital Industries Software SAS, formerly the LMS Imagine company prior to its acquisition by Siemens PLM in 2013, develop for over 20 years the Simcenter Amesim system simulation solution. Involved research teams are located in Lyon and Roanne, in France, and count over 150 researchers and engineers, have developed physical libraries with over 5000 validated components enabling time and frequency domain simulation of complex systems, and more specifically automotive systems. The Simcenter Amesim system simulation solutions are distributed at worldwide level, mainly serving automotive, aerospace and energy businesses, from early design to hardware in the loop testing.

Role in the project:

- WP1 Operational scenario Specification and Requirements – Task 1.1 Define operational profiles and requirements for a broad set of vessels
- WP2 concept design and optimization – task 2.1 Creation of high-level ESS simulation components and Mission Profiles
- WP2 concept design and optimization - Task 2.2 Create pre-design simulation models dedicated for concept optimization
- WP2 concept design and optimization - Task 2.3 Optimization of the vessel architecture and power/energy management strategy
- WP2 concept design and optimization – Task 2.4 Verification of the viability of the optimized vessel using Digital Twin
- WP3 Cell level characterization and model development - Task 3.3 Electro-thermal modelling of SC and SSB
- WP4 Conceptual module design, prototyping and functional testing - Task 4.2 Conceptual ESS module design with optimised Balance of Plant (BoP)
- WP4 Conceptual module design, prototyping and functional testing - Task 4.4 Functional testing and validation of the battery modules
- WP5 Testing and validation – Task 5.1 Simulation models of ship power system components converters
- WP 5 Testing and Validation – Task 5.2 Development of a downscaled real-time HIL platform for testing
- WP 5 Testing and Validation - Task 5.3 Validation of the entire ship system with downscaled HIL platform
- WP 6 Impact analysis, business models and exploitation – Task 6.1 Life cycle, cost, environmental and safety impact analysis
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

SIE will use the results to make products, especially software that will be exploited via licenses. Also, the results obtained from the project development will be used to develop new products and processes.

5.3.5 VAASAN YLIOPISTO (UVA)

Description of project partner:

The University of Vaasa is an institution in which they study and conduct research to solve significant societal challenges. As part of the largest concentration of energy technology in the Nordic countries, in one of the most successful regions of our country, UVA is at the center of solving the realization of the energy revolution and the transition to a carbon-neutral society.

Role in the project:

- WP 1 Operational scenario Specification and Requirements – Task 1.2 Definition of the 3 AENEAS use-cases
- WP1 Operational scenario Specification and Requirements - Task 1.3 Create a monitoring and evaluation frameworks for ESS testing in WP 5

- WP2 concept design and optimization – Task 2.1 Creation of high-level ESS simulation components and Mission Profiles
- WP3 Cell level characterization and model development - Task 3.2 Advanced parameters identification of SC and SSB
- WP3 Cell level characterization and model development - Task 3.3 Electro-thermal modelling of SC and SSB
- WP4 Conceptual module design, prototyping and functional testing - Task 4.1 ESS module sizing and evaluation of different system design concepts
- WP4 Conceptual module design, prototyping and functional testing - Task 4.2 Conceptual ESS module design with optimised Balance of Plant (BoP)
- WP5 Testing and validation – Task 5.1 Simulation models of ship power system components converters
- WP 5 Testing and Validation – Task 5.2 Development of a downscaled real-time HIL platform for testing
- WP 5 Testing and Validation - Task 5.3 Validation of the entire ship system with downscaled HIL platform
- WP 5 Testing and Validation – Task 5.4 Task 5.4 Upscaled evaluation of the ESS performance
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

UVA will be used the results for academic and research purposes, also they will use the results to improve and increase their knowledge regarding next generation battery systems.

5.3.6 I2M UNTERNEHMENSENTWICKLUNG GMBH (I2M)

Description of project partner:

I2M is a technology and business development consultancy based in Graz, Austria. The company develops and markets its own technology intensive products and also supports its clients developing and marketing their products.

Bringing results of research as well as concept development with national and international partners from industry and research, with a cooperative approach, to market maturity is one of the strengths of i2m. The resulting products and services have marked competitive advantages and are characterized by reduced development costs and short development times.

Role in the project:

- WP1 Operational scenario Specification and Requirements – Task 1.1 Define operational profiles and requirements for a broad set of vessels
- WP2 concept design and optimization – task 2.1 Creation of high-level ESS simulation components and Mission Profiles
- WP2 concept design and optimization - Task 2.2 Create pre-design simulation models dedicated for concept optimization
- WP2 concept design and optimization - Task 2.3 Optimization of the vessel architecture and power/energy management strategy

- WP2 concept design and optimization – Task 2.4 Verification of the viability of the optimized vessel using Digital Twin
- WP 5 Testing and Validation – Task 5.4 Task 5.4 Upscaled evaluation of the ESS performance
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 6 Impact analysis, business models and exploitation – Task 6.4 Future deployment of technologies
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

I2M will use the results in order to improve their knowledge of the waterborne transport sector and the new pathways to electrify the global fleet. Also, they will use the results to foreground in further research activities other than those covered by the project, creating and providing new services.

5.3.7 GRIMALDI EUROMED SPA (GRIM)

Description of project partner:

With an experience dating back to 1947, the Grimaldi Group is a multinational logistics company specializing in the operations of roll-on/roll-off vessels, car carriers and ferries. It provides major vehicle manufacturers with integrated logistics services based on maritime transport. On its maritime routes, the Group transports cars, various types of rolling stock, containers, palletized goods and passengers.

Role in the project:

- WP1 Operational scenario Specification and Requirements – Task 1.1 Define operational profiles and requirements for a broad set of vessels
- WP 1 Operational scenario Specification and Requirements – Task 1.2 Definition of the 3 AENEAS use-cases
- WP1 Operational scenario Specification and Requirements - Task 1.3 Create a monitoring and evaluation frameworks for ESS testing in WP 5
- WP 5 Testing and Validation - Task 5.3 Validation of the entire ship system with downscaled HIL platform
- WP 6 Impact analysis, business models and exploitation – Task 6.2 Feseability and adequacy for a board range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 6 Impact analysis, business models and exploitation – Task 6.4 Future deployment of technologies
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

GRIM as a shipowner is interested in the implementation of the AENEAS solution on board their vessels. GRIM hopes AENEAS will provide him with a viable and fossil solution to electrify his fleet.

5.3.8 INLAND SHIPPING SRL (INSL)

Description of project partner:

INSL is a company dedicated to the freight transport with both their own fleet and their customer's vessels:

- Mineral Oils.
- Dry Cargo.
- Biofuel and Chemical Products.

INSL retains their customers from trouble by realizing a broad ship management:

- Maintenance
- Repair.
- Security.
- Purchasing.
- Human Resources.
- Communication and Administration.

Due to its loyal and dedicated employees *INSL* is a stable market player. The wide range of services they offer includes:

- Customized solutions in ship management.
- Specific security advising for inland vessels.
- Training and development opportunities in the field of inland shipping.
- Trade in ships.

Role in the project:

- WP1 Operational scenario Specification and Requirements – Task 1.1 Define operational profiles and requirements for a broad set of vessels
- WP 1 Operational scenario Specification and Requirements – Task 1.2 Definition of the 3 AENEAS use-cases
- WP 5 Testing and Validation - Task 5.3 Validation of the entire ship system with downscaled HIL platform
- WP 6 Impact analysis, business models and exploitation – Task 6.1 Life cycle, cost, environmental and safety impact analysis
- WP 6 Impact analysis, business models and exploitation – Task 6.2 Feseability and adequacy for a board range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 6 Impact analysis, business models and exploitation – Task 6.4 Future deployment of technologies
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

INSL as a shipowner is interested in the implementation of the AENEAS solution on board their vessels. INSL hopes AENEAS will provide him with a viable and fossil solution to electrify his fleet.

5.3.9 FUNDACION DE LA COMUNIDAD VALENCIANA PARA LA INVESTIGACION, PROMOCION Y ESTUDIOS COMERCIALES DE VALENCIAPORT (FV)

Description of project partner:

FV is an Applied Research, Innovation & Training center providing services to the port and logistics cluster. This initiative of the Port Authority of Valencia has enjoyed the collaboration of notable businesses, universities and institutions from the port community. Since its establishment, it has developed projects in more than 60 countries, primarily Mediterranean nations, as well as from the rest of Europe, Asia and Latin America.

Among its many activities, the following stand out:

- Fostering innovation, by promoting the design, implementation and execution of R&D&I projects in the port logistics sector, aimed at improving the competitiveness of companies and institutions in the sector.
- Knowledge management initiatives, offering specialized, high-value-added training for the continuous improvement of the human capital of the port logistics community.
- Policy of active cooperation with other port communities around the world, by means of technical assistance initiatives and support for Spanish logistics operators in their internationalization processes. Raising the international profile of the Port of Valencia's know-how.
- Market intelligence service for developing indexes, databases and reports of strategic interest for the sector.
- Structuring the port logistics community, fostering cooperation within the sector, while reaching out to and engaging in dialogue with the general public, all within the framework of a collective social responsibility strategy.

Role in the project:

- WP1 Operational scenario Specification and Requirements – Task 1.1 Define operational profiles and requirements for a broad set of vessels
- WP1 Operational scenario Specification and Requirements - Task 1.3 Create a monitoring and evaluation frameworks for ESS testing in WP 5
- WP 6 Impact analysis, business models and exploitation – Task 6.2 Feasibility and adequacy for a board range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 6 Impact analysis, business models and exploitation – Task 6.4 Future deployment of technologies
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

The results obtained from AENEAS will allow FV to know if its port grid needs to be updated and adapted to the new generation of battery systems, as well as to know if the port grid will be able to supply all the electric and hybrid vessels that will arise in the coming years.

5.3.10 ARISTOTELIO PANEPISTIMIO THESSALONIKIS (AUTH)

Description of project partner:

The Aristotle University of Thessaloniki is the largest university in Greece. The main campus is located in the centre of the city of Thessaloniki and covers an area of about 33.4 hectares. It comprises 10 faculties which consist of 40 schools and 1 single-School Faculty.

Some educational and administrative facilities are located off campus for practical and operational reasons. A number of these facilities are located outside the city of Thessaloniki or even in other cities. About 88.283 students study at the Aristotle University, 77.198 in undergraduate programmes and 6.588 in postgraduate programmes. There are also 3.952 at Doctoral level).

There are 1.682 faculty members. There are also 311 members of the Special Laboratory Teaching Personnel (S.L.T.P.).

Faculty members are also assisted by 144 members of the Special Technical Laboratory Personnel (S.T.L.P.).

The administration office consists of 278 permanent employees and 256 employees under a private law contract of indefinite duration

Role in the project:

- WP2 concept design and optimization - Task 2.2 Create pre-design simulation models dedicated for concept optimization
- WP2 concept design and optimization - Task 2.3 Optimization of the vessel architecture and power/energy management strategy
- WP2 concept design and optimization – Task 2.4 Verification of the viability of the optimized vessel using Digital Twin
- WP4 Conceptual module design, prototyping and functional testing - Task 4.2 Conceptual ESS module design with optimised Balance of Plant (BoP)
- WP4 Conceptual module design, prototyping and functional testing - Task 4.4 Functional testing and validation of the battery modules
- WP 6 Impact analysis, business models and exploitation – Task 6.1 Life cycle, cost, environmental and safety impact analysis
- WP 6 Impact analysis, business models and exploitation – Task 6.2 Feasibility and adequacy for a board range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 6 Impact analysis, business models and exploitation – Task 6.4 Future deployment of technologies
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

AUTH will use the results for academic and research purposes, also they will use the results to improve and increase their knowledge.

5.3.11 FUNDACION CENTRO TECNOLOGICO SOERMAR (SOER)

Description of project partner:

In 2002 the Soermar Technological Center Foundation was established, the purpose of which will be to seek new lines of joint action in Technical and Technological matters that improve the competitiveness of the Shipyards.

The main lines of action of both entities are based on:

- Prepare Research, Development and Innovation projects both at national and European level.
- Support shipyards and companies in the maritime sector in the application of new technologies: industry 4.0, cloud computing, Big Data, robotization, artificial intelligence, with new business models, designing smart, energy-efficient ships and devices, connected and non-polluting that will modernize maritime transport.
- Analyse new emerging technologies and their application within the maritime sector.
- Promote all those actions that may result in a competitive improvement of shipyards and companies in the maritime sector through an increase in the efficiency of their industrial activity.
- Support to companies in the maritime sector in the search for financial aid and instruments for the materialization of R + D + i projects.

Role in the project:

- WP1 Operational scenario Specification and Requirements – Task 1.1 Define operational profiles and requirements for a broad set of vessels
- WP 1 Operational scenario Specification and Requirements – Task 1.2 Definition of the 3 AENEAS use-cases
- WP 6 Impact analysis, business models and exploitation – Task 6.2 Feasibility and adequacy for a board range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 6 Impact analysis, business models and exploitation – Task 6.4 Future deployment of technologies
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

SOER will use the results of AENEAS to keep its shipyard network aware of the latest developments and technologies related the next generation battery systems, keeping them informed about the potential application of this new technology and the expectations that shipowners decide to implement it on their vessels. Also, SOER will use the results to improve its knowledge and foreground in further research activities.

5.3.12 FORMARE- POLO NAZIONALE PER LO SHIPPING SRL (FMAR)

Description of project partner:

ForMare is the service company of Confitarma the Italian Shipowners Association, and it is a leading professional and technical hub for shipping and Blue Economy.

ForMare promotes networking activities with Public Authorities and key stakeholders of the maritime industry supporting the promotion of training courses responding to the new technological and innovation challenges of the maritime, and activities of R&I for the shipping and blue economy sector.

Role in the project:

- WP1 Operational scenario Specification and Requirements - Task 1.3 Create a monitoring and evaluation frameworks for ESS testing in WP 5

- WP 6 Impact analysis, business models and exploitation – Task 6.2 Feasibility and adequacy for a board range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

FMAR will use the results of AENEAS to keep its network aware of the latest developments and technologies related the next generation battery systems, keeping them informed about the potential application of this new technology within the waterborne transport sector.

5.3.13 INSTITUTE FOR SUSTAINABLE SOCIETY AND INNOVATION (ISSN)

Description of project partner:

The Institute for Sustainable Society and Innovation ISSNOVA is an independent not-for-profit research organization aimed at delivering viable solutions to integrate environmental and social priorities with economic development.

In July 2016 ISSNOVA was founded with the main scope to contribute to the Sustainable Innovation and Integrated knowledge of the research growth for supporting the new generation to live better. The mission is to network excellences from various scientific communities (Universities, R&D centres, Professionals) for inoculating free of charge the social sustainability goal as part of the on-going research they are running in domains with an evaluable impact on the quality of the life of the earth and the peoples. ISSNOVA researchers are engaged in cross-cutting fields such as responsible research and innovation, resilient, inclusive, and smart communities, knowledge integration, circular economy, safety and security for water, energy, food, aerial, terrestrial and maritime transports, land use, climate change, mitigation and adaptation, environmental management systems, adaptive planning. and in any critical context for people and environment safety, focusing on both technology, processes and social-related aspects.

Role in the project:

- WP1 Operational scenario Specification and Requirements – Task 1.1 Define operational profiles and requirements for a broad set of vessels
- WP 1 Operational scenario Specification and Requirements – Task 1.2 Definition of the 3 AENEAS use-cases
- WP 6 Impact analysis, business models and exploitation – Task 6.1 Life cycle, cost, environmental and safety impact analysis
- WP 6 Impact analysis, business models and exploitation – Task 6.2 Feasibility and adequacy for a board range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 6 Impact analysis, business models and exploitation – Task 6.4 Future deployment of technologies
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

ISSN will use the results for academic and research purposes, also they will use the results to improve and increase their knowledge

5.3.14 CONSTRUCCIONES NAVALES P FREIRE SA (FS)

Description of project partner:

Construcciones Navales P. Freire (Freire shipyard) is a family-owned company established in 1895 by Mr. Paulino Freire in Vigo (Spain). Today, Freire builds and repairs highly complex offshore, oceanographic, hydrographic, research and fishing vessels as well as luxurious yachts, tall ships, patrol vessels and tugs for the most demanding owners around the world.

FS has a team of professionals consisting of engineers and designers who are engaged in each project and have a direct relationship with the clients. their engineers and technicians are involved in all stages of the building process, from the development of the preliminary design to the detailed drawings. This provides FS with a great flexibility and capacity to adapt to complex and customized projects.

Role in the project:

- WP1 Operational scenario Specification and Requirements – Task 1.1 Define operational profiles and requirements for a broad set of vessels
- WP 1 Operational scenario Specification and Requirements – Task 1.2 Definition of the 3 AENEAS use-cases
- WP1 Operational scenario Specification and Requirements - Task 1.3 Create a monitoring and evaluation frameworks for ESS testing in WP 5
- WP 6 Impact analysis, business models and exploitation – Task 6.2 Feseability and adequacy for a board range of waterborne operations
- WP 6 Impact analysis, business models and exploitation - Task 6.3 Exploitation and protection of intellectual property
- WP 7 Dissemination and Communication
- WP 8 Project Management and Scientific Coordination

Expectations:

As a shipyard, FS needs to be aware of the potential of application of this new and innovative technology and how the increase in electric and hybrid vessels in the global fleet will affect its ship design and construction process, and what measures will have to be taken to adapt the shipyard.

6 Business plan for AENEAS KERS

As part of the exploitation plan of the AENEAS project, a business plan has been developed for the selected KERs.

The objectives of the Business Plan are mainly two:

- Detail in depth the project exploitation plan.
- Attract potential investors to invest in the solutions that AENEAS offers to the waterborne transport sector and energy sector.

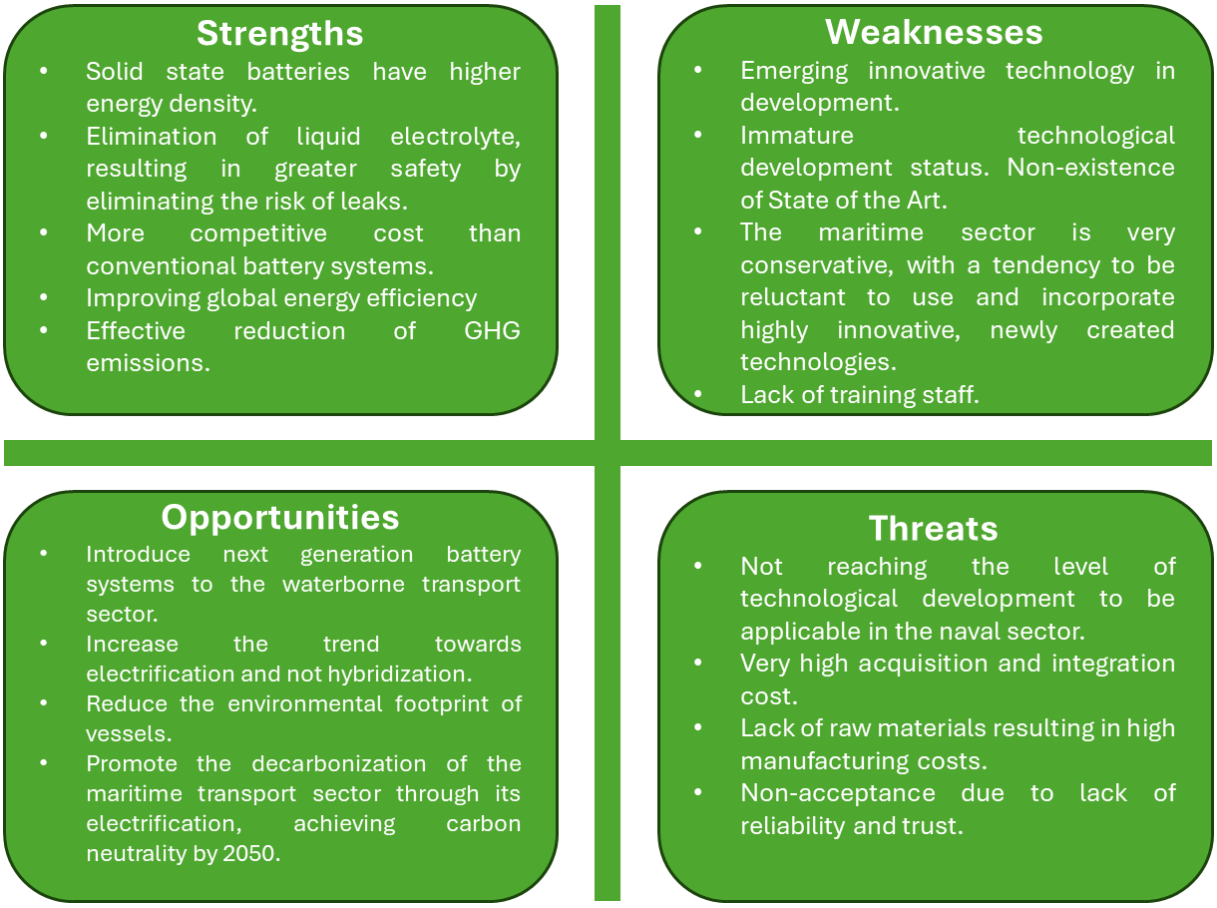
The Business Plan describes the following:

- Potential and relevant market.

- Exploitation routes of project results.
- Potential barriers to market penetration.
- Potential financial and business models to allow the future commercialization of AENEAS and attract investors.
- SWOT analysis of AENEAS solution.

During the first meeting held for task 6.3 (kick-off), all partners involved in the development process of the exploitation plan were informed, which also included the process of obtaining information to develop the Business Plan. In this sense, each partner was asked to fill out a template with the necessary information to develop this activity, which is attached in section 2.3 of this deliverable.

Firstly, a SWOT analysis of the AENEAS solution has been carried out. This analysis has allowed to discover the positive and negative factors of AENEAS in a first sight, identifying the obstacles that must be overcome and minimized to be successful in the short and long term. Here below a summarized tab with the key information of the SWOT analysis conducted:



The SWOT analysis served as a framework to generally evaluate the competitiveness of the solution proposed by AENEAS and as a basis to establish a strategic development plan through the development of a business plan.

Secondly, a business model is established and generated. This business model will be updated as the development of the project progresses, and solid results are obtained.

The business model selected corresponds to the model generated by Alexander Osterwalder, commonly known as Business Model Canvas. This kind of business model offers a visual chart with elements describing the AENEAS solution value proposition, infrastructure, customers,

and finances, assisting to align the project activities and developments by illustrating potential trade-offs.

It is made up of nine boxes, the descriptions of which are included below:

- **Key partnerships:** Refers to the network of suppliers and partners that make the business model work. The establishment of the key partnership allows us to strengthen the business model, reduce risks and obtain valuable resources.
- **Key activities:** The most important activities in executing a company's value proposition. An example for Bic, the pen manufacturer, would be creating an efficient supply chain to drive down cost.
- **Key resources:** The resources that are necessary to create value for the customer. They are considered assets to a company that are needed to sustain and support the business. These resources could be human, financial, physical and intellectual.
- **Value propositions:** The collection of products and services a business offers to meet the needs of its customers. The value proposition provides value through various elements such as newness, performance, customization, "getting the job done", design, brand/status, price, cost reduction, risk reduction, accessibility, and convenience/usability.
- **Customer relationship:** To ensure the survival and success of any businesses, companies must identify the type of relationship they want to create with their customer segments. That element should address three critical steps of a customer's relationship: How the business will get new customers, how the business will keep customers purchasing or using its services and how the business will grow its revenue from its current customers
- **Customer segments:** To build an effective business model, a company must identify which customers it tries to serve. Various sets of customers can be segmented based on their different needs and attributes to ensure appropriate implementation of corporate strategy to meet the characteristics of selected groups of clients.
- **Channels:** Effective channels will distribute a company's value proposition in ways that are fast, efficient and cost-effective.
- **Cost structure:** This describes the most important monetary consequences while operating under different business models.
- **Revenue streams:** The way a company makes income from each customer segment. Several ways to generate a revenue stream

In this sense, the creation of the business model has allowed us to establish a first vision of the potential and relevant market, as well as establish potential exploitation routes by defining the market segments in which the AENEAS solution could have great potential to be introduced with the aim of identifying possible investors.

<table>
<tr><th>Key partnerships</th><th>Key Activities</th><th>Value Propositions</th><th>Customer relationships</th><th>Customer segments</th></tr>
<tr>
<td rowspan="3">AENEAS partners

AENEAS Advisory Board

European Commission

Other European project partners involved in similar topics

Ship operators

Classification Societies

Ports

Technology providers

Shipyards

Maritime associations

Engineering services

ESS designers and manufacturers

Scientific community</td>
<td>1. Finetuning of requirements to bring SSB, SC and hybrid SSB/SC based ESSs in different waterborne transport applications.

2. Employ simulation and modeling platforms to develop innovative ESS concepts for marine applications with optimal control and energy management strategies.

3. Developing modules/packages of solid-state battery and supercapacitor with multiple cells and optimized balance of plant.

4. Develop innovative SSB, SC and SSB/SC hybrid ESS downscaled testing, validation and upscaling with flexible HIL test bench.

5. Define decarbonization strategies for future maritime applications based on EU/international CO2 legislations.

6. Assess environmental benefits, costs and safety issues of the ESS, and compare them with traditional battery systems</td>
<td rowspan="3">1. Comprehensive understanding of potential innovative energy storage systems other than batteries and their applicability to waterborne transport

2. Solutions to improve energy efficiency and make waterborne transport climate neutral

3. Technical feasibility and adequacy including efficiency, safety, cost competitiveness compared to batteries, skills requirements, and regulatory aspects

4. Contribution to two full scale on-board demonstrators by 2027 for two different ESS solutions

5. In the medium term, upscaling of proven solutions for a broad range of ship types (e.g. IWT, ferries, short sea shipping) and operational scenarios, as an alternative to batteries

6. Ensuring European leadership for energy storage systems based on different technologies that will be fit-for-purpose for diverse waterborne applications</td>
<td rowspan="2">Personal assistance

Dedicated personal assitance

Self service

Automated Services</td>
<td rowspan="3">Waterborne transport sector (electrification of the fleet)

Energy sector (Introduction of next generation EES)

Automotive sector (Dirtect application substituting conventional battery systems)

Aerospace sector (Direct application)

Railway sector (Direct application)

Nuclear industry (direct application as UPS)

AUV and UAV industries (Direct application)</td>
</tr>
<tr>
<td>Key Resources</td>
<td>Channels</td>
</tr>
<tr>
<td>Experience and expertise from the partners involved in the project

Experience and expertise from the Stakeholder Advisory Board

Industrial stakeholders

Academia/scientific stakeholders

Propietary Knowledge</td>
<td>Networking

Social media

Direct contact

Periodic communications</td>
</tr>
<tr><td colspan="2">Cost Structure</td><td colspan="3">Revenue Streams</td></tr>
<tr><td colspan="2">Technical and personnel costs</td><td colspan="3">Partner's funding
Research funding
Company investment
Sales</td></tr>
</table>

The decision to combine the SWOT analysis with the business model canvas lies in the great synergy and complementarity that exists between both elements when improving the business plan. Following the article “SWOT Analysis: Business Model Canvas Explained”, written by the company Untailored, applying a SWOT Analysis to the Business Model Canvas can provide valuable insights into how a business can leverage its strengths and opportunities and mitigate its weaknesses and threats. This can be done by examining each of the nine building blocks of the Business Model Canvas through the lens of the SWOT Analysis [4].

The benefits obtained from the combination of SWOT analysis and the Business Model Canvas are the following:

- It will **provide a comprehensive view of AENEAS current situation and future potential**. It allows the project to identify and address gaps in the business model, and to strategize on how to leverage their strengths and opportunities to achieve the project business objectives.
- It will improve **business resilience**, better risk management and increased AENEAS business success.
- It will aid in **strategic decision making**. By understanding the strengths, weaknesses, opportunities, and threats of AENEAS, and how these relate to the business model, decisions can be made about where to invest resources, which markets to target, and how to differentiate their offerings.
- It will **foster business innovation**. By identifying opportunities and threats in the market and understanding how these can be leveraged or mitigated through the business model, AENEAS consortium can identify new ways to create value for their customers, in order to increase business growth and profitability.

Below are described the barriers that AENEAS will have to face for its solution to be introduced into the market in the future. These barriers were already identified in the Grant Agreement, as well as the necessary actions that will have to be carried out to overcome them. No new barriers have been identified to date.

Barriers identified	Activities required to overcome barriers
Slow adaptation of the shipping sector to the technological changes	Modern competition challenges, upset also by Covid19, needs an acceleration of the Digital and Green Transition process. Therefore, to overcome the current economic situation and start up the recovery (in a fair way) it is imperative to reduce any technological gap. Green and digital are the key words driving and setting the orientations for EU research and innovation investments. So, this "epochal change" needs a new entrepreneurial culture, renewed business models and news kills/competences. The innovations of AENEAS will be demonstrated in different applications where the results will be shared with the European industrial and research communities so that the market penetration can be accelerated. Task 6.2 will carry out an assessment of market potentials for each EES solution on EU and global level. Additionally, the further support from policy makers (carried out through T7.3, by engaging with stakeholders) will enhance the adaption of shipping sector to new technologies. AENEAS will contribute to this by providing roadmaps for new electrical energy storage technologies for marine sector that can overcome the technological challenges with typical batteries.
Slow process of public investments and not incisive plans of investments at governance level	Public investments and interventions represent a key-point in this process. EU, National and regional Institutions play a main role in defining the direction and removing barriers (such as financial ones) especially for SMEs. A weak governance plan of investments and not incisive decisional process together with bureaucracy could discouraging stakeholders in investing resources and time.
Entrepreneurial adaptation to new challenges	Shipping sector is traditionally engaged with fossil-fuel Industry and considered "hard to abate", in a combined-role of customers and suppliers. A commercial (and, generally, economic) resistance, the "fear" of losing business partners, could be an issue. In this regard, it's extremely relevant to implement a "new economic" approach and persuasion towards new economic challenges and change, based on data and a cost-benefits ratio analysis, as well as a cultural one. The Task 6.4 of AENEAS will define the pathways for the future deployment of technologies (extending the TRL to TRL7-8) and develop a roadmap to bring the innovations to a higher TRL and ensure widespread adoption. Based on the comprehensive understanding of the market deployment potential and technical feasibility of the solutions, AENEAS will develop a technical and financial roadmap to obtain maximum impact through both market segment and geographical expansion of AENEAS solutions to diverse waterborne applications.
Pandemic and linked economic slowdown	In the general context of the pandemic and economic slowdown, it is possible that the level of private investment will be reduced and limit the development of technology. However, the ambitious recovery plan from the European Commission seems to be favorable to the support of European innovative industries that foster the transition towards decarbonated economy, which AENEAS could benefit from.
Geopolitical issues	The new world geopolitical framework following Ukraine war, is in progress and could be an issue in the Transitions path.

It should be noted that this does not mean that during the second stage of project development, new barriers arise derived from the future market situation as well as the technologies that are currently in development and that could become potential competitors.

It should be noted that at the date of completion of this deliverable, a large part of the technical and technological developments of the project are being carried out, and no results have been obtained that would allow the business plan to be developed in greater detail. In this sense, the following conclusions are shown:

- There is still some further research to do on the project to determine the scope of AENEAS solution within the target market. Likewise, and taking into account the novelty of the solution, and that there is nothing similar in the market today, it will be necessary to analyze later, in a more advanced stage of the project, the existence of competitors. A further customer segmentation has to be carried out and the problems associated with the specific market segments need to be investigated and validated, so that the proposed can be tuned to address the customer and market needs.
- There is a need for a further risk analysis as more advanced stages of project development are reached.
- The project is in a very early stage of technological development, with the technical WP in full progress, so there are still no solid results to generate a financial model. In this sense, the financial model will be developed during the second stage of the project, once solid results are obtained from the technical WPs, and will be included in the deliverable D6.4 “Final exploitation plan, including IPR

In this sense, once AENEAS enters a more advanced phase of development, in which potential results have already been obtained, an update of the Business Plan will be carried out, much more in-depth and with a greater degree of detail. This version will be included in D6.4 “Final exploitation plan, including IPR”.

7 Conclusions

As a summary, this deliverable D6.1 includes a detailed IPR strategy, which has been defined to protect the different IPRs identified in the project, as well as intellectual property rights. This strategy will be reviewed throughout the duration of the project and updated as more advanced stages of project development are reached.

On the other hand, a detailed exploitation plan has been described, in which the strengths, opportunities, threats and weaknesses of the project have been identified, through a SWOT analysis, as well as the barriers that AENEAS must overcome to be successful and able enter the market in the maritime transport sector. Likewise, a business model canvas has been generated with which a visual chart has been created with elements describing the AENEAS solution value proposition, infrastructure, customers, and finances, establishing a first vision of the potential and relevant market, as well as establishing potential exploitation routes by defining the market segments and identifying possible investors.

The SWOT analysis has been combined with a business model canvas given the great synergy and complementarity that exists between both elements. This combination will allow:

- Provide a comprehensive view of AENEAS current situation and future potential.
- Improve business resilience, better risk management and increased AENEAS business success.
- Improve the strategic decision making of AENEAS.
- Foster business innovation.

Finally, mention that D6.1 includes an intermediate exploitation plan, which has been generated with the information available to date. This exploitation plan will be updated periodically as the development of the project progresses and solid results are obtained. The final version of the exploitation plan will be included in D6.4 “Final exploitation plan, including IPR”.

8 References

[1] zero-Emission Waterborne Transport. Strategic Research and Innovation Agenda for the Partnership on. June 2021, https://www.waterborne.eu/images/210601_SRIA_Zero_Emission_Waterborne_Transport_1.2_final_web_low.pdf

[2] Horizon Results Platform. European IP Helpdesk, https://intellectual-property-helpdesk.ec.europa.eu/system/files/2022-02/HEU%20Results%20platform.pdf

[3] Institute of Risk Management, https://www.theirm.org/media/2517823/8-short-guide-risk-management-process.pdf

[4] Untaylored, https://www.untaylored.com/glossary/swot-analysis-business-model-canvas-explained

9 Acknowledgements and disclaimer

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

#	Partner	Partner full name
1	FM	FLANDERS MAKE
2	CEA	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES
3	ABEE	AVESTA BATTERY & ENERGY ENGINEERING
4	SIE	SIEMENS INDUSTRY SOFTWARE SAS
5	UVA	VAASAN YLIOPISTO
6	I2M	I2M UNTERNEHMENSENTWICKLUNG GMBH
7	GRIM	GRIMALDI EUROMED SPA
8	INLS	INLAND SHIPPING SRL
9	FV	FUNDACION DE LA COMUNIDAD VALENCIANA PARA LA INVESTIGACION, PROMOCION Y ESTUDIOS COMERCIALES DE VALENCIAPORT
10	AUTH	ARISTOTELIO PANEPISTIMIO THESSALONIKIS
11	SOER	FUNDACION CENTRO TECNOLOGICO SOERMAR
12	FMAR	FORMARE- POLO NAZIONALE PER LO SHIPPING SRL
13	ISSN	INSTITUTE FOR SUSTAINABLE SOCIETY AND INNOVATION
14	FS	CONSTRUCCIONES NAVALES P FREIRE SA

LEGAL DISCLAIMER

Funded by the European Union

Abbreviations and Definitions

Term	Definition
ESS	Energy Storage System
EU	European Union
HIL	Hardware In the Loop
IMO	International Maritime Organization
IPR	Intellectual Property Rights
KER	Key Exploitable Result
NASA	National Aeronautics and Space Administration
SC	Supercapacitors
SOTA	State Of The Art
SSB	Solid-state batteries
SWOT	Strengths, Weaknesses, Opportunities, Threats
TRL	Technology Readiness Levels
WP	Work Package

List of Figures

List of Tables