HYPOBATT

Hyper powered vessel battery charging system

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LIST OF ACRONYMS

Acronym	Name
WP	Work Package
SWOT	Strengths, Weaknesses, Opportunities and Threats
GHG	Greenhouse gas
IMO	International Maritime Organization
KPI	Key Performance Indicator
PESTEL	Political, Economic, Social, Technological, Environmental and Legal
EC	European Commission
ISO	International Organization for Standardization
EMSA	European Maritime Safety Agency
OEM	Original Equipment Manufacturers
EU	European Union
EMC	Electromagnetic compatibility
PV	Photovoltaic
SPE	Special Purpose Entity
GSE	Government-sponsored enterprise
FIT	Fit-In Tariff
EPC	Engineering, procurement, and construction
O&M	Operations and Maintenance
CMMS	Computerised Maintenance Management System
ERP	Enterprise Resource Planning System
NREL	National Renewable Energy Laboratory
SREC	Solar Renewable Energy Credit
DSO	Distribution System Operator
AP	Accounting Point
PCG	Party Connected to the Grid
ES	Energy Supplier
BRP	Balance Responsible Party
PO	Port Operator
EV	Electric Vehicle
BESS	Battery Energy Storage System
TSO	Transmission System Operator
MWh	Megawatt hour
LP	Legal Person

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1. EXECUTIVE SUMMARY

This document is part of **WP6, Business Model and Stakeholder Engagements**, showing the results obtained in **Task 6.1 Stakeholder Integration and business model requirements definition**. This study will define the main aspects of the strategic vision, as requirements, solutions, current and future operations, and economic risks of stakeholders, and how it can be factored into business models for electrical ships and their port operations and to develop an overarching view on hyper vessel charging business in European and Global shipping industry. A SWOT analysis will be conducted to give better insight into internal and external business environment of Hyper powered vessel battery charging system. All these analyses will be used to identify the project's key stakeholders, carry out an assessment of their interests and the ways in which these interests affect the project and its viability. The analysis has been carried out by following the next steps:

- Integration of all relevant stakeholders and actors.
- Identification of the stakeholders and actors' inherent requirements regarding vessel hyper charging solution and future port vision towards green transition.
- Identify challenges and solutions strategies for the stakeholders and actors in ports.
- Stakeholder risk-analysis performance.
- Quantify operational and economic risks of stakeholders.
- Quantify operational and economic benefits of stakeholders.
- Identification of the port community goals.
- Definition of key variabilities and similarities in port operations.
- Definition of regulatory and standardisation gaps and how it impacts business model/case.
- Building a hierarchy of hyper charging transition for ports and hyper charging line.
- Identification of key business players involved in the selected port areas (Norddeich, Nordeney, Valencia).
- Priorities and expected "green value-in-use" for stakeholders in port communities.
- PV analysis to identify best techno-economic solution, optimal sizing and integration.

In conclusion, define the main aspects of the strategic vision, as requirements, solutions, current and future operations, and economic risks of stakeholders, and how it can be factored into business models for electrical ships and their port operations and to develop an overarching view on hyper vessel charging business in European and Global shipping industry.

2. OBJECTIVES

The overall objective of WP6 is to design and build the appropriate business models for electrical ships and their port operations based on:

- The market study on current and future hyper power charger technologies and the definition of hyper power charging applications and specifications which will be conducted in WP1.
- The analysis of the current regulatory framework and standardization (WP7), and WP2 to 5 outputs.

This objective will be achieved in close cooperation with land side stakeholders, engaging port and terminals owners and/or operators, ship builders, shipping line operators, electric grid operators, dock operators, and policy developers. In addition, the developed business models will consider future port and energy infrastructures and will be founded on high availability, reduced maintenance, and fast turnaround.

In summary, the specific objectives of this deliverable show the analysis and mapping of hyper power charging stakeholders' needs and requirements gathering and designing tools for business modelling.

3. INTRODUCTION

Maritime transport emits around 940 million tons of CO_2 annually and is responsible for about 2.5% of global greenhouse gas (GHG) emissions. In this regard, the International Maritime Organization (IMO), in line with the internationally agreed temperature goals under the Paris Agreement, has targeted to reduce total annual GHG emissions from shipping by at least 50% by 2050 compared to 2008.

For this reason, to achieve the established environmental objectives, not only can the solution of the problem be focused on the electrification of the fleet, replacing the conventional propulsion systems based on the use of fossil fuels with battery systems, it is also necessary to focus the solution on ports, since the degree of electrification of the fleet, and the fact that shipowners opt for this route rather than conventional ones, will depend, to a certain extent, on the capacity of the chargers located in the ports to cover their energy needs.

Given the ambitious objectives that HYPOBATT intend to achieve, which converge on the design and development of two innovative full modular multi-MW charging systems, the active participation of a large number of stakeholders will be necessary, and not only those directly related to the innovation, but of all the stakeholders that make up the value chain of the electrification of the maritime sector. For this, it has been necessary to carry out a study and analysis of the most important stakeholders, which will be used later to generate the business models.

The goal of the stakeholder analysis is to identify and engage with the relevant stakeholders to reach the objectives set out in the HYPOBATT project.

In this sense, the main objectives of the stakeholder analysis are:

- To draw out the interest of stakeholders in relation to the project's objectives – stakeholders who will be directly affected by, or who could directly affect the project, are clearly of greater importance than those who are only indirectly affected.
- To promote HYPOBATT in the maritime field regarding the forthcoming industry about the electrification of European ports and, as a consequence, the European fleet.
- To identify actual and potential conflicts of interest – a stakeholder who is vital to the project may have many other priorities and the consortium need to know this, in order to plan how to engage with them.
- To identify viability other than in purely financial terms.
- To help provide an overall picture of the types of stakeholders that will influence or be influenced by the results of HYPOBATT.
- To help identify relationships between different stakeholders – helping to identify possible areas for collaboration.
- To identify potential candidates to complete the list of stakeholders for business exploitation.

It is recommended that the relationship with stakeholders has the following four steps:

1. Identify the stakeholders
2. Create a Stakeholder Map

3. Identify Stakeholders Allegiance
4. Create a Stakeholder Management Strategy

4. DESCRIPTION OF WORK

Executive Summary

This deliverable is part of WP6, Business Model and Stakeholder Engagements, showing the results obtained in Task 6.1 Stakeholder Integration and business model requirements definition. This study will define the main aspects of the strategic vision, as requirements, solutions, current and future operations, and economic risks of stakeholders, and how it can be factored into business models for electrical ships and their port operations and to develop an overarching view on hyper vessel charging business in European and Global shipping industry. A SWOT analysis will be conducted, in order to give better insight into internal and external business environment of Hyper powered vessel battery charging system. In this sense, the analysis will be used to identify the project's key stakeholders, carry out an assessment of their interests and the ways in which these interests affect the project and its viability. The analysis has been carried out by following the next steps:

- Integration of all relevant stakeholders and actors.
- Identification of the stakeholders and actors' inherent requirements regarding vessel hyper charging solution and future port vision towards green transition.
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- Priorities and expected "green value-in-use" for stakeholders in port communities.
- PV analysis.

In conclusion, the main aspects of the strategic vision, as requirements, solutions, current and future operations, and economic risks of stakeholders, and how it can be factored into business models for electrical ships and their port operations and to develop an overarching view on hyper vessel charging business in European and Global shipping industry, have been defined within this deliverable.

The stakeholder analysis has served to identify the most relevant stakeholder groups that could affect the development of the project, either positively or negatively, categorizing them by sector and activity. Once identified, a PESTEL analysis has been prepared to clarify the priorities of each Stakeholder within the project, identifying their interests, motivations and concerns within it. Likewise, and to avoid internal conflicts between the identified stakeholders, an analysis of

alliances was subsequently carried out, to establish the best synergies between the different stakeholders and avoid possible conflicts between them in the future.

4.1 Identification of the stakeholders

Stakeholder analysis is the identification of a key stakeholders for a project, an assessment of their interests and the way in which these interests affect the project success and its dissemination.

To carry out a consistent and solid analysis, all the KPIs defined in the deliverable D1.2 have been taken into account.

4.1.1 The consortium

The consortium members have joined the project because of the expected potential benefits the potential benefit for the decarbonization of the maritime sector, and for the electrification of the fleet, the development of innovative hyperchargers for ships. The HYPOBATT project partners are the following:

	Consortium members	Type of organization	Size	Private	Country
1	IKERLAN S. COOP (IKERLAN)	Research	Large	No	Spain
2	HELIOX BV (HELIOX)	Fast charging manufacturer	SME	Yes	Netherlands
3	FUNDACION VALENCIAPORT (FV)	Research	Large	Yes	Spain
4	RINA SERVICES SPA (RINA)	Class Society	Large	Yes	Italy
5	RELIABILITY AND SAFETY TECHNICAL CENTER (RSTER)	Consultancy/ other services	Large	Yes	Belgium
6	BRUSSELS RESEARCH AND INNOVATION CENTER FOR GREEN TECHNOLOGIES	Research	Large	Yes	Belgium
7	FUNDACON CENTRO TECNOLOGICO SOERMAR	Research	SME	Yes	Spain
8	FLANDERS MAKE	Research	Large	No	Belgium
9	IMECAR ELEKTRONIK SANAYI VE TICARET LIMITED SIRKETI	Engineering/ Battery manufacturer	Large	Yes	Turkey
10	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	Research	Large	No	France
11	RHOE	Research	SME	Yes	Greece
12	STEMMANN-TECHNIK GMBH	Energy and data transfer components manufacturer	SME	Yes	Germany

13	TECHNISCHE HOCHSCHULE INGOLSTADT	University	Large	No	Germany
14	FUNDACJA MOTUS	a non-profit organization, conducts research, organises seminars and conferences, deliver opinions, actively participates in projects	Small	Yes	Poland
15	AKTIENGESELLSCHAFT REEDEREI NORDEN-FRISIA	Broad-based service company	Large	No	Germany
16	DAMEN RESEARCH DEVELOPMENT & INNOVATION BV	Shipyard	Large	Yes	Netherlands
17	OTASKI ENERGY SOLUTIONS LTD	Consultancy/ Other services	SME	Yes	United Kingdom
18	UNIVERSITY OF STRATHCLYDE	University	Large	No	United Kingdom

Table 1: HYPOBATT Consortium members

As can be seen in the table above, the consortium consists of 16 EU partners and 2 UK partners, representing many of the relevant supply chain players in the maritime industry and in the battery market:

- **Research organizations** (IKERLAN, BRING, SOERMAR, FM, FV, CEA). Their role is to increase our understanding of the hyper-power recharging systems, and everything related to it. They will not only offer knowledge, since some of them have sufficient capacity to carry out development and designs.
- **Engineering designers / Battery manufacturers** (IMECAR). Their role is to provide knowledge and experience from the automotive sector and apply it to the maritime sector and the development of the new hyper-power recharging system.
- **Class societies** (RINA). Their role is to identify and mitigate the risks of designing and developing a technology for which there is no defined regulation and standards, providing guidance and advice to designers and manufacturers.
- **Shipyards** (DAMEN). Their role is to provide all their knowledge about electric vessels and how the existing recharging technology can be upgraded to the new one.
- **Energy and data transfer components manufacturers** (GMBH). Their role is to provide high quality hardware and high-tech systems for power and data transfer from the industrial and railway applications to the maritime sector applications.
- **Fast charging manufacturers** (HELIOX). Their role is to provide the necessary knowledge, expertise and technology that allows implementation of fast charging systems in the naval sector.

- **Transport and logistics knowledge sharing organization** (MOTUS). Their role is to provide knowledge and know how about the current situation of fleet electrification in the Baltic Sea region and Norway.
- **Universities** (THI, USTRATH). Their role is to exploit the results of the project by publishing findings in peer-reviewed journals and conferences, disseminate the new methods, approaches and experiences to students at undergraduate and postgraduate level, and explore the application of generalized methods to different sectors and domains.
- **Broad-based service companies** (FRISIA). Their role is to demonstrate the feasibility of the technology being developed in HYPOBATT and promote the changeover to electric motors to support environmental sustainability.
- **Consultancies** (OTASKIES). Their role is to assist the other project partners, creating the business model for hypercharger systems within the maritime sector, which will be used to convince investors, ship owners/ship operators, and other stakeholders.

4.1.2 The Advisory Board

The role of the Advisory Board is to advise and follow-up the project consortium and help with its dissemination. Actually, it consists of 14 members:

- **5 port organizations**: BALTIC PORTS ORGANIZATION, PORT OF HELSINGBORG, AUTORIDAD PORTUARIA DE VALENCIA, PORT OF ROTTERDAM, PORT OF AMSTERDAM.
- **1 Engineering advanced technologies entity** (DANFOSS B.V.).
- **1 Global** sales and marketing business supplier specialised in fuels, lubricants and giving **technical support services to the marine industry** (SHELL MARINE).
- **2 Leading entities in the renewable, green and sustainable energy sector** (IBERDROLA y SIEMENS ENERGY).
- **1 leader entity in innovative technologies and lifecycle solutions for the marine and energy markets**.
- **1 organization specialized in battery systems used withing shipping** and offshore industries (MARITIME BATTERY FORUM).
- **1 industrial organization dedicated to promote the interoperability based on the Combined Charging System** of the automotive sector (CharIN).
- **1 regulatory agency in charge of securing a high, uniform and effective level of maritime safety**, maritime security, prevention of, and response to, pollution caused by ships (EMSA).
- 1 **technical office specialized in the energy sector and energy storage systems**. (IKITECH).
- **1 energy technology company which develops and supplies energy storage solutions for maritime applications** (EST-FLOATTECH).

4.1.3 Other participating stakeholders

Not only are those stakeholders that are part of the advisory board identified as the most relevant and critical, since there are a multitude of stakeholders that are both directly and indirectly related to the maritime sector, which must be taken into account while making decisions about the development of the project, in order to meet the objectives and meet the needs of stakeholders.

The identified stakeholders are defined below:

- **EST Floattech**, a Dutch energy technology company that develops and supplies energy storage solutions for maritime and land-based applications.
- **IKITECH**, a Spanish Technology developer, strategy and innovation business.
- **ABB**, Technological Pioneer Leader which collaborates with a lot of companies, industries and infrastructures, including the energy sector and maritime industry.
- **General Electric**, as a world energy leader providing equipment, solutions and services across the energy value chain from generation to consumption, specialized in the development of new energy technologies.
- **Shore-link**, as a shore power solutions provider for ports and vessels.
- **SINTEF Energy Research**, as an institute for applied research dedicated to creating innovative energy solutions.
- **Norwegian University of Science and Technology**, as a university specialized in technology and natural science, in possession of an oceanographic vessel.
- **VAN MEER**, as a system integrator and service provider for electrical and mechanical drive systems for different industrial sectors and the maritime world.
- **Port of Rotterdam and Lower Saxony Port**, as relevant port authorities.
- **BELLONA**, as an environmental organization based in Norway, specialized in climate and environment related to maritime and arctic issues.
- **Marpower Eekerls technology B.V.**, as a technical engineering office specialized in offering technological solutions to ships and mega yachts.
- **EALING project consortium**, as a major stakeholder pursuing the same objective as HYPOBATT but on a large scale, through the electrification of 16 European ports.

4.1.4 Maritime sector

The consortium and advisory board represent some of the players of the maritime and waterborne transport, sector and energy market, which is made up of many different players operating in the EU, and globally. The maritime and waterborne transport sector consists of all the supply chain players: shipyards, shipowners, ports, port authorities, research organizations, battery manufacturers, regulatory bodies such as IMO, EMSA, class societies, battery recycling organizations, OEMs (Original Equipment Manufacturers), service providers, auxiliary industry, etc.

4.1.5 Outside environment

The environment where the maritime industry operates. The waterborne transport industry, governments, and the society in the EU and worldwide, standardization bodies such as ISO. The European Commission (EC) is a key stakeholder in the project, as a funding body of the HYPOBATT project, which uses EU taxpayer money to promote innovation via programs like HORIZON2020.

5. PESTEL ANALYSIS

PESTEL analysis (formerly known as PEST analysis) is a framework or tool used to analyse and monitor the macro-environmental factors that may have a profound impact on an organization’s performance. PESTEL analysis is useful to identify the stakeholders relevant in a project, sorting them in political, economic, social, technological, environmental, and legal, as the figure below shows. It studies the key external factors that influence an organization, and in this case, it has been used to analyze each of the stakeholders and how they will influence the HYPOBATT project, guiding the consortium in strategic decision-making. Also, PESTEL analysis allows for creation of a vision of the risks and benefits for each stakeholder within the project, and how it will affect them in future.

Figure 1: PESTEL Analysis. Source: Marketing Theories – PESTEL Analysis (professionalacademy.com)

Members of the consortium, advisory board, and relevant members of the maritime sector, energy sector and battery market, and outside environments have been identified and sorted using the PESTEL Analysis as follows:

Political/Regulatory	Economic	Social
International Maritime organizations (IMO) Classification societies Port Authorities European Maritime Safety Agency (EMSA) National Administrations European Commission (EC) International Standards Organizations (ISO)	Shipowners Shipyards Ports Broad-based service companies Consultancy manufacturers Engineering companies Fast charging manufacturers Maritime energy storage suppliers Energy components manufacturers Battery manufacturers Engine manufacturers Transport and logistic organizations	Shipyards Ports EU society Environmental and green energy entities / clusters
Technological	**Environmental**	**Legal**
Engineering companies Research organizations Automotive industrial organizations Fast charging manufacturers Maritime energy storage suppliers Energy components manufacturers Shipyards Ports Consultancy companies Universities	EU Society European Maritime Safety Agency (EMSA) Recycling companies Ecologist Organizations Transport and logistics organizations Broad-based service companies Environmental and green energy entities / clusters	Consultancy companies National Administrations

Table 2 Detailed information on the Stakeholders identified

Stakeholders		Stake in the project	Needs and contributions	Perceived attitudes/risks	Risk if they are not engaged
1	**EU Society**	Potential benefit to the EU waterborne and battery sectors. New jobs.	Keep an open attitude and understand the value of investing research.	Expectant. Interested in technology breakthroughs. Against if new hypercharger systems cannot incentivize the electrification of the fleet, and directly reduce the maritime environmental footprint. EU taxpayers are funding the project, and they would expect results.	Small impact on society. It will be difficult to justify future projects.
2	**ISO**	They are an international standardization body. Supports innovation, ensure high quality.	Support standard creation through working group.	Positive. Open innovation.	If no standards are created, it will slow down technology uptake.
3	**IMO**	The outcomes of the project will provide evidence to assess if existing IMO regulations are fit for purpose or need to be updated.	Provide a forum for discussion, of existing and potentially new regulation of large battery systems integrated in ships. Observe and gather information.	The IMO reflects the view of its member states. In general, is conservative, but attitudes are changing.	Block progress.

Stakeholders		Stake in the project	Needs and contributions	Perceived attitudes/risks	Risk if they are not engaged
4	**EMSA**	Asses if the current regulation is in line with the aim of the project, from the safety point of view.	Observe the progress that is being developed during the project.	Expectant. Seek evidence to assess the legislation (for example fire safety).	Legislation not in line with the aim of the project. Resist updating the regulations.
5	**Class societies**	Understand the risks, and mitigation measures, to be able to class future hypercharging systems installed on ports.	Guidance documents, rules and help with the dissemination.	Expectant. Support technology, after evidence. Guarantee that safety is not compromised. Promote innovation, rather than be seen as a barrier.	Block progress.
6	**Port Authorities**	Potential environmental impact reduction within the port logistic chain.	Provide a global vision where the entire logistics chain of the port is considered, acting as a developer, matchmaker, facilitator, driver, director, investor, and initiator.	Expectant and optimistic, but worried about how the implementation of a very new technology can affect the complex logistics of the port. In some ports (locations) there might be difficult to have available energy power (level/capacity).	They are the main beneficiaries of the technology being developed in the project. Their participation and collaboration is critical, and without their experience and know-how the technology would not be developed based on real needs.
7	**National Administrations**	The outcomes of the project will provide evidence to assess if existing national regulations are fit for	Provide a forum for discussion, of existing and potentially new regulation.	Expectant. The National administrations reflect the view of each country.	Block progress.

Stakeholders		Stake in the project	Needs and contributions	Perceived attitudes/risks	Risk if they are not engaged
		purpose or need to be updated.			
8	**European Commission (EC)**	Funding body, which promote innovation in EU.	Keep funding HYPOBATT project and similar for the technology update.	Supportive.	Question the role and project impact. Engagement is recommended to send follow-up projects.
9	**Shipowners**	Potential cost saving and environmental benefits using multi-power hypercharging systems.	As end user, they need to use the technology, creating the demand.	Positive. They perceive it as a cost reduction opportunity. Concern about the system capabilities, which could not be able to cover all their needs.	Technology will not develop if there is insufficient demand.
10	**Shipyards**	New battery systems have potential to be the key to the electrification of the fleet.	Know-how on building of large ships.	Optimistic, but battery systems are oversized and expensive, with many regulatory barriers which need to be solved.	It will slow down innovation.
11	**Ports**	New multi-power charging systems have potential to be the key for both, the electrification of the fleet and the decarbonization of the port area.	As end user, they need to use the technology, creating the demand.	Optimistic, but hypercharging applied in the maritime sector implies a challenge, also regarding the port grid. In some ports (locations) there might be difficult to have available energy power (level/capacity).	They are the main beneficiaries of the technology being developed in the project. Their participation and collaboration is critical, and without their experience and know-how the technology would not be developed based on real needs.

Stakeholders		Stake in the project	Needs and contributions	Perceived attitudes/risks	Risk if they are not engaged
12	**Broad-based service companies**	As a port service supplier, potential new business opportunity regarding the electrification of their fleets and carbon footprint reduction.	As end user, they need to use the technology, creating demand.	Optimistic, but hypercharging applied in the maritime sector implies a challenge, also regarding the port grid	They are beneficiaries of the technology. Your participation is totally necessary to analyze within a framework and real situation the technological viability of what is going to be developed in the project.
13	**Consultancy companies**	Offer professional advice and guidance.	Viable solutions to problems that arise during the development of the project.	Optimistic. New solutions to electrify the maritime sector. The risk lies in that the proposed solutions may not be applicable to the problems that arise during the development of the project.	It will slow down innovation.
14	**Engineering companies**	Potential new business opportunities related to the design and integration of new hypercharging systems concept.	Design and analysis of port hyper charging systems and how this can be integrated on ports.	Positive. Potential new market. The main risk lies in the fact that the solution obtained does not meet the established objectives, and the proposed technological leap is not achieved.	It will slow down innovation.
15	**Fast Charging manufacturers**	Potential new business opportunities related to the manufacturing of fast charging systems for the maritime sector.	Knowledge on mechanical and electrical behavior of fast charging systems.	Support the development of emerging technological innovations within the project.	As one of the main objectives of HYPOBATT is the reduction of charging time, without the participation that is intended to be achieved with the project is the reduction of charging times.

Stakeholders		Stake in the project	Needs and contributions	Perceived attitudes/risks	Risk if they are not engaged
16	**Maritime energy storage suppliers**	Potential new business opportunities increasing their energy storage systems sells.	Provide specifications and technical data of various battery systems that allow analyzing and studying their compatibility with the new port hypercharger that is being developed at HYPOBATT.	Positive. Potential new market in the demand for battery systems due to the growth of the electrified fleet. The main risks lies in the fact the solution obtained does not encourage shipowners to electrify their ships.	Relevant stakeholders in order to promote the technology that is developed in the project. They have a commercial and communicative role, closely related to shipowners, and this will greatly benefit HYPOBATT in order to promote results and encourage, and give shipowners confidence to electrify their ships.
17	**Energy components manufacturers**	Potential new business opportunities related to the manufacturing of new energy components for charging systems, applied within the maritime sector.	Knowledge and know-how regarding energy components that will allow to achieve the technological objectives of the HYPOBATT innovation.	Support the development of emerging technological innovations within the project.	Their knowledge and experience in manufacturing energy components is highly relevant and critical. Without their participation, we run the risk of not achieving innovation.
18	**Battery manufacturers**	Potential new business opportunities due to the increase in battery systems installed on board ships (increased electrification).	Technical support is needed , regarding the clarification of the design, modularity and compatibility of the system.	Positive. Potential new market in the demand for battery systems due to the growth of the electrified fleet. The main risks lies in the fact the solution obtained does not encourage shipowners to electrify their ships.	It will slow down innovation

Stakeholders		Stake in the project	Needs and contributions	Perceived attitudes/risks	Risk if they are not engaged
19	**Engine manufacturers**	Potential threat, leading to market loss.	Nothing at this stage. They will need to understand the innovation and accept it.	Opponent. Risks losing their business if maritime battery systems evolve.	Resist to innovation.
20	**Environmental and green energy entities**	Potential resistance to the development of the project.	Nothing at this stage. They will need to understand the innovation and trust in the environmental contingency plans that are going to be applied in the project (Circular Economy).	Opponent. Risks associated to the environmental impact. Lithium recycling technologies are not sufficiently developed.	Resist to innovation.
21	**Research organizations**	Increase knowledge of new design of hypercharging systems through research.	Knowledge on mechanical and electrical behaviour of hyperchargers.	Support the development of emerging technological innovations within the project.	Not enough knowledge will block technology uptake.
22	**Automotive industrial organizations**	Transfer of knowledge from the automotive sector to the maritime sector related to fast charging technologies.	Knowledge, know-how and technology from the automotive sector applicable to the maritime sector.	Support the development of emerging technological innovations within the project.	Without their participation and without their technology transfer, the innovations of the project could not be achieved.
25	**Universities**	Increase knowledge of new design of hypercharging systems systems through research.	Knowledge on mechanical and electrical behaviour of hyperchargers.	Support the development of the innovations within the project.	Universities have a great communication capacity and are great disseminators in many fields, both academic, scientific and industrial. Without their participation, you

Stakeholders		Stake in the project	Needs and contributions	Perceived attitudes/risks	Risk if they are not engaged
					risk not adequately promoting HYPOBATT innovations.
26	**Recycling companies**	Potential business opportunity if technology allows.	Develop know-how in relation to new technologies associated with battery recycling.	Positive. New business opportunity	Environmental hazard. Current technologies do not allow to recycle lithium in a proper way.
27	**Ecologist organizatio ns**	Potential resistance to the development of the project.	Nothing at this stage. They will need to understand the innovation and trust in the environmental contingency plans that are developed in the project (Circular Economy).	Opponent. Risks associated to the environmental impact. Lithium recycling technologies are not sufficiently developed.	Resist to innovation.
28	**Transport and logistics organizatio ns**	Potential business opportunity if technology arise. Reduce costs in the transport of goods.	Nothing at this stage. They will need to wait until the innovation is developed.	Positive. New business opportunity. Deriving a large amount of road transport to maritime transport.	Deriving transport from road to transport by sea will mean a great advance in the decarbonization of the transport and logistics sector.

5.1 Stakeholders map

The relevant stakeholders are mapped in the following table, according to the level of impact (interests) of the change on them and the importance (power, influence) these stakeholders have in the success of the project. Depending on their power and interests, stakeholders should be managed in different ways, as shown in the following table.

For example:

- **Regulators** (IMO, Port Authorities, EMSA, etc.) have some interest in the outcome of the project. They would need to be kept satisfied, with the aim that in the near future standardization can be achieved.
- **Shipowners and ports** are important for the success of the project, without their support the technology will fail. They also have a high interest because they could reduce their costs significantly. They need to be actively managed.
- **Class societies**, with less power than regulators, have some interest because they must keep abreast of new technologies and update their rules accordingly. They will need to be kept on side.
- **The energy market** (manufacturers, material suppliers and recycling companies) with some power, without them it would be very hard for the technology to take off, and are very interested, because of the large business opportunity. They need to be kept on the side.

Power Influence Importance	LOW	MEDIUM	HIGH
HIGH	**Watch**	**Keep satisfied** **IMO,** **Class societies,** **EMSA,** **National administrations,** **Port Authorities,** **Automotive industrial organizations**	**Actively manage** **Shipowners,** **Battery manufacturers,** **Ports,** **Broad-based service companies,** **Fast Charging manufacturers,** **Energy components manufacturers,**
MEDIUM	**Keep on side** **EU society,** **ISO,** **Research organizations,** **Universities**	**Keep on side** **EC,** **Shipyards,** **Engineering companies,** **Maritime energy storage suppliers,** **Battery manufacturers**	**Keep on side** **Consultancy companies,** **Recycling companies,** **Ecologist organizations,** **Environmental and green energy entities,** **Transport and logistics organizations**
LOW	**General communication** **Other industries**	**Keep informed** **Engine manufacturers**	**Keep informed**

Interest - Impact

5.2 Stakeholders' allegiance

Once all the stakeholder groups that will influence the development of HYPOBATT and its impact at a technological, environmental, and social level have been identified, it is necessary to identify, determine and evaluate the degree of involvement of each one of them, if they support or oppose the project. Next, a table is presented where the possible allegiances are identified, which stakeholders would form each group and how they should be managed with a view to generating the business model.

Assessment	Definition	WHO?	How to manage?
Advocates	• Group which is driving HYPOBATT. • Active communications, keep regularly involved.	• Research organizations, • EC, • Ports, • Broad-based service companies, • Fast charging manufacturers, • Energy components manufacturers, • Research organizations • Recycling companies	• Internal sponsorship. • Receive Inputs from their side regarding key milestones and decisions. • Use them for internal promotion of objectives and benefits.
Followers	• Have a low understanding of the project aims and objectives. • Increase their understanding for future benefit.	• Shipowners, • Shipyards, • Environmental and green energy entities, • Engineering companies, • Class societies, • IMO, • EMSA, • Port Authorities, • National administrations • Battery manufacturers	• Keep informed and positive, so they want to support the project.
Indifferent	• To take a definitive position on the project. • Identify gaps and seek to fill them.	• ISO, • EU society, • Consultancy companies, • Other industries, • Automotive industrial organizations,	• Seek their views on key issues. • Have a medium understanding and medium agreement of the project.

		● Transport and logistics organizations, ● Maritime energy storage suppliers	● Careful not making them opponents.
Blockers	● Shows resistance to the project. ● Low understanding and low agreement to the project.	● Non detected	● Use conflict management techniques. ● Lack of communication. ● A loss from project.
Opponents	● High understanding but low agreement to the project. ● Initiate discussions and generate reasons for low acceptance to the project.	● Engine manufacturers, ● Ecologist organizations.	● Somehow, they will lose the object of the activity. ● Counter the reasons for low acceptance, using facts and data.

5.3 Stakeholders' management strategy

Once all the groups of stakeholders that will influence HYPOBATT have been analysed and studied, and their impact on the project identified, we proceed to establish an initial position and trajectory for each Stakeholder, and how to manage each of them, so the final desired position per stakeholder can be reached. This will be represented with a face diagram, where the state and initial situation of each Stakeholder is established, and an arrow indicates the point to be reached / achieved by said Stakeholder.

Stakeholder	Power/ influence / importance	Interest-Impact	Initial situation	Initial satisfaction degree				Movement to be achieved
				Noncompliant	Indiferent	Satisfied	Very satisfied	
Research organizations	Medium	Low	Advocates					Keep on side. Use for promotion of objectives and benefits.
Engineering companies	Medium	Medium	Followers					Keep informed, positive and optimistic about results.
Battery manufacturers	Medium	Medium	Followers					Keep informed. Use for promotion of objectives and benefits
Shipyards	Medium	Medium	Followers					Keep informed, positive and optimistic about results.
Shipowners	High	High	Followers					Ask for advice and take their point of view into account concerning key issues.
Consultancy agencies	Medium	High	Indifferent					Keep on side. Take their points of view into accoun concerning key issues.
Class societies	High	Medium	Followers					Keep informed, positive and optimistic about results.
IMO	High	Medium	Followers					Ask for advice and take their point of view into account concerning key issues.
EMSA	High	Medium	Followers					Keep satisfied. Take their point of view into account concerning key issues.
EC	Medium	Medium	Advocates					Keep on side. Use for promotion of objectives and benefits.
ISO	Medium	Low	Indifferent					Keep on side. Keep informed and positive.
EU society	Medium	Low	Indifferent					Keep on side. Take their point of view into account concerning key issues
Recycling companies	Medium	High	Advocates					Keep on side. Use for promotion of objectives and benefits.
Other industries	Low	low	Indifferent					General communication
National administrations	High	Medium	Followers					Keep on side. Keep informed and positive.
Universities	Medium	Low	Advocates					Keep on side. Use for promotion of objectives and benefits.
Port Authorities	High	Medium	Followers					Ask for advice and take their point of view into account concerning key issues.
Automotive industrial organizations	High	Medium	Indifferent					General communication
Ports	High	High	Advocates					Ask for advice and take their point of view into account concerning key issues.
Broad-based service companies	High	High	Advocates					Ask for advice and take their point of view into account concerning key issues.
Fast charging manufacturers	High	High	Advocates					Ask for advice and take their point of view into account concerning key issues.
Energy components manufacturers	High	High	Advocates					Ask for advice and take their point of view into account concerning key issues.
Ecologist organizations	Medium	High	Opponents					Actively manage. Use conflict management techniques.
Environmental and green energy entities	Medium	High	Followers					Keep on side. Use for promotion of objectives and benefits.
Transport and logistics organizations	Medium	High	Indifferents					Keep on side. Use for promotion of objectives and benefits.
Engine manufacturers	Low	Medium	Opponents					Actively manage. Use conflict management techniques.

Additionally, in this chapter, an analysis of the market for electric and hybrid ships in the Baltic Sea and Norway was presented. Norway was included in this analysis as an example of a

Scandinavian country whose policies and regulations allow it to currently lead the way in the implementation of fully electric maritime vessels, taking into account that in these areas the electrification of vessels is quite developed and implemented compared to the rest of the European areas, so it will be highly beneficial for HYPOBATT to involve the stakeholders involved in these areas, incorporating their experience and knowledge into the project.

However, this technological solution still presents a challenge in terms of storing electric energy for powering different types of vessels, and further research is necessary to find and apply technologies that meet these requirements and are adapted to the needs of different types of ships.

At present, electric ships are an attractive option for short-range and inland shipping/navigation, but long-range vessels are not currently as attractive due to the lack of advanced technology and higher implementation costs. There are several selected uses of marine batteries in regional ports and ferry connections in the Baltic Sea region, and there are already examples of hybrid and fully electric ferries (Tables 2 and 3). Table 2 shows electric ferries operating in the Baltic Sea and Norway, while Table 3 lists hybrid ferries operating in the same areas. Both tables include the names of the vessels, their operators, the routes they serve, and the ferry charging system. It can be noted that the Scandinavian countries are clearly leading the way in the implementation of fully electrified ships, especially Norway.

Table 3: Electric ferries on Baltic Sea and Norway as of May 2023.

Electric Ferries				
Electric ferry	**Country**	**Operator**	**Route**	**Charging System**
MS Medstraum	Norway	Kolumbus	Stavanger - Hommersåk	Shore charging power of 2.3 MW
Bastø Electric	Norway	Bastø Fosen	Moss - Horten	Fast-charging systems supplied by Siemens Energy from the battery factory in Trondheim. The fast-charging system has a capacity of 9 MW
Boreal Sjö 1	Norway	Boreal Sjö	Launes - Kvellandstrand	Shore-based battery charging equipment. The vessels use the local onshore power grid for charging via a dedicated charging tower located on

Electric Ferries				
Electric ferry	**Country**	**Operator**	**Route**	**Charging System**
				the quayside, which enables automated quick charging between voyages. At night the vessels use a normal 400-volt plug-in solution for slower charging.
MF Svelvik	Norway	Bastø Fosen	Svelvik - Verket	The shore charging system can deliver 4,400 amps and has a maximum power of 1,200 kW.
MF Lafjord	Norway	Agder Fylkeskommune	Abelsnes - Andabeløy	
Boreal Sjö 2	Norway	Boreal Sjö	Abelnes - Andabeløy	Shore-based battery charging equipment. The vessels use the local onshore power grid for charging via a dedicated charging tower located on the quayside, which enables automated quick charging between voyages. At night the vessels use a normal 400-volt plug-in solution for slower charging.
Ampere	Norway	Norled / Statens Vegvesen	Lavik - Oppedal	Each shore with 410 kWh; 63 x Corvus AT6500-LQ (Liquid-Cooled) modules
Antonia vom Kamp	Germany / Poland	Oderhaff Reederei Peters	from the mainland to the island of Usedom (an island divided between Germany and Poland)	

Electric Ferries				
Electric ferry	**Country**	**Operator**	**Route**	**Charging System**
M/F "Tycho Brahe"	Denmark	ForSea	Helsingborg (in Sweden) - Helsingor (in Denmark)	Automated shore-side charging stations with laser-controlled robot arm
M/S "Aurora	Denmark	ForSea	Helsingborg (in Sweden) - Helsingor (in Denmark)	Shore-side charging stations. A fully automatic laser-controlled robot arm. It takes 6-9 minutes to charge a 20-minute crossing. Charging with 10 500 kW, 10 500 V and 600 Amp.
E-ferry 'Ellen'	Denmark	Ærø Kommune	island of Ærø (Soeby harbour) - mainland Jyland (Fynshav)	Onshore charging station and charging arm for the ferry's 4.3MW battery. Charging effect - 4MW
Movitz	Sweden	Ballerina	Solna Strand - Stockholm's Old Town	DC-DC charger. The charging time takes around 10 minutes for a one-hour run time.
Elvy	Sweden	Västtrafik	Canals of Gothenburg	When the battery runs out of power, it can be recharged during operation, or with electricity onshore. The power relies on three independent power sources (two battery packs and one generator.

Table 4: Hybrid ferries on Baltic Sea and Norway – state of art.

Hybrid Ferries				
Ferry Name	**Country**	**Operator**	**Route**	**Vessel Charging System**
MF Husavik	Norway	Torghatten Nord AS	Bognes-Lødingen	
MF Kvernes	Norway	Fjord1 ASA	Seivika-Tømmervåg	
MS Nordkapp	Norway	Hurtigruten AS	Bergen-Kirkenes	
MF Ytterøyningen	Norway	Kystekspressen AS	Kristiansund-Trondheim	
Color Hybrid	Norway	Color Line	Sandefjord, Norway - Strömstad, Sweden	
MF Gloppefjord	Norway	Fjord1 ASA	Anda – Lote	
MF Eidsfjord	Norway	Fjord1 ASA	Anda – Lote	
MS Roald Amundsen	Norway	Hurtigruten	No fix route, many places around the world	Is charged using a combination of shore power and its own onboard power generation systems The batteries have an energy of 1,360 kWh. This means that a voyage of only 20 to a maximum of 30 minutes is possible. An upgrade by a factor of three to approx. 5,000 kWh is planned
MS Fridtjof Nansen	Norway	Hurtigruten	No fix route, many places around the world	Is charged using a combination of shore power and its own onboard power generation systems The batteries have an energy of 1,360 kWh. This means that a voyage of only 20 to a maximum of 30 minutes is possible. An upgrade by a factor of three to approx. 5,000 kWh is planned
Fannefjord	Norway	Fjord1 ASA	Molde and Vestnes	Thas a plug-in hybrid system that allows it to charge its batteries from shore power while it is docked at port. The charging system was developed by Siemens and has a charging power of up to 4.6 megawatts.
MS Silja Europa	Estonia	Tallink Silja	Helsinki, Finland - Tallinn, Estonia	

Hybrid Ferries				
Ferry Name	**Country**	**Operator**	**Route**	**Vessel Charging System**
MF Tõll	Estonia	Saaremaa Laevakompanii AS	Virtsu-Kuivastu route in Estonia, connecting the mainland with the island of Muhu	
MS Stena Jutlandica	Sweden	Stena Line	Gothenburg, Sweden - Frederikshavn, Denmark	The works commenced in spring 2018 and later that year "Stena Jutlandica" was converted to a battery hybrid vessel. In the third final step of innovation the vessel will be able to operate for around 50 nautical miles – the distance on route Gothenburg – Frederikshavn, solely on electrical power. Callenberg Technology Group has been responsible for 1 MWh battery installation onboard ferry. The ship is assumed to charge green electricity in both ports and by her aux engines.
MS Molslinjen Express 4	Denmark	Molslinjen	Odden- Ebeltoft	
M/V Berlin	Germany	Scandlines	operates on the route between Germany and Denmark	Ferry's hybrid system includes a large battery bank, which is charged by the vessel's generators and through regenerative braking, and electric propulsion motors that allow the ferry to operate silently and with zero emissions in electric mode. The diesel engines are used primarily to charge the batteries and provide backup power when needed.
MF Finnswan	Finland	Finnlines	Naantali-Långnäs-Kapellskär	The ferry's hybrid system includes a large battery bank, which is charged by the vessel's generators and through regenerative braking, and electric propulsion motors that allow the ferry to operate silently and with zero emissions in electric mode. The diesel engines are used primarily to charge the batteries and provide backup power when needed.
Finneco I	Finland	Finnlines	Helsinki - Kotka - Travemünde -	

Hybrid Ferries				
Ferry Name	**Country**	**Operator**	**Route**	**Vessel Charging System**
			Zeebrugge - Antwerp - Bilbao	
Finneco II	Finland	Finnlines	unknown	
Finneco III	Finland	Finnlines	unknown	
FINNSIRIUS	Finland	Finnlines	Naantali–Långnäs–Kapellskär route	Using the shore power connection, the vessels will be able to turn off their auxiliary engines in port while also charging the onboard batteries which will provide power at sea.
FINNCANOPUS	Finland	Finnlines	Naantali–Långnäs–Kapellskär route	Using the shore power connection, the vessels will be able to turn off their auxiliary engines in port while also charging the onboard batteries which will provide power at sea.
Elektra	Finland	FinFerries	Parainen - Nauvo	Battery packs are being charged directly from the grid and diesel electricity generators used alongside them as a backup are serving as the energy source. The energy storage system is being charged at each side of the crossing, using a shore-based connection to the local grid.
MS Viking Grace	Finland	Viking Line	Turku, Finland - Stockholm, Sweden	

There are many examples of small and medium-sized electric ferries already sailing in Norway. Tables 2 and 3 show the current state of art, and it can be seen that Norway is a leader in the implementation of electric and hybrid ferries. In 2015, the first fully electric ferry, the MF Ampere, began operating in western Norway. Norway has ambitious climate goals at the county, national, and regional levels. The responsibility for the development of the ferry market and its electrification is shared between the counties and the Norwegian Public Roads Administration (NPRA). This situation creates additional interesting opportunities related to procurement practices in ferry tenders. In 2015, the Norwegian parliament passed a resolution stating that all new ferry tenders must, if possible/feasible, require low-emission technologies. Another reason why Norway is a pioneer in ferry electrification is that in Norway, electric power is cheaper than (bio)diesel and LNG, which provides an incentive to maximize the speed of electrification. It is worth noting that Norway is characterized by an innovative system that is based on a culture of close collaboration, mutual trust, and information exchange. This state of affairs allows for overcoming potential initial resistance to electrification.

5.4 Definition of key variabilities and similarities in port operations

This section will briefly describe the similarities and differences between the ports participating in the project, and at which the technology being developed at HYPOBATT will be demonstrated, both the port of Valencia and the port of Norddeich and the port of Norderney. Likewise, in section 5.8 of this deliverable, a conceptual analysis of the business model associated with the photovoltaic integration of solar panels in ports is carried out, which will be developed in detail in task 6.2.

5.4.1 Port of Valencia

The port of Valencia is the largest Mediterranean port in Europe based on the number of containers moved annually. The port has multiple terminals for cargo and passengers. The following terminals can be found at the port:

CARGO TERMINALS

Container terminals

- MSC Terminal Valencia (337.000 m2)
- Noatum Container Terminal Valencia
- APM Terminals Valencia (APM 450.000 m2 + TCV Stevedoring Company S.A 16.114 m2)
- CSP IBERIAN VALENCIA TERMINAL, S.A.U. (CSPV) (89.000 TEU)

Refrigerated warehouses (1.500 m2)

Oil terminal

- Galp Energía España

Cement terminal:

- Holcim España S.A. (2.957 m2)
- Cemex Logística España (5.259 m2)

ID Logistics (35.208 m2)

Bulk terminal:

- Temagra (70,000 m2)

Liquid Bulk Terminal (Chemical product, oil products, and non-flammable liquid)

- TEPSA
- TEVA-TANK 3.700 m2

RoRo Terminal

- Valencia Terminal Europa (209.000 m2)

PASSENGER TERMINALS

Balearia

Valencia Nautical club
Marina de Valencia
Transmediterranea

Figure 2: Port of Valencia. Source: Autoridad Portuaria de Valencia

5.4.2 Ports of Norddeich and Norderney

On the one hand, the Port of Norddeich is located in Lower Saxony, in northern Germany, and its activity is mainly focused on passenger transport and, to a lesser extent, cargo transport, being able of transporting 2.650.000 passengers per year. It has 7 piers and an extension of 14,000 m^2.

Figure 3: Port of Norddeich. Source: mapcarta.com

On the other hand, the port of Norderney, located on one of the East Frisian Islands, is a small port dedicated, like the port of Norddeich, mainly to the transport of passengers and, to a lesser extent, to the transport of cargo. It has 3 piers, which makes it the smallest port and, therefore, the one with the lowest capacity of the three.

Figure 4: Port of Norderney. Source: portmaps.com

5.4.3 Identification of similarities and variabilities. Port community goals and key business operators in the port areas

As can be seen, as a main similarity, and a common aspect to all ports globally, the three ports have passenger terminals and cargo terminals, carrying out operations related to passenger and cargo transportation. The three ports have battery charging terminals for those hybrid or electric ships that dock at their terminals that need it.

Regarding the variabilities, among the main ones, and that will have to be taken into account for the development of the business models, the dimensions, extension and relevance of the ports are identified. While the ports of Norddeich and Norderney are more focused on the transport of passengers and cargo between islands, which limits the type of ships that frequent their terminals (ferries, Ro-Pax, small cargo ships, etc.), As the port of Valencia is one of the most important connection ports with the Mediterranean Sea (4th European port and 20th worldwide), the daily traffic of ships it receives is much higher, which is directly related to the type of vessels and types of cargo it receives. Among the types of ships that it receives daily are container ships, bulk carriers, cement carriers, oil tankers, RoRos, cruise ships, RoPax and ferries, among others. In this sense, the ships that transit the port of Valencia are larger and have more power demands, each with its operating profiles and energy needs.

This fact is of relative importance, and it will have to be taken into account when developing business models, given that while small and medium-sized ships pass through the ports of Norddeich and Nordeney, mainly passenger vessels which have similar operational profiles, the integration of the technology that is being developed in HYPOBATT, a priori, will be easier than in the port of Valencia, given the difference in types of vessels that transit through it, the great variety of operational profiles and energy needs in each of them.

Taking into account the above, it can be concluded that the common port community goals that both ports have resided in the transport of people (tourists and citizens) and cargo associated with the passage (luggage, vehicles, etc.) as well as the waste that generate. Regarding cargo, it should be mentioned that the goals of the port of Valencia are broader than those of the port of Norddeich and Norderney, given the different types and volumes of cargo that it handles daily, which have been mentioned above.

In this sense, it has been possible to identify the business operators that operate in these ports, in general, which must be taken into account when developing the technology proposed in HYPOBATT, which are presented below:

- **For Norddeich and Norderney ports:**
    - Tourism
        - Restaurants (fish from the sea, etc.)

        - Hotels, rentable houses for tourism
        - Boats for trips (sightseeing) and short trips to the islands
        - Activities for fun: water sports (surfing, kitesurfing, etc), bike rent services, shops with souvenirs
        - Best connection from far: train station in the port, many parking lots, many electric chargers for cars
    - Health
        - Health resort visitors (Norddeich, Norderney, Juist, etc)
        - Salty air for skin diseases
        - Clinics for skin, psychology, mother-child recreation, hospice
    - Offshore wind park companies
        - Maintenance for the wind park
        - Company site for administration
        - CTV piers
- **For Valencia port:**

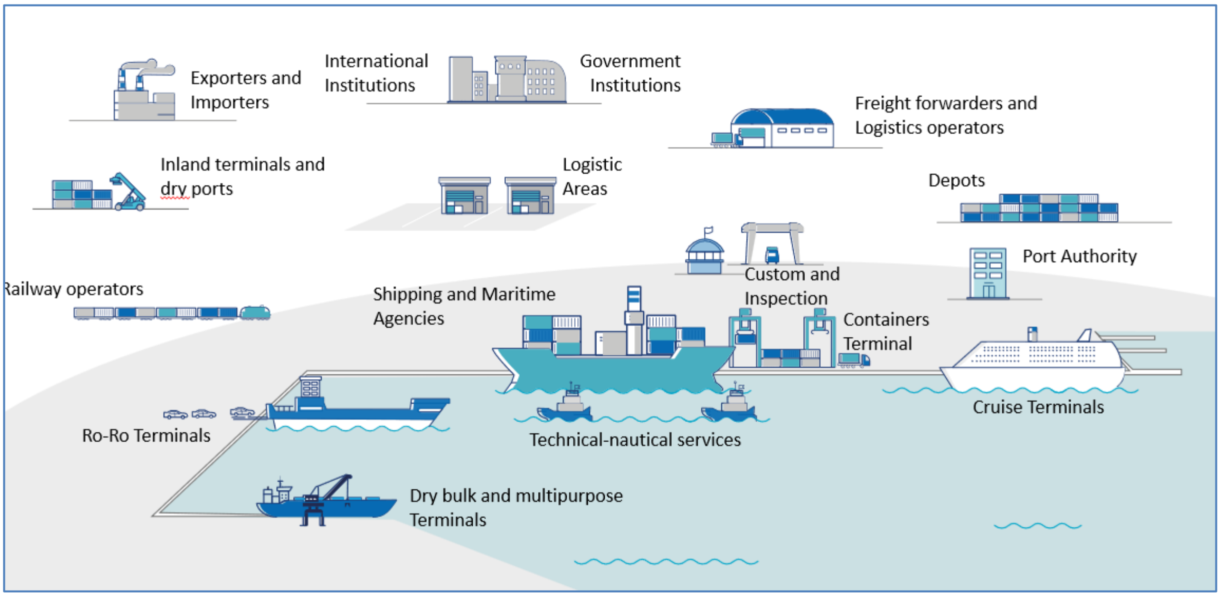

Figure 5: Key business operators in Valencia port

Currently Valencia port is defining its 2030 strategic plan. The vision is to be a leader port in the Mediterranean Sea and a national reference in terms of innovation, digitalisation, decarbonization and integration. The vision for the three ports of the Valencia port Authority is defined below:

- Valencia as the best-connected logistics-port platform in the Western Mediterranean and a leader in container traffic.
- Sagunto is a multi-purpose port and a key hub for the global energy transition.

- Gandía is a port at the service of the regional economy and a generator of wealth around the blue economy.

To achieve it, work will be carried out on five strategic pillars:

- Value generated for people.
- Ecosystem energiser.
- Environmentally sustainable and resilient.
- Leader in digitalisation and innovation.
- A benchmark in management ensuring the general interest.

Fourteen strategic quantifiable objectives have been defined in the framework of the 14 pillars, aligned with the sustainable development goals of the United Nations.

5.5 Regulatory and standardisation impact in business model. Gap analysis

In the maritime and industrial applications, different standards exist for safety, both in general as for installations. The most relevant standards are mentioned in WP1.

The *European Maritime Safety Agency* (EMSA) has compiled a collection of standards valid for the maritime field. On the other hand, no standards exist for e.g., charging sequence and control methods, required safety principles, EMC levels, port back-office connections, and grid power availability communication.

Because of the lack of land side requirements, it erases the hypothesis of referring to the ship-side requirements also for the land side where it makes sense, for example the environmental requirements for the equipment installed on the pontoon, i.e. very close to the sea; these requirements would be assessed on a case-by-case basis, and possibly partially adopted if they are more "stringent" than necessary. The opportunity to use these requirements also as a reference for ashore systems remains an option to be evaluated as a next project's step by technology developers to make up for any lack of adequate standards on the shore side; the feasibility of this choice may derive from an appropriate Risk Assessment with the definition of adequate Risk Control Options.

If this assumption were adopted, the business model could be influenced by different weights, volumes and costs; it will be decided in the next project developments and will be reported in D6.2.

Moreover, the task 7.2 is focused on the interpretation of the current legislation, identifying gaps and defining guidelines:

- Proposals to cover all relevant aspects (ship, shore and their connection)

- Definition and development of additional standards for fast recharging of high-power systems to the E-vessels
- Preparation of the specification for the charging infrastructure and ship-to-shore connection system

The trend in maritime regulatory framework is to address novel solutions and innovative technologies via risk analysis and technology qualification process, aimed at identifying an equivalent level of safety. In other words, provisions currently applied to other industrial solutions are to be assessed to demonstrate their suitability for marine use, and equivalence to the existing level of safety for on board systems.

In case of gaps in the applicable rules and standards for the installations foreseen in HYPOBATT, risk analysis and technology qualification process are necessary.

The risk assessment is to demonstrate an equivalent level of safety of novel technologies compared to existing technologies, with specific reference to the prevention of any harmful consequence on the ship and her systems (fire, explosion…). Additionally, the reliability and redundancy of the power generation and storage systems needs to be determined to prevent any unintended blackout or loss of energy that would affect the ship propulsion or essential services in operation.

5.6 Hierarchy of hyper charging transition. Ports and ship models development

The transition towards electrification of the fleet in the port is a long process and requires the joint efforts of different entities to promote the ecosystem electrification. A detailed system specification of the hyper charger has been described in detail in the deliverable 1.4.

In the case of hyper chargers, the following elements have been identified:

1. Market electrification analysis. This includes the electrification of the fleet calling into the port, understanding the tendencies and scenarios, and acting accordingly. In the case of large ports such as Valencia, the port has dedicated terminals so segmenting the electrified fleet calling into the port supports the decision making described in deliverable 1.2.
2. Boost the alliance of multiple entities enhancing the legislators to create a regulatory framework. This point has been extensively described in the deliverable 7.1.
3. Civil engineering works, including:
    a. Maritime works including the adequation of the area for the vessels that shall be charged during the vessel call.
    b. Civil work for the installation of the hyper charger into the port facilities and to adapt the grid for the extra demanded power. This may include electric

substations or new cables layout as extensively described in the deliverable 1.2 Port integration and grid requirements.

5.7 Expected "Green Value in Use" for stakeholders related and in consonance with ports

Ports play a significant role in the global supply chain, impacting directly the environment and local communities.

"Green value in use" (GVIU) refers to environmentally friendly practices and procedures in learning the way of using, repairing, and maintaining green product innovations. The installation of hyper-charger shall be aligned with a team of skilled professionals that can operate and maintain the chargers in operating conditions.

Since the chargers are not in a scale economy, the impact in local industry may not be very high.

5.8 BM related to PV integration

5.8.1 Stakeholders related to PV integration

According to [410.1, SPE] the different roles and activities associated with the integration of PV solar plants in ports are:

Roles	Description
Property owner	[410.1]: Owner of the land or building on which the solar PV system is located.
Solar PV System Owner (and investor)	[410.1]: Owner of the solar PV system who is responsible for financing, procurement, construction, and installation of the technology.
Off-taker [SPE]	[SPE]: The entity that pays for the produced electricity. This role is still evolving and is often divided according to national renewable power support schemes: • State or national grid operator / electricity seller(s), or specific authorities for renewable energy (e.g. GSE in Italy) in a feed-in tariff (FIT) scheme. • Energy traders or direct sellers in a direct marketing scheme. End customers in schemes that underline autonomy in energy supply.
The System Installer/EPC	[SPE]: The entity in charge of the Engineering, Procurement and Construction of the solar power plant. The EPC contractor is in

Roles	Description
(Engineer, Procure, Construct)	charge of delivering the full solar power plant to the Asset Owner from authorisation to commissioning and grid connection.
Project developer	[SPE]: The Project Developer is the entity that initiates the project and focuses on site selection, customer identification, conducting preliminary studies, application for permits, securing the financing and selection of the EPC provider. Project developers may own the project in the early development stages or even longer.
Lender	[SPE]: The lender or debt provider (financing bank) is not considered an “Asset Owner” even if the loans are backed up by securities (collateral).
O&M service provider	[SPE]: The service provider in charge of O&M activities as defined in the O&M contract includes Power Plant Operation and Power Plant Maintenance and, in some cases, Technical Asset Management.
Monitoring Provider or Data-related service Providers	[SPE]: Providers of hardware and software solutions such as Monitoring Systems, Asset Management Platforms, Computerised Maintenance Management Systems (CMMS) or Enterprise Resource Planning Systems (ERP) or advanced data analysis providers that acquire data from the site and also analyse the data to calculate KPIs (analytical tools) and/or provide data repository for key site information whilst facilitating some administrative workflows.
Asset Manager	[SPE]: The service provider responsible for the overall management of the PV plant, from a technical, financial and administrative point of view. As an example, Asset Managers manages the site to ensure optimal profitability of the PV power plant (or a portfolio of plants) by supervising energy sales, energy production, and O&M activities.
Attribute Marketer	[NREL]: Party that provides a monetary value for the unique attributes of the electricity generated by the PV system (e.g., solar renewable energy credits [SRECs], emissions credits).

According to [RM] the different roles and activities associated with the grid are:

Distribution System Operator (DSO)	A party responsible for operating, ensuring the maintenance and, if necessary, developing the Distribution system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of this system to meet reasonable demands for the distribution of electricity.

Accounting Point (AP)	A domain under balance responsibility where Energy Supplier change can take place and for which commercial business processes are defined.
Party Connected to the Grid (PCG)	A party that contracts for the right to take out or feed in energy at an Accounting Point.
Energy Supplier (ES)	An Energy Supplier supplies electricity to or takes electricity from a Party Connected to the Grid at an Accounting Point.
A Balance Responsible Party (BRP)	A party is responsible for its imbalances, meaning the difference between the energy volume physically injected to or withdrawn from the system and the final nominated energy volume, including any imbalance adjustment within a given imbalance settlement period.

5.8.2 Description of current context at Frisia

From Deliverable 2.1, the following picture represents the power network model of the port of Norden and of the future PV plant:

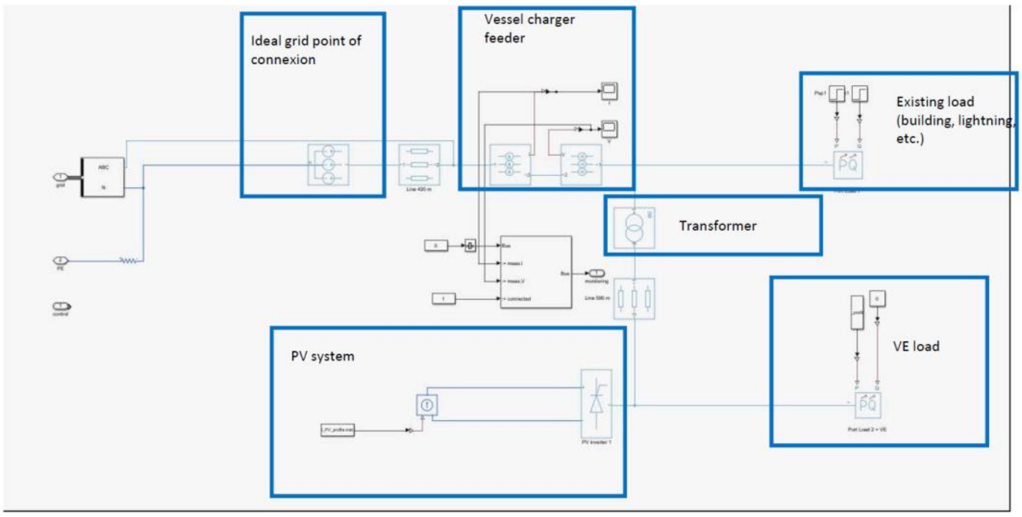

Figure 6: Power network model of the port and future PV plant and EV charging stations

We consider that the User0=Port Operator (PO) is the "private" DSO of the private power network located behind the 'ideal grid point of connection' (of Figure 2). This private network connects the vessel chargers, the other existing loads (buildings, lightning, etc.), the EV charging stations and the future PV plant.

The Figure 6 represents the different roles and activities of the stakeholders in the actual situation.

The ‘ideal grid point of connection’ is considered as an Accounting Point (AP), further called accounting point PO, represented by a green counter on the Figure 3.

We consider that the User0=PO is the Party Connected to the grid (PCG).

We consider that the User0=PO contracts with the local DSO for this grid access, through a payment that is generally function of the maximum power that can be withdrawn from the grid (at the accounting point) and of the energy that is withdrawn (at the accounting point). Sometimes, the payment depends on hours and on dates.

We consider that the User0=PO contracts with an energy supplier ES for the supply of all the power of the port withdrawn by existing loads (buildings, lightning, etc.), vessels and electrical vehicles.

We consider that the energy supplier ES of the User0=PO is also its Balance Responsible Party (BRP).

In the following, we consider three users of the private power network:

- “User0” = Port operator by default.
- “User1” which owns and operates the buildings and vessels chargers.
- “User2” which owns and operates the EV charging stations.

We consider that these two users User1 & User2 are “independent” (the term ‘independent’ will be further detailed and its meaning will depend on the business models). The PO, as the private DSO, has to install sub energy-meters (represented in grey on the Figure 3) to separate the port network into two different sub-networks operated by the User1 and User2.

- Sub-network ‘User1’: buildings and vessels chargers.
- Sub-network ‘User2’: EV charging stations.

The consumption of the sub-network ‘User1’ is noted ‘C1’ (for Consumption ‘User1’) and the consumption of the sub-network ‘User2’ is noted ‘C2’ (for Consumption ‘User2’).

We also consider that User0=PO charges User1 and User2 for the access to the private network.

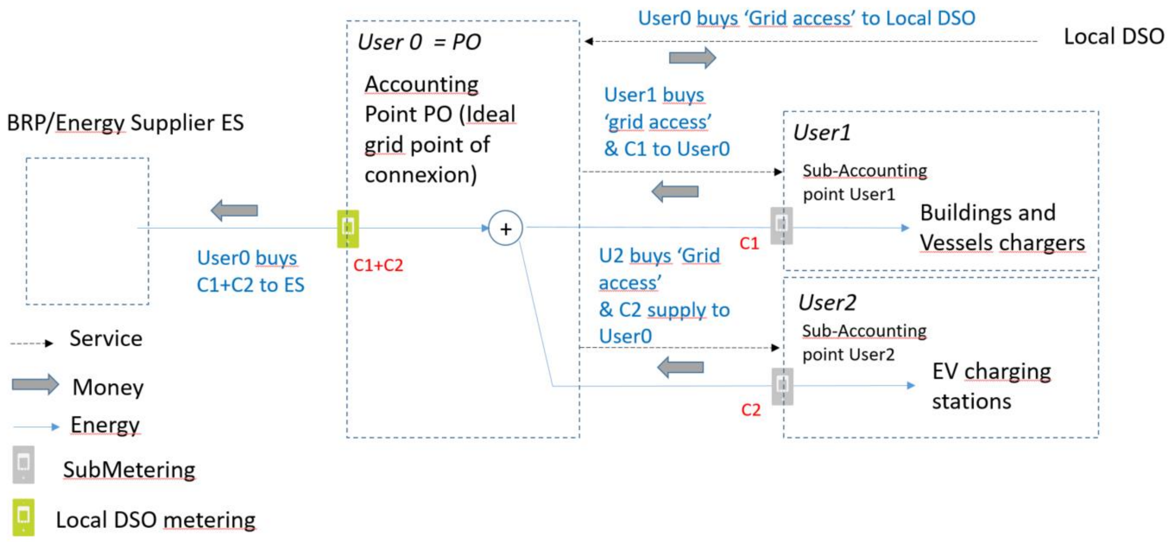

Figure 7: Situation without PV integration

We consider that User0=PO buys the energy C1+C2 to ES.

We consider that the PO "resells the energy" (that he has bought to the Energy Supplier ES) to port users: PO resells C1 to User1 and resells C2 to User2.

Use-case "Norden":

- User0=Frisia
- User1=Frisia. The existing loads are the terminals 'Juist' and 'Norderney' and the e-vessel charging station. The consumption of all these loads is expected to be equal to approximately 1.2GWh.
- User2=Frisia. This EV charging station will be made of 600 charging points @3.6kW for an expected power consumption of 350MWh.

Use-case "Valencia":

- User0=Valenciaport
- User1=Terminal Operators1

User2=NA

5.8.3 BM Examples with PV integration and with/without BESS

5.8.3.1 Hypothesis

In all the following BM, we consider that the User0=Port Operator (PO) is a private DSO (as actual situation).

We consider that PV plant is associated or not with energy storage system (BESS). In the following, the term "PV plant" refers to "PV plant" or to "PV plant with energy storage system" or to "wind turbine".

We consider that 'User3' owns and operates the PV plant and that 'User3' also owns the property on which the solar PV is installed.

We consider that the attribute of the PV solar production (i.e., Renewable Energy Certificates) is not valorised.

We consider that the PV plant only produces energy and, in particular, that it doesn't provide ancillary services to the TSO.

Use-case "Norden":

User3=Frisia. The PV plant will reach 2.5MWp. The installation of an energy storage system and of a wind turbine is also planned by Frisia.

Use-case "Valencia":

In Valencia two major investments have taken place recently. Both will start producing energy into the port grid by the end of 2024.

- Over 2,000 MWh/year (3% year port consumption) in Principe Felipe dock, 6420m² for PV installation
- Over 8,000 MWh/year (11% year port consumption) in Grimaldi terminal, 27700m² for installation of 10773 photovoltaic panels over Grimaldi terminal with two four transformers (2 x 1,250 kVA and 2 x 1,600 kVA)

User3= Valenciaport.

Figure 8 : Valencia port overview with the future PV plant installation area

5.8.3.2 BM1: User3 as an independent PV producer

The 'ideal grid point of connection' is considered as an Accounting Point (AP), as for the actual situation. We consider that the User0=PO is the Party Connected to the grid (PCG).

User0=PO pays for the network connection to the local DSO and User0=PO contracts with an energy supplier ES for the supply of consumption measured at the accounting point PO.

User1 owns and operates the buildings and vessels chargers (as actual situation). The consumption is C1.

User2 owns and operates the EV charging stations (as actual situation). The consumption is C2.

User3 owns and operates the PV plant. The PV production is noted 'P'.

The consumption C1 and C2 are measured with sub energy meters operated by the private DSO (here, User0=PO).

The PV plant stays physically "behind the accounting point of the PO", but the PV plant is "seen", from the local DSO, as a separated Accounting Point (in French en "contrat de décompte"). The considered accounting point is the grid connection of the PV plant. In such a configuration, User3 is a new Party Connected to the Grid. User3 pays for the network connection to the local DSO.

User3 sells 100% of the electricity produced by the PV plant to the Energy Supplier ES.

User3 and the Energy Supplier ES agree on a long-term contract (PPA) for the sale of the electricity produced by the PV plant.

User1= PO and User2 agree with User0=PO:

- User1 buys its consumption C1 (Building and vessels chargers) to User0=PO
- User2 buys its consumption C2 (EV charging station) to User0=PO
- User0 charges User1 for the access to the private network
- User0 charges User2 for the access to the private network

Optional: 3-party contract between ES, User3 and PO about the long-term price of the electricity produced.

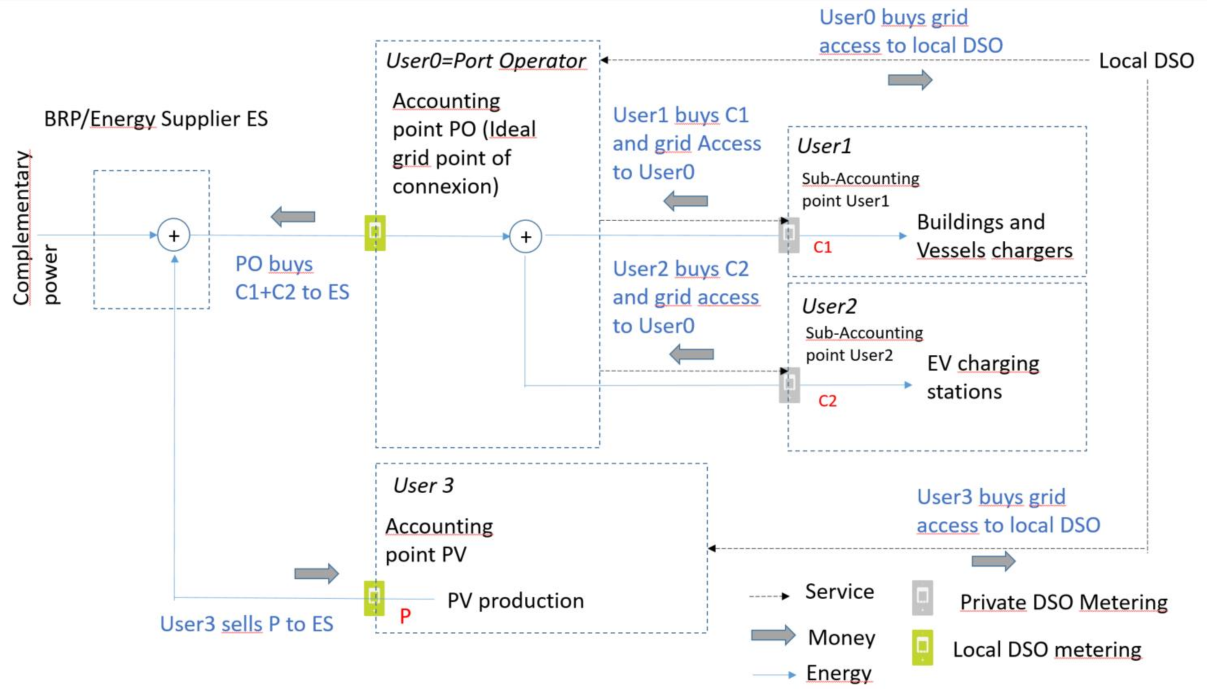

Figure 9: Independent producer

5.8.3.3 BM2: French Individual/ Collective "self-consumer" for the local DSO

Common points to BM1:

- User0="PO" is the private DSO (as actual situation).
- The 'ideal grid point of connection' is considered as an Accounting Point (AP), as for the actual situation. We consider that the User0=PO is the Party Connected to the grid (PCG).

- User1 owns and operates the buildings and vessels chargers (as actual situation). The consumption is C1.
- User2 owns and operates the EV charging stations (as actual situation). The consumption is C2.
- User3 owns and operates the PV plant. The PV production is noted 'P'.

User2 (EV charging stations owner) = User3 (PV plant owner).

Differences with BM1:

- In BM1, the PV plant stay physically "behind the accounting point of the PO", but the PV plant is "seen", from the local DSO, as a separated Accounting Point (in French the PV plant and the charging station are "en contrat de décompte"). In BM2, the considered accounting point combining PV plant and EV charging station, noted 'PVEV', is the grid connection of the PV plant and the EV charging station (i.e. at the transformer of Figure 2). In such a configuration, User2=User3 is a new Party Connected to the Grid.

User2=User3 pays for the network connection to the local DSO.

We consider that User2=User3 contracts with an Energy Supplier ES for the supply and for the purchase of CSCI (see below).

User0=PO pays for the network connection to the local DSO. Note that with the supplementary accounting point PVEV, the accounting point associated to PO corresponds to the sub power network constituted with the vessel chargers and buildings only (i.e. consumption of User1 only).

We consider that the User1 contracts with an Energy Supplier ES1 for the supply of CS1C (see below).

User2=User3 is an individual "self-consumer" for the private DSO:

- The production entity is the PV plant.
- The consumption entity is the EV charging stations.
- User2=User3 contracts with an Energy Supplier ES2 for the supply of CSCI (see below).
- The excess of power production is sold according to a collective self-consumption scheme. More precisely:

The User1 and User2 are in contract for sharing the excess power production of User2. They form a consortium called 'Legal Person' or LP (or 'Personne Morale Organisatrice' PMO in french). The local DSO is responsible for the virtual dispatch (in front of the power meters associated with the Accounting Point PO and PVEV) between ES2, ES1, User1, User2=User3 and the LP.

Let's define:

- EEI=max(P-C2,0) : Excess Energy of User2 in the Individual Self-Consumption Scheme
- EECI=max(EEI-C1,0) : Excess Energy of LP in the Collective/Individual Self-Consumption Scheme
- CS1C=max(C1-EEI,0) : Complementary Supply of User1 in the Collective Self-Consumption Scheme
- CSI=max(C2-P,0) : Complementary Supply of User2 in the Individual Self-Consumption Scheme
- CSCI=CSI-EECI : Complementary Supply (or Excess Energy) of User2 in the Collective/Individual Self-Consumption Scheme

LP is a collective “self-consumer” for the local DSO.

- User2=User3 sells EEI to LP.
- User2=User3 buys EECI to LP.
- User1 buys (EEI-EECI) to LP.
- User1 buys CS1C to his energy supplier ES1.
- User2=User3 sells/buys CSCI to his energy supplier ES2

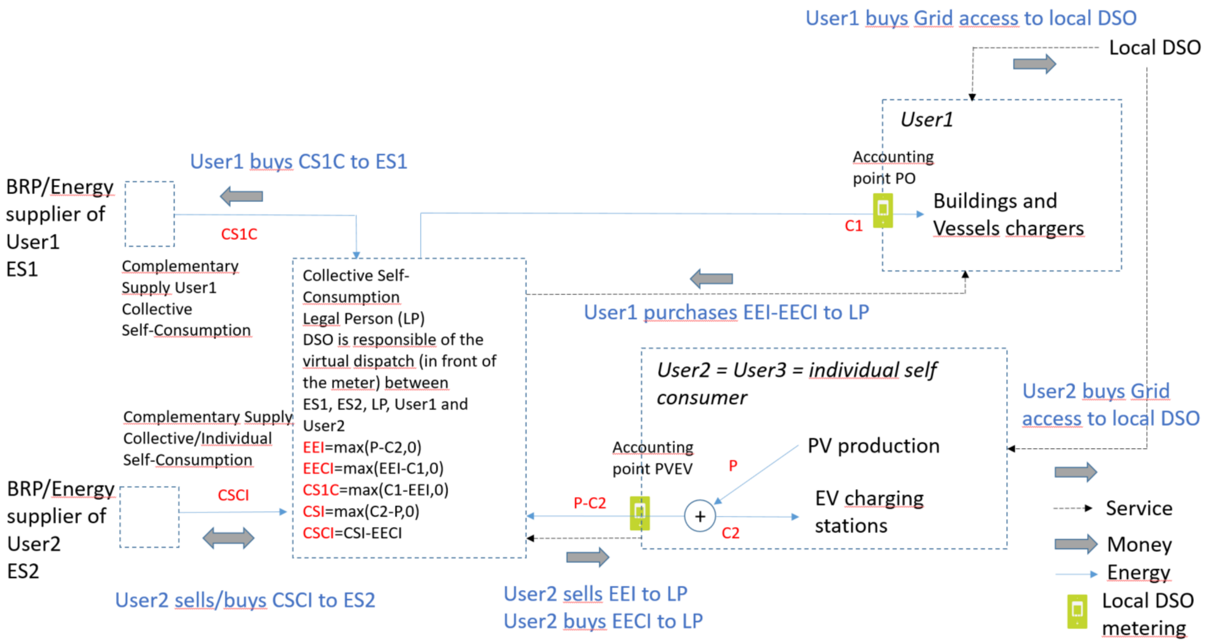

Figure 10: French individual/collective self-consumption

The following table expresses the different values of energy, depending of the relative values of production and consumption (C2 and C1+C2).

Table 5: Dispatch of energy case “French individual/collective self-consumption”

Name	cases		Excess Energy Individual Self-Consumption	Complementary Supply Individual Self-Consumption	Excess Energy Collective/Individual Self-Consumption	Complementary Supply User1 Collective Self-Consumption	Complementary Supply Collective/Individual Self-Consumption
Short Name			EEI	CSI	EECI	CS1C	CSCI
Formulae			max(P-C2,0)	max(C2-P,0)	max(EEI-C1,0)	max(C1-EEI,0)	CSI-EECI
PV supply all loads	P-C2>0	P-(C1+C2)>0	P-C2	0	P-(C2+C1)	0	C1+C2-P
PV partially supplies loads	P-C2>0	P-(C1+C2)<0	P-C2	0	0	C1+C2-P	0
No PV from User2	P-C2<0	P-(C1+C2)<0	0	C2-P	0	C1	C2-P

5.8.3.4 BM3: French collective "self-consumer" for the local DSO

In this case,

- User1 owns and operates the buildings and vessels chargers (as actual situation). The consumption is C1.
- User2 owns and operates the EV charging stations (as actual situation). The consumption is C2.
- User3 owns and operates the PV plant. The PV production is noted 'P'.

The PV plant and the EV charging stations stay physically "behind the accounting point of the PO", but the PV plant and the EV charging station are "seen", from the local DSO, as a two separated Accounting Point (in French the PV plant and the charging station are "en contrat de décompte").

The first new accounting point, noted EV, is the grid connection of the EV charging station. In such a configuration, User2 is a new Party Connected to the Grid. User2 pays for the network connection to the local DSO. We consider that the User2 contracts with an Energy Supplier ES2 for the supply of CS2C (see below).

The second new accounting point, noted PV, is the grid connection of the PV plant. In such a configuration, User3 is a new Party Connected to the Grid. User3 pays for the network connection to the local DSO. We consider that User3 contracts with an energy supplier ES3 for the sales of EECI (see below).

The 'ideal grid point of connection' is considered as an accounting point (AP), as for the actual situation. We consider that the PO is the Party Connected to the grid (PCG). Note that with the supplementary accounting points EV and PV, the accounting point PO corresponds to the sub power network constituted with the vessel chargers and buildings only (i.e. consumption of User1 only).

We consider that the User1 contracts with an energy supplier ES1 for the supply of CS1C (see below).

User1 pays for the network connection to the local DSO.

The User1, User2 and User3 are in contract for sharing the power production. They form a consortium called 'Legal Person' or LP (or 'Personne Morale Organisatrice' PMO in french). The local DSO is responsible for the virtual dispatch (in front of the meter) between the supplier of User1, the supplier of User2, the supplier of User3, User1, User2, User3 and the LP.

For the local DSO, the LP is collective self-consumer with two consumers (building, vessel chargers and EV charging stations) and one producer (PV plant).

Let's define:

- EEI=P: PV Production of User3
- EECI=max(P-(C1+C2),0): Excess Energy of User3 in the Collective Self-Consumption Scheme
- CS1C=A1*max(C1+C2-P,0) with A1=C1/(C1+C2): Complementary Supply of User1 in the Collective Self-Consumption
- CS2C=A2*max(C1+C2-P,0) with A2=C2/(C1+C2): Complementary Supply of User2 in the Collective Self-Consumption

Note that A1 and A2 can be chosen differently. The only constraint is that A1+A2 has to be equal to 1.

User1, User2 and users3 agree in the LP:

- User1=PO buys A1*(EEI-EECI) to LP.
- User1=PO buys CS1C to his energy supplier ES1.
- User2 buys A2*(EEI-EECI) to LP.
- User2 buys CS2C from his energy supplier ES2.
- User3 sells EEI to LP.
- User3 buys EECI to LP.
- User3 sells EECI to his energy supplier ES3

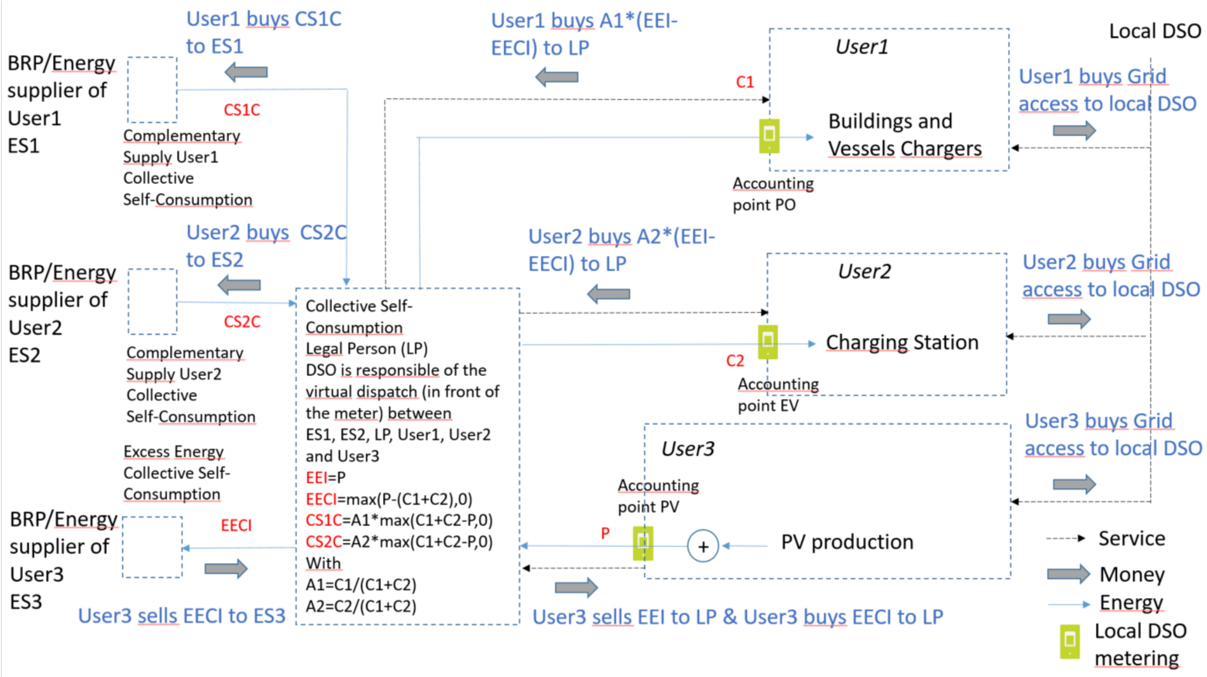

Figure 11: French collective self-consumption

The following table expresses the different values of energy, depending on the relative values of production and consumption (C2 and C1+C2).

Table 6: Dispatch of energy case "French collective self-consumption"

Name		cases	PV energy	Excess Energy Collective Self-Consumption	Complementary Supply User1 Collective Self-Consumption	Complementary Supply User2 Collective Self-Consumption
Short Name			EEI	EECI	CS1C	CS2C
Formulae			P	max(P-(C1+C2),0)	A1*max(C1+C2-P,0)	A2*max(C1+C2-P,0)
PV supply all loads		P-(C1+C2)>0	P	P-(C2+C1)	0	0
PV partially supplies loads		P-(C1+C2)<0	P	0	A1*(C1+C2-P)	A2*(C1+C2-P)

5.8.3.5 BM4: "Users & PO" as an "energy community" for the local DSO

In this case,

- User1 owns and operates the buildings and vessels chargers (as actual situation). The consumption is C1.
- User2 owns and operates the charging stations (as actual situation). The consumption is C2.
- User3 owns and operates the PV plant. The PV production is P.

User1, User2, User3 and private DSO agree to constitute an "Energy Community", noted 'EC'.

The 'ideal grid point of connection' is considered as an accounting point (AP), as for the actual situation. We consider that the EC is the Party Connected to the grid (PCG).

EC pays for the network connection to the local DSO.

EC contracts with an energy supplier ES for the sale/purchase of the consumption/production of the port.

The consumption C1, C2 and the production P are measured with sub energy meters operated by the private DSO (here, the PO). The measurements are transmitted to the EC.

User1, User2 and users3 agree in the EC:

- User1 buys its consumption C1 (buildings and vessels chargers) to EC
- User2 buys its consumption C2 (EV charging station) to EC
- User3 sells its PV production to EC
- EC charges User1 for the access to the private network
- EC charges User2 for the access to the private network
- EC charges User3 for the access to the private network

EC is seen as an "energy community" for the local DSO:

- The production entity is the PV plant,
- The consumption are the buildings, the vessel chargers and the EV charging station,
- EC buys the complementary power to the energy supplier ES when the PV production is lower than C1+C2,
- EC sells the excess energy to the energy supplier ES when the PV production is higher than C1+C2.

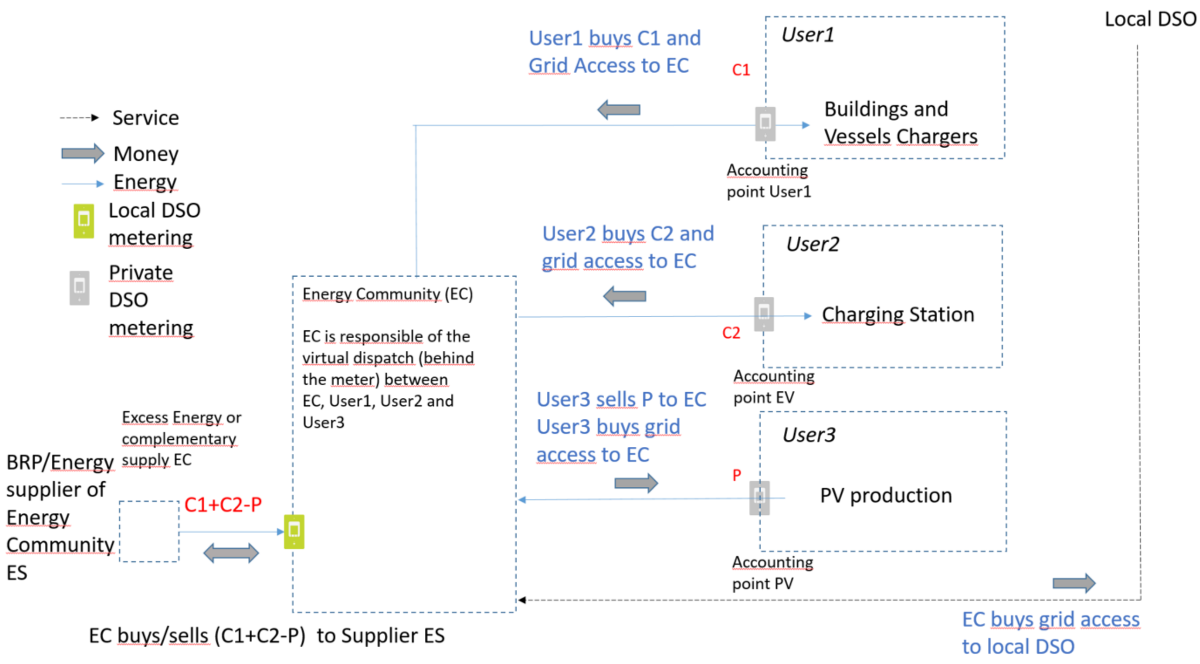

Figure 12: Energy community

Use-case "Norden": This BM should correspond to the future situation at Norden because User1=User2=User3=Frisia

Use-case "Valencia": This BM seems to be suitable to the future situation at Valencia port with: PO=User3=Valenciaport as "Energy community" operating PV and then charges the terminals operators (User1) based on their consumption

5.8.4 Data input listing

Here below are described data inputs needed:

- PV production and forecast, P.
- Power consumption and forecast of Vessels and Buildings, C1.
- Power consumption and forecast of EV charging stations, C2.
- Prices of energy and grid access for the different BM.
- Taxes for energy and grid access.

6. DISSEMINATION, EXPLOITATION AND STANDARDISATION

With this deliverable, the aim has been to study and analyse the framework of the most influential stakeholders for HYPOBATT, both in the development of its technologies and in decision-making, identifying the benefits that will be for the project by having them participate in the developments and results that are achieving in the project. The results of this document will be used as a basis to increase the number of stakeholders, contacting the most relevant groups of entities, inviting them to attend and participate in future events (workshops) and keeping them updated through the website and the newsletters that are generated throughout the life of HYPOBATT.

7. RESULTS AND DISCUSSION

In this deliverable, a detailed and exhaustive analysis of the stakeholder framework has been carried out, and how they will influence the project, identifying both the benefits and the risks of not involving them in HYPOBATT developments. Likewise, it was considered very relevant to analyse the fleets of the Baltic Sea and the North Sea, given that it is the area of Europe in which the largest number of fully electric ships are concentrated, and it would be very beneficial and relevant for the project to involve them. to the stakeholders associated with said fleet.

Likewise, this deliverable will serve as the basis for the future tasks of WP6, in which the business models will be developed in detail.

8. CRITICAL RISKS

There are no potential risks or problems detected in this deliverable that will have an impact on the project progress.

9. CONCLUSIONS

In conclusion, the main aspects of the strategic vision have been defined, as requirements, solutions, current and future operations, and economic risks of stakeholders, and how it can be factored into business models for electrical ships and their port operations and to develop an overarching view on hyper vessel charging business in European and Global shipping industry, have been defined within this deliverable.

The stakeholder analysis has served to identify the most relevant stakeholder groups that could affect the development of HYPOBATT, either positively or negatively, categorizing them by sector and activity. Once identified, a PESTEL analysis has been prepared in order to clarify the priorities of each Stakeholder within the project, identifying their interests, motivations and concerns within it. Likewise, and to avoid internal conflicts between the identified stakeholders, an analysis of alliances was subsequently carried out, to establish the best synergies between the different stakeholders and avoid possible conflicts between them in the future.

Likewise, this deliverable will serve as the basis for the future tasks of WP6, in which the business models will be developed in detail.

10. REFERENCES

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