STEERER

STRUCTURING TOWARDS ZERO EMISSION WATERBORNE TRANSPORT

D3.5 Results of the Third Consultation Phase: Priorities & SWOT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.875285

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Dissemination level	Public
Due date	31/03/2022
Delivery date	13/04/2022
Version	Final Version

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List of abbreviations

CAPEX – Capital Expenditure

cPP ZEWT - Co-Programmed Partnership on Zero-Emission Waterborne Transport

E.E. - Energy Efficiency

EEDI – Energy Efficiency Design Index

EEOI - Energy Efficiency Operational Indicator

EEXI – Energy Efficiency Index for Existing Vessels

ETS – Emission Trading System

EU – European Union

FC - Fuel Cell

GHG – Greenhouse Gas

GSEG – Green Shipping Expert Group

H2 - Hydrogen

HFO – Heavy Fuel Oil

ICE – Internal Combustion Engine

IWT – Inland Waterway Transport

LCA - Life-Cycle Assessment

MGO – Marine Gas Oil

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OPS – Onshore Power Supply

RD&I – Research, Development & Innovation

SRIA – Strategic Research and Innovation Agenda

SWOT – Strengths, Weaknesses, Opportunities & Threats

TRL – Technology Readiness Level

WAPS – Wind-Assisted Propulsion Systems

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1. Introduction

STEERER (Structuring Towards Zero Emission Waterborne Transport) will coordinate the establishment and communication of a Strategic Research and Innovation Agenda[1] and an Implementation Plan **towards zero-emission waterborne transport, in cooperation with all key stakeholders needed to facilitate the transformation to clean waterborne transport**. In the definition of STEERER, as well as cutting greenhouse gas emissions, all harmful environmental emissions, water pollution and noise emissions have to be eliminated. STEERER's mission is to bring the various initiatives and sectors' stakeholders together to join forces for a combined effort with the maximum impact on the climate, people's health and Europe's economy.

STEERER is coordinated by SEA EUROPE, counting with the participation of a total of eight partners from six EU countries.

Figure 1: STEERER's Partners

[1] The STEERER project will provide input to the Waterborne TP regarding the development and update of the Strategic Research and Innovation Agenda of the Candidate Co-Programmed Partnership on Zero-Emission Waterborne Transport in the framework of Horizon Europe (https://ec.europa.eu/info/sites/info/files/research_and_innovation/funding/documents/european_partnership_for_zero-emission_waterborne_transport.pdf).

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In sum, STEERER aims to:

- Jointly set emission targets towards 2050 (including targets for 2025 and 2030);
- Contribute to the update of the Strategic Research and Innovation Agenda of the Co-Programmed Partnership on Zero-Emission Waterborne Transport (cPP ZEWT)[2] in the framework of Horizon Europe, to be able to reach these targets in time;
- Develop an Implementation Plan to reach the targets in due course while staying competitive and offering a valid business case;
- Develop and implement a communication campaign, aimed at broader awareness of the waterborne transport sector and its commitment towards zero-emission transport, to become a fully sustainable mode of transport;
- Monitor and assess the implementation of the Strategy defined and adapting where necessary, after the project's conclusion, by the Green Shipping Expert Group.

The consortium functions as a Secretariat, where the broader expertise is involved in the **Scientific Committee (SC)** and the **Green Shipping Expert Group (GSEG)**[3] to be established by the project.

STEERER is funded by the European Commission research and innovation programme Horizon 2020, with an investment of 1.5 million euros over 36 months, starting in December 2019. STEERER plays an important role in the preparation and execution of the co-programmed Partnership on Zero-Emission Waterborne Transport which is established in the context of the new programme for Research and Innovation: Horizon Europe.

[2] https://www.waterborne.eu/images/documents/201021_SRIA_Zero_Emission_Waterborne_Transport_spread.pdf
[3] https://www.waterborne.eu/projects/coordination-projects/steerer/green-shipping-expert-group/member-list?view=members

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2. Overview of the Current Task

The third phase of the consultation process served to collect insights and expert views to feed the work of the STEERER team on the *areas of intervention and relevant actions to reach zero-emission waterborne transport* and progress on the definition of a vision for the future of the sector and a strategic research agenda to achieve it.

The work on the areas of intervention builds on the results of the previous two research steps carried out in the project: (1) the state-of-play of the waterborne transport sector (Deliverable 2.1), and (2) the definition of the scenarios on the possible futures of the waterborne sector transport with quantified emission targets for 2025, 2030 and 2050 (Deliverable 2.2). The areas of intervention are in line with the Strategic Research and Innovation Agenda (SRIA) of the Co-Programmed Partnership on Zero-Emission Waterborne Transport, which defines six activities (see figure below).

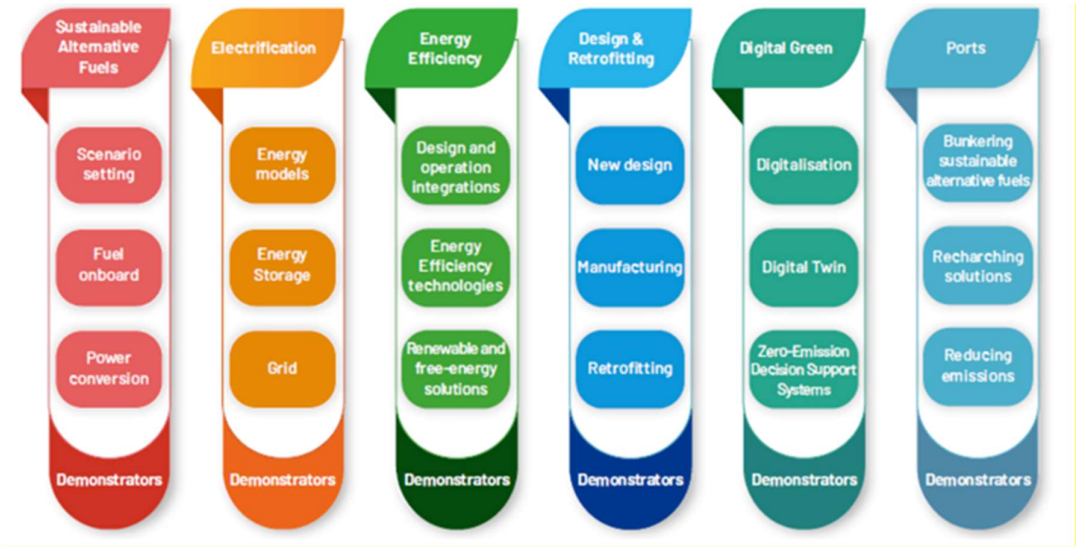

Figure 2: Six areas of intervention[4]

For each of these six intervention areas, the STEERER team has identified a preliminary list of relevant actions to support/fasten the further development of each of the technological solutions defined. In addition, the partners have also outlined a list of general actions covering all areas, which are not always specifically related to only one

[4] ZEWT cPP: SRIA

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technological solution per se. Actions are of different nature: technical, regulatory or business related.

The aim of the third round of consultations was therefore to share with the Green Shipping Expert Group (GSEG) members the state-of-the-art of the analysis carried out by the consortium and adjust and complete the list, whilst setting priorities and identifying strength and weaknesses of the solutions proposed.

In sum, two were the main tasks for the consultation with the GSEG and the Broader Group of Stakeholders:

- 1st task: **Refining the actions on the areas of intervention to achieve zero-emission targets where priorities are set and agreed among the multiple cross-sectoral stakeholders;**
- 2nd task: **Carrying out the SWOT analysis for these actions related to the areas of intervention.**

The tasks are in line with the STEERER consultation process, as originally conceived at the project outset.

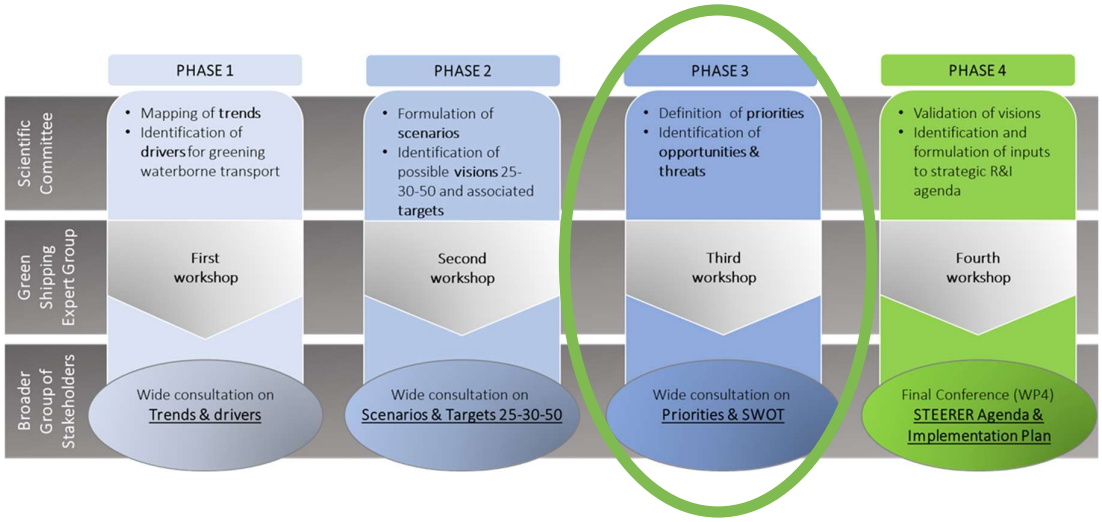

Figure 3. STEERER Consultation process overview.

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3. The Third Phase of the Consultation Process

The third phase of the STEERER consultation process consisted of three well-identified chronological steps:

a. The meeting with the Scientific Committee (SC) – online;
b. Organisation of the third meeting of the GSEG – online;
c. Open consultation (via an online survey, in the form of open questions) with a broader list of stakeholders.

a. The Scientific Committee Meeting

The meeting with the Scientific Committee took place on the 8th of December 2021 and was focused on reviewing the preliminary analysis made by the consortium on the actions related to the intervention areas and the SWOT assessment. The aim was to decide which of the main information should be under the scrutiny of the GSEG.

b. The Third Meeting of the Green Shipping Expert Group

The objective of the third meeting with the Green Shipping Expert Group was to validate the priorities of the actions identified by the STEERER team for the areas of intervention, and also to carry out a SWOT analysis. The meeting was organised on Zoom on January 12th, 2022, and a second part on February the 4th 2022 to continue the discussion on the 'digital green' pillar (see the Agenda - Annex 1).

The majority of the Green Shipping Experts Group members took part in both meetings and actively contributed to the discussion (see the List of participants – Annex 2).

The meeting was structured around plenary and breakout sessions, as described below.

Welcome and Update of the STEERER Project

In the beginning, the GSEG members were updated by SEA Europe on the project's state of the art and intermediate achievements. They were also reminded of the official launch

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of the Co-Programmed Partnership on Zero-Emission Waterborne Transport (ZEWT) in the framework of Horizon Europe, to which STEERER provides support in the update of the Strategic Research and Innovation Agenda during this year. The GSEG members were informed that all the input they provide during this discussion on the areas of intervention will be used for the update and further refinement of the Strategic Research and Innovation Agenda (SRIA), which is planned to be finished in June 2022 and adopted by the Partnership Board.

Presentation of Results from the 2nd Round of Consultation and Introduction to the Next Steps

The members of the GSEG were then informed by ISINNOVA on the outcomes of the second phase of the consultation process on D2.2 Scenarios with quantified targets for 2025, 2030 and 2050 - "Common stakeholder target scenarios":

- All four scenarios identified (Business as Usual, the Independent Green, Stewardship, Local Strength - see deliverable D3.4) were validated and were confirmed as plausible;
- The open comments and considerations collected through the consultation process were used by the STEERER team to enrich and refine the formulation of the scenarios;
- In the total ranking the Independent Green Scenario was chosen as the most plausible scenario;
- The climate-related targets for the waterborne transport sector were discussed and agreed upon in both contexts: (1) the well below 2° C climate target (during the GSEG meeting) and (2) the impact of the Fit for 55 package on the waterborne transport sector (in another off-line consultation with the GSEG).

Presentation of the key actions per area of intervention

The key actions per area of intervention were presented by KBRV, in addition to an explanatory document that was circulated before the event.

The participants were asked to discuss the key actions considering three main dimensions:

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- **Technical**: how can the emissions be further reduced? What is needed to increase the TRL of the related technologies?
- **Regulatory**: How can policy support and facilitate the innovations that are needed? Are the safety measures in place? What existing regulatory measures need to be updated?
- **Business**: Is it economically feasible to invest in technology? What is the return on the investment? Is there enough access to capital for R&D, pilots and deployment?

Discussion on the key actions per area of intervention

After the introductory parts, two parallel sessions were organised, focusing on the following areas of intervention:

- Use of sustainable alternative fuels: focus on methanol, hydrogen and ammonia;
- Electrification (fully electric and hybrid);
- Energy efficiency (EE), including hybrid solutions and wind-assisted propulsion;
- Design and retrofitting: modular design, fuel flexible vessels and retrofit of exhaust cleaning;
- Digital green: digital twin.

A Mural board was set allowing experts to write down contributions for the 5 topics (as above: Sustainable alternative fuels, Electrification, Energy efficiency, Design & retrofit, Digital Green. See Annex 2), in response to two main questions:

- Which key actions are required to bring the solution to a higher readiness level? Indicate whether this is an action that can be completed before 2030 (short term) or not (long term).
- Describe the ideal use case for the solution assuming money wouldn't be an issue and all the right policies would be in place.

SWOT analysis

EICB presented the findings of Task 2.4 on the SWOT analyses carried out as part of the work on the areas of intervention. The GSEG members were asked to validate those findings and to discuss and add additional points. Selected specific actions were further discussed (in line with the key actions per area of intervention):

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- General SWOT;
- Hydrogen;
- Methanol;
- Ammonia;
- Electrification;
- Wind-assisted propulsion;
- Digital Twins.

The Mural setting and the predefined questions prepared by the consortium succeeded in engaging the participants in a lively debate where valuable insights were exchanged and discussed. The relevant contributions resulting from the GSEG meeting are reported in Chapter 4.

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c. Open Consultation with the Broader List of Stakeholders

The open consultation with the broader list of stakeholders was organised in the form of an online survey with a list of open questions reflecting the most important outcomes from the GSEG meeting on the priority actions identified for each area of intervention.

The Open Consultation was organised in the following way:

- The STEERER team extracted the most relevant comments and observations made by the experts at the GSEG meeting, and turned them into a list of 11 short statements (presented below).
- The consultation process was organised through the collection of open comments on the statements via a questionnaire.
- The statements were promoted through the STEERER LinkedIn and Twitter accounts, as well as the social media of the consortium members, in separate posts. See an example below:

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The respondents of the survey were asked to comment on the following 11 statements:

1. Shipowners/operators don't want to share their operational data with technology providers.

   A lack of transparent operational data hampers the uptake of new technologies. Are you willing to share/pay for this data, and at which price?
2. All new vessels should have an electric drivetrain to ensure fuel/technology-flexibility.

   When taking into account new technologies which feed additional energy to the ship such as WAPS, the vessel needs to be designed in a way that this additional energy doesn't affect the optimal engine load.
3. Deviations from the standard vessel design come at extreme additional costs resulting in less efficient ships.

   How can ship building contracts be revised to give new green technologies a chance to be incorporated in more ship designs?
4. WAPS-technologies have the highest chance of success as lease options on the windiest shipping routes.

   Plug and play systems could enhance the uptake of WAPS since a ship operator can then choose to lease a solution when sailing on windier routes - on which routes would you go for this solution?
5. The speed of approval processes hampers the development of demonstrators.

   How can the speed of approval processes be increased to allow demonstrators to develop faster?
6. WAPS should be categorized as auxiliary power instead of energy efficiency.

   WAPS cannot compete with other sustainable fuels as long as they are categorized under energy efficiency.
7. Fit For 55 is a gamechanger and has the potential to achieve the required emission reductions by providing the right incentives.
8. The target for zero direct (tailpipe) CO2 emissions for vessels by 2025 according to the EU Taxonomy legislation is an unrealistic target and will deteriorate the competitiveness of the European waterborne transport sector without helping to achieve the climate targets.

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9. There will be an abundant amount of sustainable sources and feedstock to supply the waterborne transport sector with sufficient sustainable energy/fuels to reach the emission reduction goals.
10. Also combustion engines, using sustainable fuels, will play an important role on the longer term after 2050 and thus are not a transition technology but can be considered as a final solution for larger vessels.
11. With instruments like CEF, Horizon Europe, Interreg, Life, Innovation Fund and EIB instruments, there is enough financial/funding support on EU level to facilitate the waterborne transport sector to make the transition towards zero-emission in 2050.

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4. Results from the Consultation with the GSEG

The main outcomes of the GSEG discussion organised on the third workshop (12 January 2022) are presented below and structured according to the main sub-topics of the discussion.

SUSTAINABLE ALTERNATIVE FUELS

The GSEG members noted that first the technology needs to be developed and then proven that it is safe. In addition, the regulatory framework needs to be amended to allow full deployment beyond the pilot phase. The speed of this entire process causes hesitance to introduce new technologies at large scale.

From the business perspective, regardless of the fuel: there is a discrepancy between the ambitions and available funding. There is currently no business case for these fuels, and everything is based on public subsidies. When the subsidies are over, the work on new fuels will stop. This is also why long-term contracts with fuel suppliers for such fuels are preferred, to ensure financial stability and business cases.

Shipowners also need commitments from their customers regarding the use of the new fuels, to generate and justify these new investments, ensuring financial stability via long term contracts to be able to invest in clean technologies. The investment costs are not the only risk factors to be considered; if the product/service is not competitive, it will be impossible to sell it, or the customers are the ones that will pay the additional price. It is therefore important to find a safer solution financially.

A lot of ships will not be operated in the EU nor owned by the EU stakeholders. It is therefore unclear how resilient and competitive ships sailing on sustainable alternative fuels will be when operating outside the EU, meaning that non-EU countries have lower safety requirements and control measures. This problem also includes the scrapping aspect of ships.

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There is a need for more full-scale pilots for the safety regulations to be put in place. But ship owners are reluctant to do them because the funding is for the initial investment, and they don't receive full funding for the additional operating costs[5]. And until there are no CO_2 taxes in place to level the prices between fossil and sustainable alternative fuels, this will be a problem.

In the case of hydrogen, the operational profile of ships is the most important aspect. Yet this is often not fully known, and it hampers in the selection of the best engines/fuel cells – either for green fuels or electricity. And this affects the business case as well. The same is applicable for dual-fuel combustion engines. Consequently, one may have on paper a green solution, but in practice it will rarely be used.

A lot of ships work with 20-30% engine load very often, and this can be used to the advantage of green solutions. This can also mean that some of the operations should be changed/adjusted.

Some GSEG members expressed the following opinion: *Hydrogen is often seen as the base solution for the use of green fuels, while methanol could be for large ocean-going containers or cruise ships. However, it should be clarified whether the hydrogen storage is liquid, compressed, LOHC, bulk or containerized, etc. This is also related to the ship profiles and bunkering facilities and processes, and required bunkering time. It has been noted that hydrogen generally has an advantage over ammonia. High-speed vessels have an interesting profile and relevant impact on GHG, this can also be used for hydrogen.*

- **ELECTRIFICATION**

GSEG members underlined that regarding the fully electric option, there is a need to standardize the on-shore power supply (OPS) solutions, as there is no international standard on this. Norway has a lot of experience in this case, but more steps are needed. In their case, electrification is mostly based on public-procurement criteria, and also on different contract models for the operators, depending on who is the infrastructure owner on-shore. Some common projects with other Nordic countries have been done on this

[5] Note from the Consortium: the Innovation Fund may cover some part of the additional OPEX.

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topic, and the stakeholders in the area are interested to do more of them. Furthermore, the requirements can differ between different shipowners and ship sectors/types.

It was noted that in case a ship has an electrical engine on fuel cells that reacts like a diesel engine, it will not need a big battery. Fuel cells can be very dynamic and can handle mostly the same power as Diesel engines. The operational profiles are the one to define the optimal solutions between Diesel and fuel cells.

However, it is (for the moment) out of the question to have ships with big batteries operating on rivers on longer distances due to both weight and safety factors[6]

- ENERGY EFFICIENCY

The experts agreed that increasing energy efficiency is a priority for the future of the sector and a better use of energy should be further promoted. Financial mechanisms should be put in place to incentivise the use of EE solutions, and to support innovation to increase the energy efficiency on board and in real operating conditions (not only for loading or speed). Using waste for heating, improving insulation, more efficient accommodation and storage for heating were just some examples the experts provided. The promotion of 'best cases' could then give market confidence. The idea of an ‘efficiency label / index’ for smaller vessels (like for larger vessels) was also suggested[7].

Wind propulsion was widely debated, with an overall agreement on its great potential benefits and on the need to intervene with regulatory actions to provide financial support and incentives for the further development of the technology. With slow steaming, wind can have a bigger contribution to the propulsion & energy needs in general and most class societies already have guidelines for wind assistance technologies. What is needed is to give the industry confidence in wind as a response to CII/EEXI, and this can be done through education, financial incentives and real-world demonstrators.

[6] Note from the Consortium: there is quite a lot of potential to use fully battery drive but on shorter distances and on stable routes for container inland vessels and ferries.

[7] Note from the Consortium: EEXI, EEOI, EEDI already exist, as well as an expected steep increasing fuel price due to ETS.

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- DESIGN AND RETROFIT

The experts underlined that it is important to find how the operational performances can be measured in new ways and include them in shipbuilding requirements.

The main concern of a shipowner is the buying cost (CAPEX), though it would be smarter to invest more in a flexible system. But the question is whether (or how much) the shipowner will get back financially when selling his 2nd hand ship – this information does not exist in the market in the case of new technologies. So far, there is little incentive for shipowners to build more efficient ships from a business point of view; but the pressure is coming from the regulatory part.

At this moment buyers are acquiring flexible ships not for greening as a priority, but for new businesses. However, the sector cannot afford to miss its decarbonization targets, due to increasing pressure from society, thereby missing the business in case not speeding up the process of decarbonization as soon as there will be internalization of external costs (e.g. ETS) or willingness to pay for green transport by customers.

- DIGITAL GREEN

Technologies related to digitalization are already quite advanced and applied in ship operations, route optimisation, but also to regulate and monitor energy consumption, However, digitalization doesn't seem to be a priority at the moment as the concerns about decarbonisation and the shift towards greener technologies are currently the main focus of shipowners.

Interoperability between systems was raised by the experts as a key issue affecting the full exploitation of digital advancements. Indeed, there is a lack of initiatives to define industry standards on data interfacing, which would allow to connect different systems with one another.

Availability and use of data was also considered to be a priority to boost digital green, and the need to collect more data on operational profiles and also from costumers, in the respect of privacy regulations.

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SWOT ANALYSIS

1) GENERAL SWOT

The GSEG members have discussed the main points of the SWOT analyses presented by EICB and have agreed on the ones at general level:

Strengths	Weaknesses
• Strong network, position, knowledge and cooperation in Waterborne TP • Some technologies are full zero-emission tailpipe • Some technologies are already feasible for short term implementation	• Some technologies are not full zero-emission tailpipe • Additional space and weight for energy storage on board • Poor business case & lack of grants • Long lead-times of processes and calls and implementation. This hampers short term impact.
Opportunities	**Threats**
• Societal and legal pressure (e.g. Fit for 55) creating incentives and business case • Green hydrogen imports from other continents (e.g. solar power H2 Africa) • Joint projects and development with other modes and industrial sectors • Co-financing opportunities / blended finance	• Uncertainty and long winding policy development • No adoption for Fit for 55, lack of global climate policy actions • Unrealistic policy targets and expectations on emission reductions to be achieved by Waterborne sector • Access to global competitive finance in Europe (e.g. Taxonomy) • High prices and lack of supply of feedstock for renewable fuels (e.g. green electricity, hydrogen) causing a high costs of transport and reduction of trade and transport demand. • Economic crisis, low transport demand, shrinking market with overcapacity of vessels (e.g. as result of inflation to cause economic downturn, COVID-19 to persist, nature disasters, wars, etc.)

The experts have added some points on the four dimensions:

Strengths

- Willingness of industry partners to take the lead in cooperation.

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Weaknesses

- Lack of agreement on the assessment of Fuel life-cycle assessment (LCA): there is no consensus on the available information for LCA assessments for all sustainable alternative fuels, making it difficult to compare the fuels to each other.
- Lack of clear baselines for non-ETS maritime vessels to base their improvement paths on and assess technological solutions[8].

Opportunities

- There are new jobs and economic advantages for front runners.
- Digital technologies can sharpen business cases and enable the involvement of multiple value chain partners towards zero-emission paths.
- Long term commitment between partners in the value chain or working area.

Threats

- A lack of global acceptance creates competitive disadvantages. This is the case where only some countries adopt the Fit for 55 package or other global climate policy actions.
- Risk of stranded assets - especially with land-based fuel selection/taxonomy.
- Lack of business incentives and support of chain partners in sharing costs and risks.

2. SWOT – SUSTAINABLE ALTERNATIVE FUELS

The SWOT on sustainable alternative fuels was split over the different fuel types.

a. HYDROGEN

Strengths	Weaknesses
• Zero emission (in case of application in Fuel cell) • Link to hydrogen as cargo	• Additional weight and size for fuel on board • Safety concerns • High prices for hardware and fuel and complex to apply in existing combustion engines (only some dual fuel blended options for internal

[8] Note from the Consortium: For inland vessels there is the CCNR Roadmap with detailed assessments made already.

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	combustion engines, where such an application will not reach a full zero-emission performance)
Opportunities • Increasing (fossil) fuel prices • Strong policy promoting hydrogen, EU policy Fit for 55: ETS, EU Fuel Maritime • Production facilities for green hydrogen	**Threats** • Unclear policy developments • Lack of support for climate goals • Low availability of green hydrogen • Accidents with hydrogen in pilot projects

The GSEG members have agreed on the SWOT analyses prepared by EICB in the lead and added some points on the four dimensions:

Strengths

- Hydrogen can be truly zero-emission at the tailpipe.

Weaknesses

- Safety concerns are significant for hydrogen - spilled liquid hydrogen will create enormous gas pressures, tearing apart vessels without safety valves. Prime danger from fuel cell and hydrogen-powered vehicles are the risks of electrical shock and the flammability of the fuel.
- Hydrogen leads to additional weight and size for energy storage on board, which effects on operational profile and business case.
- Hydrogen can be applied in dual fuel for combustion engines, possibly even for retrofit in existing engines. Although this can be cost-effective to bring down emission levels, it will not achieve full zero-emission performance.

Opportunities

- Hydrogen can be manufactured in a diffused network.
- Hydrogen container tanks can be a solution for the future (at least in the IWT sector).

Threats

- The availability and price of green hydrogen are influenced by the competition with the industry.
- Pure green hydrogen production without using the electricity from the grid (for balancing) is not a techno-economic feasible solution.

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b. METHANOL

Strengths	Weaknesses
• Net zero emission in case of fuel cell application and using 100% green methanol • Relatively safe, easy and efficient to bunker • Gravimetric and volumetric density	• Still a carbon content in the molecule (CH3OH) which requires that the carbon comes from sustainable sources when producing the methanol (e.g. CO2 captured from air or from advanced biological feedstock in the first place to close the cycle) • Risk of NOx and formaldehyde emissions at ICE • Need for specific bunker tanks and ICE (no ''drop-in')
Opportunities	Threats
• Increasing (fossil) fuel prices • EU policies: Fit for 55: ETS, EU Fuel Maritime, etc. • Production facilities green methanol from sustainable feedstock and e-methanol from H2	• Unclear policy development • Lack of support for climate goals • Low availability of sustainable feedstock, green hydrogen

The GSEG members have agreed on the SWOT analyses prepared by EICB and added some points on three of the four dimensions:

Strengths

Green Methanol is also net zero GHG emission energy carrier in ICE. The retrofit of existing engines is possible at comparatively low costs (including technical design e.g. tanks, etc.)

Weaknesses

- Emissions from methanol if applied in ICE.
- Methanol has carbon content.
- Methanol can only be zero-emission tailpipe when combined with onboard CO2 storage for Fuel cell and near zero-emission when applying after treatment for ICE[9].

[9] Note from the Consortium: From Well-to-Tank viewpoint, this is not correct, when using green methanol, carbon is already captured from air in the upstream part and therefore after fuel usage the balance is zero (net zero GHG emission).

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Opportunities

- Possible fast uptake on large vessels, meaning first-mover advantage.
- Technical applicability and efficiency based on the operational profile.

c. AMMONIA

Strengths	Weaknesses
• Zero emission if N_2O emission is eliminated • Relatively low loss of storage space compared to HFO and MGO. • Link to Ammonia as cargo	• Strong safety and environmental concerns • Risk of N_2O as emission, dramatic CO_2 equivalent • Difficult to apply as mono-fuel for ICE
Opportunities	**Threats**
• Increasing fuel prices • EU policies: Fit for 55: ETS, EU Fuel Maritime, etc. • Production facilities of green hydrogen/ammonia in other continents	• Unclear policy development • Lack of support for climate goals • Accidents with ammonia in pilot projects • Low availability of green hydrogen/ammonia

The GSEG members have agreed on the SWOT analyses prepared by EICB and added some points on two of the four dimensions:

Weaknesses

- Since there are serious environmental concerns, the ships using ammonia might be classed as carrying toxic cargo and thus this will increase overall costs.
- Ammonia fails with regard to N_2O emissions.

Threats

- Nitrous oxide / laughing gas (N_2O) emissions needs further consideration.

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5. Results from the Open Consultation

The survey was open for four weeks – from the 1st of February until the 1st of March 2022. The main results of the survey are presented below.

	Statements	Main hints taken from the survey participants
1.	***Shipowners/operators don't want to share their operational data with technology providers.*** *A lack of transparent operational data hampers the uptake of new technologies. Are you willing to share/pay for this data, and at which price?*	• Operational data is the backbone of the business and contains sensitive information that can be harmful to the operators if used the wrong way. Provided that at least some of the data should be shared for the uptake of new technologies, a distinction could be made between: (i) what data to be released for free; (ii) what data can be released upon payment and at which price; (iii) what data cannot be released.
2.	***All new vessels should have an electric drivetrain to ensure fuel/technology-flexibility.*** *When taking into account new technologies which feed additional energy to the ship such as WAPS, the vessel needs to be designed in a way that this additional energy doesn't affect the optimal engine load.*	• Integrating different power and energy sources is vital in new ships to future-proof them. However, mandatory electric drivetrains are not seen as the solution. Instead of full electrification, a combination of alternative solutions can be considered. • Different vessels need different solutions. E-drivetrain is costly and whilst sometimes it represents a good investment, in other cases can also create lower efficiencies. Engines can be future proof as well. • Electricity can also be generated by a conventional engine running on fossil fuels/ bio fuels; a dual fuel engine.

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3.	***Deviations from the standard vessel design come at extreme additional costs resulting in less efficient ships.*** *How can ship building contracts be revised to give new green technologies a chance to be incorporated in more ship designs?*	• Ship owner, ship builder and ship designer should start cooperation much earlier in the process thereby agreeing on the share of costs and risks. This would result in less additional costs. • A general policy to support the shipbuilding and the marine technology industry would allow sharing the costs between the authorities the EC and the governments, e.g. through Green (Public) Procurement (GPP).
4.	***WAPS technologies have the highest chance of success as lease options on the windiest shipping routes.*** *Plug and play systems could enhance the uptake of WAPS since a ship operator can then choose to lease a solution when sailing on windier routes - on which routes would you go for this solution?*	• To be successful, WAPS technologies need ships that are built to mount and dismount the WAPS systems quickly and cost-efficiently, and that can use preferably more than one type of WAPS system. This also means taking higher risks on the windiest routes (e.g. storms). • As fuel prices increase WAPS technology can make a greater impact. However, there is the need for real-world demonstrators operating on multiple routes, as pointing to one particular route narrows the options for innovation. • Big data might be able to shade light on the question.
5.	***The speed of approval processes hampers the development of demonstrators.*** *How can the speed of approval processes be*	• Classification societies should approve demonstrators on a provisional basis to fasten innovation and enhance better practices. At the moment, first movers are struggling with

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	increased to allow demonstrators to develop faster?	the approval process and an over-protection attitude to avoid risks. • Possible ways to apply for subsidies should be better promoted, and open up for calls made more frequent. • On top of the speed of approval, the lack of finance for early-stage technology is a key factor that hampers demonstrators.
6.	***WAPS should be categorized as auxiliary power instead of energy efficiency.*** *WAPS cannot compete with other sustainable fuels as long as they are categorized under energy efficiency.*	• There is not a clear position on whether WAPS should be categorized as auxiliary power instead of energy efficiency, but nothing against it either. • The fact that WAPS doesn't reduce the need for energy, but is an energy contributor instead, would support the case to consider it as an auxiliary power and make it a separate category. • On the other side, being considered as energy efficiency, WAPS has higher potential for funding: in the Green Deal allocation, energy efficiency has overall a bigger share than any other category of energy-related measures.
7.	***Fit For 55 is a gamechanger and has the potential to achieve the required emission reductions by providing the right incentives.***	• FF55 has the potential of being a gamechanger as it provides support to the industry, R&I institutes, and universities that deal with research in waterborne transport to fasten technological innovation. This would allow to maintain the competitiveness of the European shipbuilding industry.

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		• FF55 is not enough: to reach the emissions reductions, obligations and sanctions for (not) meeting the emission targets should be considered. • The success of FF55 is however questionable, as the shipowners shall pass the financial burden to the end user. Demonstrators should be supported all over the world
8.	*The target for zero direct (tailpipe) CO2 emissions for vessels by 2025 according to the EU Taxonomy legislation is an unrealistic target and will deteriorate the competitiveness of the European waterborne transport sector without helping to achieve the climate targets.*	• The target for zero direct (tailpipe) CO2 emissions does not consider the full Life Cycle of a fuel, which would allow to choose the lowest GHG emitting ones, without leaving any promising fuel out of the future spectrum. • Placing a zero-emission target reduces the efforts and investments towards energy efficiency measures, which could achieve up to 25-30% reduction by 2030, but can never achieve zero-emission. The 2050 target would result in higher fuel prices, whatever is the fuel, and a continuous search for the "so-called zero GHG fuel". • The target should be better refined considering different ship categories/cases. • Setting the target to 'CO_2 neutral' and not on the tailpipe would avoid the scenario where CO_2 is released elsewhere.
9.	*There will be an abundant amount of sustainable sources and feedstock to supply the waterborne*	• It is doubtful that sustainable sources and feedstock to supply the waterborne transport sector will be abundantly available in the short

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	transport sector with sufficient sustainable energy/fuels to reach the emission reduction goals.	and medium-long future as there is a quest for energy sources in all sectors. • Availability might vary depending on the regions, the types of energy sources, and the timeline. However, it is most probable that by 2030 electricity will be generally scarce, unless shipping is prioritized over other sectors (transport or not) which is very hard to happen. In the longer term, by 2050, there should be enough electricity in all or vast majority of regions, but still not for the new fuels, which would imply a major paradigm shift (e.g. imports are reduced as more production is relocated in Europe or very close to it). • Regulatory systems and policies play a major role. For example, using nuclear energy for the production of green hydrogen is a case that brings radical reduction of CO2, but it is not supported by policies in all countries. • The industry has the responsibility to be prepared.
10.	*Also, combustion engines, using sustainable fuels, will play an important role in the longer term after 2050 and thus are not a transition technology but can be considered as a final solution for larger vessels.*	• The high efficiency of combustion engines remains a key factor for the coming decades as they need to be phased out if we are to achieve zero-emission. However, internal combustion engines as such are not the (main) cause of GHG emissions. Indeed, the

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		real challenge will be the use of sustainable fuels in an ICE, and not only for larger vessels.
11.	*With instruments like CEF, Horizon Europe, Interreg, Life, Innovation Fund and EIB instruments, there is enough financial/funding support on EU level to facilitate the waterborne transport sector to make the transition towards zero-emission in 2050.*	• There are several financial programmes for RD&I addressing different needs of the value chain, which are vital for the sector. • However: ○ EU-funded projects are often too slow. 4-year projects do not allow for fast changes. ○ There is a lack of instruments to support an advanced uptake of sustainable technologies resulting in a faster reduction of GHG emissions. The revenues from ETS for shipping could be used to this aim. ○ Applying for these types of financial support is often too expensive for climate-led SMEs who are generally more innovative than large corporations. Special mechanisms could be considered in favour of SMEs. ○ The projects' selection criteria should focus on the real needs related to the zero-emission. ○ Climate change is a global problem and not just EU-related. Financing the EU market from flagships ETS can create potential market distortions.

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6. Conclusions and Way Forward

The third phase of the consultation was successfully concluded, and a wealth of insights, experts' opinions and suggestions for achieving a zero-emission waterborne transport sector were collected from members of the GSEG and the Broader Group of Stakeholders.

An overall agreement was reached on the key actions and technologies identified by the STEREER consortium for the six intervention areas, and the main enabling factors and threats to the success of their implementation were identified.

A number of priority actions have been proposed to give a boost to the adoption of green fuels and technologies at large scale. While funds for RD&I are ensured by several EU programmes, and policy support should also come via the FF55 package, the further deployment beyond pilot cases should be supported by additional financial mechanisms and the speeding up of the approval process of innovative solutions. Attention should be paid to modular design and innovative business models (e.g. pay-per-use) not only for the newbuild but also for the existing fleet. This would make the necessary investment to uptake sustainable technologies worthwhile and give market confidence. Furthermore, a knowledge sharing platform should be set up to give objective and reliable information to stakeholders about the different technologies and fuels which can be implemented in the path towards zero-emission. This needs to be differentiated by each waterborne transport segment and vessel types and operational profiles.

Along the same lines, for energy efficient measures and wind propulsion, support to innovation and deployment through full-scale demonstrators is key to advance at a faster speed. In particular wind assisted propulsion should be further exploited in the waterborne transport sector. The reason is that this constitutes a technology with high potential to supply power requirements at low cost. However, it is required that the ships have the right equipment to support it. In this respect, the classification of WAPS an energy efficient measure should be possibly reconsidered in favour of the 'auxiliary power' nomenclature.

All green fuel technologies can contribute to reaching the emission targets, and their large-scale adoption is on top of the political agenda. For each technology, advantages and

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disadvantages were discussed with a view to defining a path towards a greener future of the waterborne transport sector, making it environmentally but also financially sustainable. However, for the achievement of the emission targets, legislation is currently lacking to consider the full life-cycle assessment of the fuels. In addition, there is no consensus on the available information for LCA assessments which would allow for a better comparison among the available options selecting the less polluting ones.

Finally, attention should be also paid to digitalisation and specifically digital green solutions, for example using digital twins as instrument for greening.

The amount of knowledge shared and reported in this document has been reflected in the compilation of the dedicated STEERER work entitled 'D2.3: Areas of intervention and priority actions to achieve the targets' where each area of intervention is presented in detail and the related key actions are described across the technical, regulatory and business-related domains. Furthermore, the feedback provided by the GSEG members is reflected in the SWOT overview which will serve as input for Deliverables D2.4 and D2.5. .

This consultation step was conducive to the elaboration of a comprehensive implementation plan for reaching the zero emission targets, which will be the subject of the fourth and final consultation phase. The GSEG experts will be called upon to validate the zero-emission pathway for the future of the waterborne transport sector and identify the key inputs to the strategic R&I agenda to achieve it over the next decades.

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Annex 1. Agenda

3rd Meeting

of the Green Shipping Expert Group (GSEG)

Wednesday, 12 January 2022, 09:30 – 16:30 o'clock

Online

Time	Topic	Speaker
09:30 -09:40	Welcome and update of the STEERER project	Jaap Gebraad (SEA Europe)
09:40-09:50	Presentation of the 2nd stage results and introduction to the next step of the consultation process	Andrea Ricci, ISINNOVA (tbc) Svetlana Ivanova, ISINNOVA
09:50-10:00	Presentation on areas of interventions and SWOT analyses	Hélène Smidt, BRV; Salih Karaarslan, Martin Quispel (EICB)
10:00 -10:15	Questions and Answers	
10:15-10:25	Introduction to the parallel sessions /possible short break	Svetlana Ivanova, ISINNOVA
10:30 – 12.30	Discission Groups on the following topics: Alternative fuels + Electrification + Ports Green Shipping Expert Group will be asked to: review the intervention areas and the priorities, identified and the threats and opportunities they entail for the waterborne transport sector.	Parallel sessions, discussion on a macro level and short poll on micro-level. Subgroups of 5-7 people

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12:30 – 13:30	Lunch break	
13:30-15:00	Discission Groups on the following topics: Energy efficiency + Design & Retrofit + Digital twins. As in the morning, the GSEG will be asked to: review the intervention areas and the priorities, identified and the threats and opportunities they entail for the waterborne transport sector	
15:00 – 15:20	Coffee break.	
15:20- 16:10	Reporting from both sessions of group discussions (morning + afternoon)	
16:10 – 16:20	Closing words	BRV, EICB, WAT

Participants: GSEG members, STEERER Consortium.

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Annex 2. List of Participants to the 3rd Meeting of the GSEG

	Name	Surname	Organisation
1	Gunther	Jaegers	Chemgas Shipping BV
2	Jaap	Gebraad	SEA Europe
3	Jogchum	Bruinsma	Nedstack fuel cell technology
4	Åsa	Burman	Lighthouse
5	Hossein	Ghaemi	Gdańsk University of Technology
6	Lennart	Swoboda	Bernhard Schulte Group
7	Selma	Ergin	Istanbul Technical University
8	Hege	Økland	NCE Maritime CleanTech
9	Salih	Karaarslan	EICB
10	Dirk	Degroote	European Tugowners Association
11	Manfred	Seitz	Secretariat Danube Commission
12	Ketil Olaf	Paulsen	Kongsberg Maritime
13	Blandine	Vicard	Bureau Veritas
14	Benjamin	Friedhoff	DST
15	Diane	Gilpin	Smart Green Shipping
16	Erik	Van der Blom	Royal IHC
17	Sander	den Heijer	Netherlands Maritime Technology

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18	Carlo	Raucci	Lloyd's Register
19	Hans Anton	Tvete	DNV
20	Sebastiaan	Bleuanus	Wartsila
21	Wolfram	Guntermann	Hapag-Lloyd AG
22	Grzegorz	Pawelec	Hydrogen Europe
23	Sandro	Vidas	Cluster of Intermodal Transport
24	Santiago	Suarez de la Fuente	UCL
25	Mihai	Barcanescu	Waterborne TP
26	Silvia	Gaggi	Isinnova
27	Svetlana	Ivanova	Isinnova
28	Hélène	Smidt	KBRV
29	Markus	Eppich	Pro Danube
30	Martin	Quispel	EICB
31	Salih	Karaarslan	EICB
32	Markus	Lehne	BALance Technology Consulting

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Annex 3. The Overview of the Mural Board from the GSEG Discussion in the Breakout Sessions

Can be accessed following this link:

https://app.mural.co/t/isinnova6696/m/isinnova6696/1641392472417/a44d13d3cf1b2095881649ad603c847cb0313d38?sender=sivanova4370

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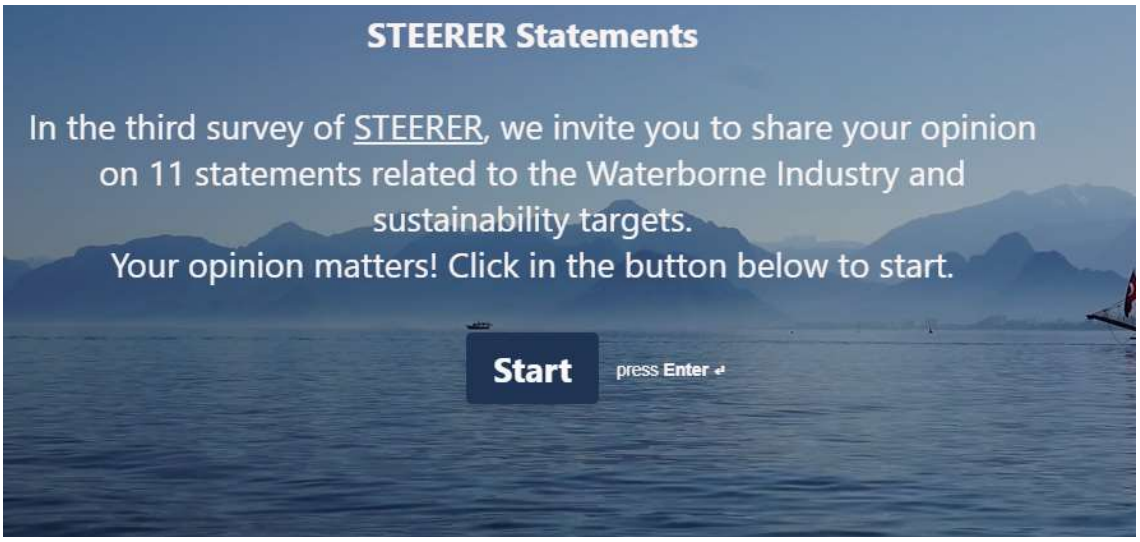
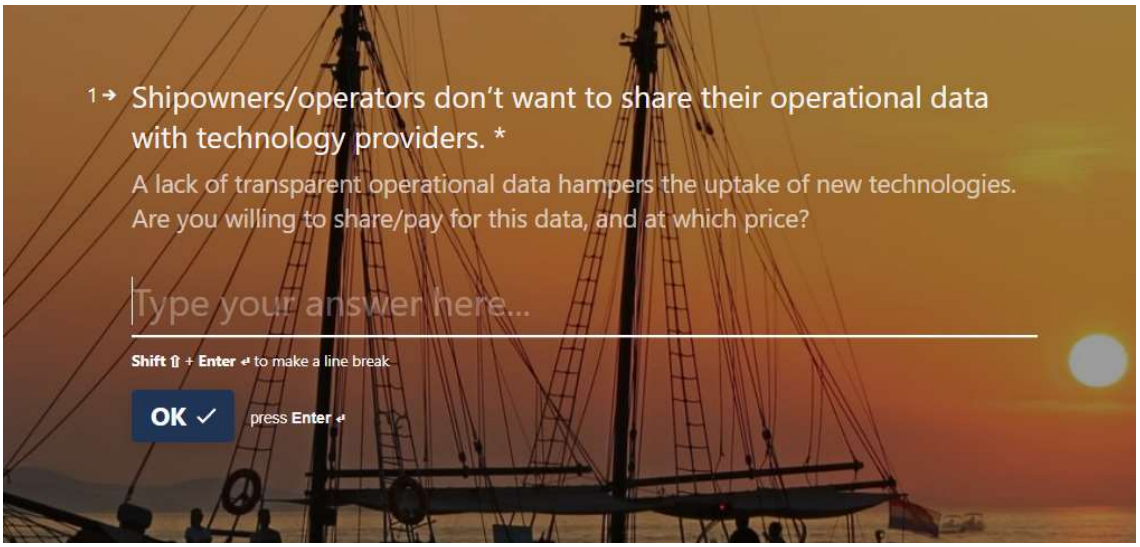
Annex 4. The Survey on the Statements Related to the Waterborne Transport

Preview of the survey layout





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