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LASTING
POWERED BY WATERBORNE

D 1.1. Report on information gaps concerning innovation needs

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This deliverable has collected first-hand information from representatives of the European waterborne transport sector via two main instruments, i.e. a questionnaire as well via bilateral interviews. In this respect, with respect to the data collected, the following clarifications shall be considered:

- The lists of findings are non-exhaustive lists, therefore the input presented might not reflect the entire actual status of the entire European waterborne transport sector.
- There are diverse personal opinions leading to sometimes contradicting findings.
- The conclusions reflect the views of the industry representatives as they have been expressed via the questionnaire & during the bilateral interviews.
- Few content related mistakes have been identified in the answers received, which had to be corrected/eliminated.
- Data clearing for the present report has been processed by the LASTING project team.

As regards the developed EU project database the following clarifications shall be considered:

- The EU project database generated in the framework of the LASTING project has been generated in a complex process of compiling data available from various official and non-official sources. In terms of content there may be unintentional omissions or missing information for some projects that may be framed in the waterborne sector. Inaccuracies in the information may be due to the availability of information from the sources as well as in the processing and treatment of the information. In addition, information not included in the sources at the time of data extraction has been completed where feasible.
- The database includes additional information useful for the project in relation to the maturity of technologies, innovation trends sorted out according to a format understandable by the Waterborne sector. The exercise of filling in this information has been guided by criteria of transparency, availability of the information, analyst's perception of the information, etc. The interpretation of the data by different analysts may differ in whole or in part depending on the pre-established objectives in compiling the database and may not accurately reflect the reality of the waterborne sector as a whole.

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List of acronyms

ALICE – Alliance for Logistics Innovation through Collaboration in Europe

CAPEX – capital expenditures

CCNR - Central Commission for Navigation on the Rhine

CEF – Connecting Europe Facility

CORDIS – Commission database of EU-funded research and innovation projects

EIB – European Investment Bank

EIBIP – European Inland Barging Innovation Platform

ENI - European Neighbourhood Instrument

ERP - Enterprise resource planning

ETA – Estimated time of arrival

EU – European Union

FP7 - Seventh Framework Programme

GDP - Gross domestic product

GHG – Greenhouse gas

H2020 - Horizon 2020 programme

IGA - Information Gap Analysis

IMO – International Maritime Organisation

INTERREG – European Territorial Cooperation instrument / funding

IWT – Inland Waterway Transport

KPI - key performance indicator

KPIs – Key Performance Indicators

LNG - liquid natural gas

NOx - Nitrogen Oxides

NRMM – Non Road Mobile Machinery

OEM – Original equipment manufacturer

OPEX – operational expenditures

RAMSSES – Realisation and Demonstration of Advanced Material Solutions for Sustainable and Efficient Ships

RCMS - Robotic Container Management Systems

RD&I – Research, Development and Innovation

SME – Small Medium Enterprises

SOx – Sulphur Oxides

TEN-T - Trans-European Transport Network

TKM - tonne-kilometre

TRIMIS - Transport Research and Innovation Monitoring and Information System

TRL – Technology readiness level

WP – Work Package

ZEWT cPP – Zero Emission Waterborne Transport co-programmed partnership

Executive summary

This deliverable gives insight in the information gaps concerning innovation needs in the waterborne transport sector. For the purpose of this research, the principal actors are consolidated into four main groups:

- Transport operators;
- Technology suppliers;
- Public bodies;
- Research bodies.

European policy is showing an increasing trend towards more stringent emission goals that are being translated into regulations, targets, and stimulation instruments. The current and future technological challenges and the innovation needs in the waterborne sector are directed from these policy goals and regulations.

The innovation needs in the sector are analysed and a comparison has been made between the current state, explaining the needs and innovations of the last ten years, and the future state of the innovation needs. Given the changed market conditions and policies (e.g. EU Green Deal, Fit For 55, etc.), specific innovation topics such as after-treatment systems have no or a significantly smaller role to play in the future innovation needs than compared to compared to their importance over the last ten years. Reducing GHG emissions and reaching zero-emissions – becoming emission free – are the primary priorities in the future state of innovation needs.

Derived from the questionnaire results, a methodological distinction has been made between four principal groups of actors with regards to the future innovation needs. The outcome of a public/targeted questionnaire-based public consultation indicates that digital green, sustainable fuels, and sustainable ports are key topics of interest and concerns for all stakeholder groups surveyed. Public bodies assign more importance to electrification, assumingly related to electrification innovations at the shore side, like cold ironing and the charging and swapping of modular batteries. Technology suppliers showed less interest in innovations in the field of social aspects. The topic automation of waterborne assets and operations has mainly priority for research bodies and far less for the other actor groups.

The questionnaire results based on 91 responses[1] show that, on average, the innovation needs of the technology suppliers and public bodies are reflected in the EU RD&I programmes (56% and 59,1% of the responses respectively) and to a lesser extent for the research bodies (51,7%). This stands in contrast to the transport operators who, with 56,3% of the responses, state that their research and innovation needs are not sufficiently reflected in the EU RD&I programmes.

[1] Response rates per actor group are as follows: research bodies 31%, technology suppliers 27%, public bodies 24%, transport operators 18%.

The reasons why some of the future research and innovation needs of the waterborne transport stakeholders are not sufficiently reflected in the EU RD&I programmes are mainly related to two aspects:

- the scope of EU RD&I funding programmes does not match the interests or fields of expertise;
- the projects under the funding programmes are financially unattractive.

It must be noted that there is a need to better inform the different actor groups in the waterborne transport sector about the new (HEU) funding for RD&I at European levels, in particular the ZEWT partnership, which addresses their needs better than FP7 and H2020. It is here also that, through their involvement, they can help shape many of the HEU calls for waterborne. The LASTING project is thus essential in helping to bridge this gap and bring together the waterborne transport stakeholders in a more coordinated approach to RD&I activities.

A slight majority of the questionnaire respondents indicates that there is an information gap concerning innovations and technological solutions needed to contribute to political objectives and societal expectations. There seems to be a mismatch between in what the sector needs and is looking for and both the content of EU RD&I programmes and the (amount of) information flowing out of corresponding RD&I projects. The information from these projects either does not, or does to an insufficient degree, successfully reach the waterborne transport stakeholders. Furthermore, project outputs like reports are complex and abstract, and not easy to read and to comprehend for SMEs. A range of suggestions have been raised during the in-depth interviews with experts in the field to tackle this gap. Based on the interviews these are for example:

- Work on easy to read & understand information sources, especially for SMEs, to disseminate EU RD&I project results or inform about project opportunities.
- Information does not reach the right people. New communication campaigns may help in this respect.
- There is information available on technical aspects, but not much on the economics and business models for technical innovations. Also, there is not much information on the uptake of certain innovations following EU RD&I projects. Organisations have a great need for information in the uptake phase, in which innovations are applied (for a longer period) in a real (business) environment.
- Much of the critical information from RD&I projects are not made public, which makes it impossible to follow up on the detailed results of previous projects.
- Try to shorten the relatively long turnaround time needed to go from an idea to an EU project call and project, as the market itself is moving really fast.
- Better link to information from relevant RD&I that may come from other sectors.
- EU RD&I projects' websites should be better structured and provide more information. These websites should also remain online for a longer period of time after the project end.

1. Introduction

1.1. European policy goals

The research and development needs of actors within the waterborne transport sector are strongly influenced by current European policy goals, of which the objective to reduce emissions is the most important ones. The emission limits in waterborne transport are regulated at European as well as international level. For maritime transport, the International Maritime Organisation (IMO) regulations are in place. Complementary, or even more stringent rules, are introduced at European level, which apply to the European territory and sea, including non-EU (based) actors that operate in the EU's waters or territories.[2] Inland Waterway Transportation (IWT) also needs to comply with the Central Commission for Navigation on the Rhine (CCNR) emission standards and more recently the EU Non-Road Mobile Machinery (NRMM) Stage V standards.

In 2018 the IMO adopted an initial strategy for reducing greenhouse gas (GHG) emissions by at least 50% by 2050, compared to 2008 levels. On EU level the European Commission announced in the European Green Deal that GHG emissions caused by EU transport should be cut by 90 % by 2050 for all transport modes including the waterborne transport sector.[3] This can be seen as an integral part of the overall goal of the EU to reach climate neutrality by 2050.

The 'Fit For 55' package is the most recent set of proposals to revise existing legislations and propose new ones as part of the European Green Deal. This package is meant to align a wide range of EU policies with the EU's 55% net emissions reduction target for 2030 (compared to 1990 levels) and net-zero emissions by 2050.[4] The package consists of 13 proposals of which eight concern revisions to existing laws and give are new proposals. The proposals combine, amongst others, the application of the emissions trading system also to other sectors (including Maritime) and a tightening of the existing EU emissions levels, increased use of clean fuels and renewable energy and an alignment of taxation policies with the European Green Deal objectives.[5] The European Parliament and the European Council reached a provisional agreement on the first-ever EU climate law making the goal of reaching 55% reduction by 2030 and climate neutrality by 2050 irreversible and legally-binding.[6]

In the run-up to these policy goals, the waterborne transport sector was already facing increasingly stricter emission requirements, mainly to reduce air pollutant emissions. Examples of these requirements are the caps on sulphur content of fuel oil, the Tier standards (since 1997), SOx Emission Control Areas (1997) and NOx Emission Control Areas for maritime shipping (2005). Moreover, since

[2] https://publications.jrc.ec.europa.eu/repository/handle/JRC123670 (p.3)
[3] https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI(2020)659296
[4] https://eeb.org/eus-fit-for-55-is-unfit-and-unfair-ngos-say/ and https://www.interregeurope.eu/policylearning/news/12610/commission-launches-the-fit-for-55-package/?no_cache=1&cHash=a371af17736f1f2f09030ee45e7dd6f2#:~:text=The%20European%20Commission%20has%20launched,net%2Dzero%20emissions%20by%202050.
[5] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541
[6] https://euobserver.com/climate/151620#:~:text=The%20European%20Parliament%20and%20the,2050%20irreversible%20and%20legally%2Dbinding.

2021 the EU Inland Waterway Transport sector needs to meet new strict emission standards (NRMM Stage V).

Developments in the past decade in EU policy show a clear shift from policy ambitions and goals to strict(er) requirements and legislation. The best-effort approach has increasingly been replaced by result oriented obligations.

In addition to overall EU policy goals, and the EU climate law for the transition towards zero-emission, the need to reduce emissions is further strongly influenced by increasing societal pressure. Due to the rising citizens' involvement in both political and civil actions, more and more people are demanding environment-friendly products and services, demands backed at times by noticeable changes in consumption behaviour and buying patterns of consumers. In addition, the public is putting increased pressure on policymakers at the national and the EU level to restrain producers and service providers who are responsible for environmental damage, and/or to enact laws that force these economic actors to change and adapt their business models.

Next to pressures from consumers, society and regulators, shipping companies are further facing pressure at a business-to-business level, for example from shippers who want to reduce emissions in their supply chains and consequently demand greener waterborne transport.[7] This stems from a mix of societal pressure, legislative changes, and efficiency needs.

Main challenges

Considering the above shifts in regulatory priorities, societal pressures, and business requirements, there is a clear need within the waterborne transport sector for mature green(ing) solutions that reduce emissions from operations further and that present a business case to invest in. However, clarity on available and proven technologies, emission reduction pathways to follow as well as business cases for such solutions are uncertain at present.

A second challenge and need that in addition – and complementary – to greening, but less of a focal area for regulatory and societal pressures, is digitalisation. Increased automation has the potential to enhance safety and enable more cost-effective shipping. Digitalisation will also be a key aspect to allow standardisation and therefore enhance the efficiency of shipping.[8] The key challenge in digitalisation lies not so much in the hardware or software, but in embracing platforms and services by sharing data that facilitate stakeholder cooperation, allowing them to realise efficiencies to the benefit of the overall transport system. Data standardisation, data transparency and transparency across the supply chain have proven to be very difficult to establish.[9,10] On a macro level, therefore, there is a need to overcome these bottlenecks to be able to leverage on the benefits of digitalisation.

[7] https://www.forbes.com/sites/mikescott/2019/06/28/shipping-sector-comes-under-increasing-pressure-to-cut-its-carbon-footprint/?sh=3cd715b71487
[8] https://www.porttechnology.org/news/digitalization-needed-save-maritime-industry-according-imo-mpa/#:~:text=%E2%80%9CIncreased%20automation%20in%20shipping%20has,enable%20more%20cost%2Deffective%20shipping.&text=%E2%80%9CDigitalisation%20and%20new%20technologies%20will,enhancing%20the%20efficiency%20of%20shipping.%E2%80%9D
[9] https://lloydslist.maritimeintelligence.informa.com/LL1136166/Digital-solutions-must-make-the-value-proposition-much-clearer
[10] https://lloydslist.maritimeintelligence.informa.com/LL1136038/Digitalising-shipping-Whats-the-hold-up

Further and final challenges faced by the waterborne transport sector are those of ensuring high safety and security standards while simultaneously trying to stay competitive as a European industry sector, e.g. vis-à-vis the (subsidised) competition from Asia endangering the European shipyards.[11]

1.2. The LASTING Project

Considering the diversity of the waterborne transport sector, its geographical scope, the international dimension, and the challenges described above, LASTING (Let's go for Waterborne Transport Research – Broadening engagement and increasing impact) will broaden engagement of the broader waterborne transport sector in European Research, Development & Innovation (RD&I) activities to render the sector more robust and decisive in meeting these challenges. This goal will be achieved by developing a communication strategy and implementing a long-lasting communication campaign beyond the lifetime of this project. This will ultimately drive stakeholder engagement in the sector and thereby increase the impact of the European waterborne transport RD&I efforts.[12]

The envisaged communication strategy, and thereby the campaign, will be based on clear key performance indicators[13] (KPIs) set at the start of LASTING, jointly developed with the relevant European Commission Services and the broader waterborne transport sector. The achievement of the KPIs will be measured at fixed intervals, to ensure that the (final) communication strategy and the campaign will be fit-for-purpose and ready for roll-out. An essential element of the communication strategy will be the development of a plug-and-play system for participation in European, national, or regional strategic maritime and/or inland waterway transport events. In the framework of LASTING, the plug-and-play system will be tested at several occasions, to ensure the system is fit-for-purpose.

In addition, high quality dissemination materials (such as flyers and banners) and other communication templates (e.g. PowerPoint) will be delivered. A key focus area will be the use of digital tools for dissemination purposes, to ensure that the communication efforts of the waterborne transport community will easily follow the concept launched in the framework of LASTING. Finally, yet important, the Waterborne Technology Platform will take over the communication strategy and campaign after the lifetime of LASTING and will ensure a durable implementation of the concepts and materials developed in the framework of the project.

LASTING is coordinated by SEA Europe and is supported by a consortium that consists of seven partners from four EU countries. Following an amendment, the Waterborne Technology Platform also became a partner.

[11] https://www.swzmaritime.nl/news/2020/02/13/do-we-need-a-european-trump-to-protect-the-shipbuilding-industry/

[12] The challenge has been described in call MG-4-10-2020: Improving impact and broadening stakeholder engagement in support of transport research and innovation

[13] A key performance indicator is a quantifiable measure of performance over time for a specific pre-defined objective. KPIs are used to measure progress, performance and to help make decisions.

Figure 1: LASTING's partners

LASTING is funded by the European Commission research and innovation programme Horizon 2020, with an investment of 1,3 million Euros, spanning the course of 36 months, starting in January 2021.

1.3. The deliverable

The waterborne transport sector is very diverse with a large geographical scope. Given the international dimension, its diversity and the challenges and opportunities ahead, LASTING will enhance the engagement of the broader waterborne transport sector in European RD&I activities.

First, this deliverable will be instrumental in establishing a joint understanding of the current and future state of play in field of waterborne transport related research, identify the main innovation topics and needs it faces in order to subsequently assess potential **information gaps** regarding the innovation needs of the sector. A shared framework which outlines the interests and perceptions of stakeholders will be established for this purpose. The deliverable is the first of a series of three covering the following focus areas:

- Innovation needs and information gaps;
- Awareness of outcomes;
- Opportunities for participation in research activities.

The assessment will be based upon the Information Gap Analysis (IGA) method consisting of the following steps:

1. assessment of current state;
2. identifying potential state;
3. identifying areas of improvement by comparing the actual and desired state. **Fout! Verwijzingsbron niet gevonden.**

Table 1 below provides a template summarizing the corresponding IGA approach.

Table 1: GAP analysis template

Information Gap Analysis template				
Focus area	Current State	Desired Future State	Identified Gap	Action Plan
What are you focusing on?	Where are we now?	Where would we like to be?	*Difference between desired & current state*	*Actions one can undertake to bridge the gap*
Innovation needs within the waterborne transport research community				
Awareness of outcomes of research projects and activities				
Opportunities for participation				

This deliverable, "*D1.1 Report on information gaps concerning innovation needs,"*, analyses key information gaps concerning both the communication and awareness of innovation needs and the technology challenges for RD&I in waterborne transport. As such, the report encompasses the above-outlined first focus area of **information gaps** concerning **innovation needs**.

Initially, desk research will provide the basis for the deliverable. Following this, there are three building blocks on the basis of which D1.1 (and the other deliverables of WP1) will be developed. The three building blocks are:

1. Internal WP-workshop;
2. Online questionnaire;
3. Interviews with experts/stakeholders;

With these building blocks, interactions will be initiated with the wider waterborne transport sector, amongst others with ship owners and operators, ports, ship builders, equipment manufacturers, academia, research bodies, public bodies, etc.

The internal workshop was attended by all partners from the project consortium and built on the kick-off meeting[14] in which the scope of the work package had been outlined at a general level. The internal workshop was utilised to further detail the scope and focus of Work Package 1 'Information GAP analysis and recommendations'. The scope and focus of WP1.1 are further defined in the next chapters.

The questionnaire was developed to obtain relevant input for all WP1.1-1.3 tasks. After coordination with the EU services, the questionnaire was distributed as widely as possible to both pre-selected relevant stakeholders from the wider waterborne transport sector and through social media. Subsequently, interviews were conducted (expert interviewees selected based on stakeholder assessment) to acquire more in-depth insights about topics listed in the questionnaire as well as to have some initial preliminary validations regarding the results of the questionnaire. The strategic session with key stakeholders is scheduled for Q4 2021 to validate the findings from D1.1-1.3 once the set of WP1 deliverables are approved according to the quality review procedure. These deliverables will further be consolidated into a practical handbook (D1.4) that also contains the recommendations and proposal for future monitoring of the innovation needs, opportunities for participation in, and awareness of research outcomes.

Chapter 2 provides an overview of the waterborne transport sector and its main actors that are relevant for this analysis. Chapter 3 details the innovation needs and technological challenges in the waterborne transport sector from the perspective of the main groups of actors in the sector. Following the IGA structure, the status-quo with regards to innovation and technological challenges constitutes the first point of focus before the report then turns to the desired state as its second focal area – assessing the latter based on a comprehensive desk research, the questionnaire results and conducted interviews. Resulting from this analysis, chapter 4 details the information gaps regarding the innovation needs of the waterborne sector. Chapter 5 provides the conclusion followed by the bibliography and annexes.

[14] The kick-off meeting took place on 20th of February 2021 and was attended by the project partners, CINEA and DG RTD.

2. The waterborne transport sector

The waterborne transport sector is an essential sector as it moves nearly 90% of all international trade[15], almost 81% of external EU trade[16] and almost 34% of internal EU trade.[17] In addition, waterborne transport is also an essential means of passenger transport. Each year, more than 400 million passengers embark and disembark at EU ports.[18]

EU-based maritime shipping companies control around 36% of the global fleet.[19] The European maritime technology sector is a global leader in high-technology shipbuilding (for example maritime and inland cruise ships, electric ships, offshore support) and green shipping technologies (e.g. clean engines and alternative technologies). EU companies supply almost half of global maritime equipment and have developed and designed the majority of the world's fleets' power systems.

Approximately 4 billion tons and 415 million passengers pass through EU ports each year. Ports are not only essential for the import and export of goods, but they also constitute energy hubs, bringing together infrastructure managers, shipping companies and energy suppliers who contribute to the uptake of electricity and clean fuels. Ports also link maritime transport with the hinterland through the different (in)land transport modes, including inland waterways. Ports generate employment: 1.5 million workers are employed in European ports, with the same amount employed indirectly across the 22 EU maritime Member States.[20]

The maritime transport sector directly employs over 685,000 workers at sea and on shore[21]. It supports 2 million workers through indirect and induced employment. The EU maritime shipping industry contributes a total of €149 billion to the EU's annual GDP[22].

In addition to maritime shipping, Europe has over 12,000 inland vessels[23] and 40,000 km of navigable inland waterways, connecting hundreds of cities and industrial regions in Europe, 250 inland ports and more than 300 Trans-European Transport Network (TEN-T) seaports. For Europe, inland waterway transport[24] is an important sustainable mode of transport for the carriage of goods and passengers, with the major share of inland waterways' freight passing through Europe's maritime ports. In 2019, the total transport performance of IWT amounted to around 144 billion tonne-kilometre[25] (TKM) of which around 74% crossed a border in one way or another (import, export or transit traffic).

[15] Review of Maritime Transport 2020 | UNCTAD
[16] International trade in goods by mode of transport - Statistics Explained (europa.eu)
[17] Freight transport statistics - modal split - Statistics Explained (europa.eu)
[18] https://ec.europa.eu/transport/modes/maritime_en
[19] https://ec.europa.eu/epsc/sites/epsc/files/epsc_clean-transport-at-sea.pdf COM(2013) 918 final 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - a Clean Air Programme for Europe.'
[20] https://ec.europa.eu/transport/modes/maritime/ports/ports_en
[21] Oxford Economics, The Economic Value of the EU Shipping Industry (London, Oxford Economics, 2020)
[22] Oxford Economics, The Economic Value of the EU shipping industry, (London, Oxford Economics, 2020)
[23] https://www.prominent-iwt.eu/wp-content/uploads/2015/06/2015_09_23_PROMINENT_D1.1-List-of-operational-profiles-and-fleet-families-V2.pdf
[24] https://ec.europa.eu/transport/modes/inland_en
[25] A tonne-kilometre is a unit of measure of freight transport which represents the transport of one tonne of goods by a given transport mode (road, rail, air, sea, inland waterways, etc.) over a distance of one kilometre.

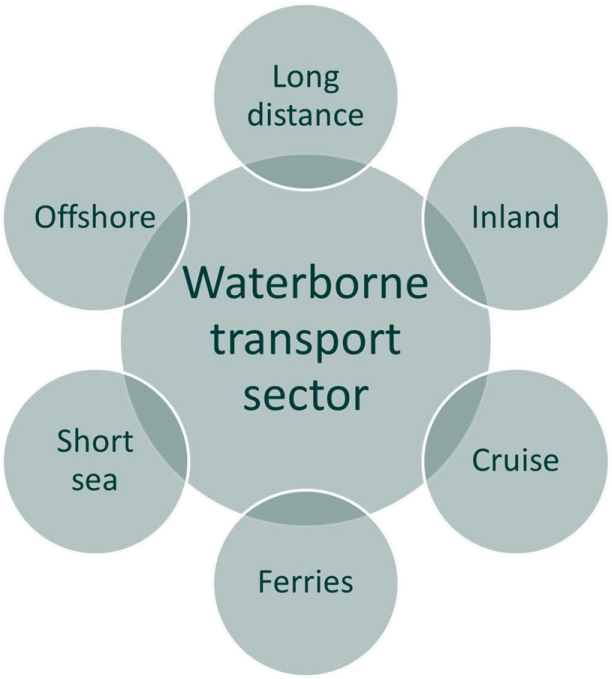
Inland waterway transport is particularly relevant for certain corridors. Current market characteristics show that for cross-border traffic within the Rhine-Alpine corridor, inland waterways have a share of 54%. For the North-Sea Mediterranean corridor, IWT traffic amounts to 35%, 38% for the North-Sea-Baltic corridor and 14% for the Rhine-Danube corridor.[26]

2.1. Waterborne transport segments

There are various types of vessels and operational areas that can be distinguished for transport services of both passengers and goods and for vessels for other services (e.g. surveying, surveillance infrastructure works, off shore support). The waterborne transport sector can be divided into six segments, following the approach of the Co-Programmed Partnership on Zero-Emission Waterborne Transport, a Partnership in the framework of Horizon Europe.

Figure 2 below provides a visualisation of this categorization approach.

Figure 2: Segments of waterborne transport sector



Long distance shipping comprises large ocean-going ships, e.g. carrying containers over long distances (intercontinental). Vessels in the **short-sea segment** are typically smaller, carrying goods on shorter distances. The **Inland Waterway Transport sector** is quite diverse and consists of passenger and freight inland vessels, pushers and floating equipment carrying goods and/or passengers, or involved in infrastructure works, on inland waterways. **Cruise ships** are large passenger ships carrying passengers on the seas. **Ferries** operate between fixed points and create a connection across the sea

26

for both pedestrians and vehicles. **Offshore vessels** describe a broad category of vessels that facilitate offshore installations, operations and maintenance, such as installation vessels, dredgers and cable-laying vessels.

2.2. Main actor groups in waterborne transport research

The group of actors active in waterborne transport research is quite diverse, consisting of among others, vessel owners/operators, shipbuilders, equipment manufacturers, ports, infrastructure managers, research bodies, etc.

For the purpose of this research, the main actors can be consolidated into four main groups:

- **Transport** operators;
- **Technology** suppliers;
- **Public** bodies;
- **Research** bodies.

A distinction can be made between the private/commercial and (semi)public/non-profit sectors. The private/commercial group can be broken up into the transport operators and the technology suppliers. The transport operators stand for actors such as the vessel owners, vessel operators and charterers. The technology suppliers consist of actors such as the equipment manufacturers and shipyards. The (semi)public/non-profit group can be broken up into public bodies and research bodies. Public bodies consist of actors such as port authorities and infrastructure managers whereas the research bodies consist of actors such as universities and research centres.

Chapter 3 provides insights into the current state of the innovation needs and the future needs from the perspective of each of these four main actor groups.

3. Innovation needs

Chapters 1 and 2 summarized the main European policy goals which are relevant to the waterborne transport sector, as well as defined the sector's subsegments. European policy is showing an increasing trend towards more stringent emission goals which are being translated into regulations. The current technological challenges in the sector and the innovation needs in this respect result from these policy goals as well as regulations.

Chapter 2 provided an overview of the waterborne transport sector, its importance on both a European and international level, and of the different segments of the sector in terms of categorization by type of vessels and function. Furthermore, the chapter outlined the four principal groups of actors in the sector that are most pertinent to the purpose of this report and to assessing the information gaps and innovation needs.

Building on the preceding two chapters, the section at hand provides insights into the innovation needs of the sector as it currently stands (current state), explaining the needs and innovations over the last ten years. This exercise is done by means of a comprehensive analysis of 565 innovation projects in the maritime transport sector conducted in the Seventh Framework Programme (FP7), Horizon 2020 programme (H2020), INTERREG + European Neighbourhood Instrument (ENI) + MED and Connecting Europe Facility (CEF) programmes. Annex III provides details of the analysed innovation projects.

Following the establishment and analysis of the current state, the future innovation needs and the conditions to meet these needs are analysed by means of a questionnaire, which has been widely distributed throughout Europe, and the results from in-depth interviews that were conducted subsequently. The results have been clustered according to the perspective of the four principals groups of actors in waterborne transport research. With regards to the questionnaire, Annex IV provides general insights into the responses, e.g. the type of organisations that provided their input and their geographical origin, the waterborne transport segment of interest, and the innovation topics of interest as well the motivations underlying the choice of interest.

3.1. Current state of innovation needs

A total of 565 EU funded maritime oriented projects were analysed, 103 of which concern FP7 projects, 273 H2020 projects, 144 INTERREG + ENI + MED projects and 45 CEF projects. The projects cover the research and innovation efforts of the past decade, reflecting the current state.

Table 2 provides an overview of the top 25 topics of innovation that the analysed projects focused on, providing an informative overview of the innovation needs in the sector.

Table 2: top 25 innovation topic of projects

Innovation topic	projects per topic
shipping - design and manufacturing of maritime assets - materials	29
shipping - design & retrofitting - retrofitting - modular design and green tech	24
hinterland transport	24
shipping - automation of maritime assets and operations - product applications and business models (automatic processes onboard, business models, route optimisation, collision avoidance, etc.)	22
shipping -resilience of waterborne assets and operations - operational practices	22
social aspects - job requirements and human factor	22
shipping - energy efficiency - energy efficiency technologies	21
blue growth[27] - seas and oceans for CO2 neutrality - ocean energy	21
ports - port operations optimisation	19
blue growth - monitoring and digitalization of seas and oceans - digital ocean	18
shipping -resilience of waterborne assets and operations - emergency response measures	17
ports - bunkering sustainable alternative fuels	16
ports - reducing emissions - monitoring systems	16
shipping - digital green - digitalization - monitoring and big data collection	15
shipping - use of sustainable alternative fuels - power conversion - including internal combustion engines and fuel cells	15
shipping - automation of maritime assets and operations - pre-requisites for automation (security, connectivity, sensorisation)	15
shipping - use of sustainable alternative fuels - fuel scenario - upstream chain of sustainable alternative fuels	14
shipping - digitalization - zero emission - decision support systems	14
blue growth - sustainable use and management of marine resources - maritime spatial planning and maritime surveillance	14
blue growth - monitoring and digitalization of seas and oceans - intelligent sensing everywhere and tools for digital transition	14
blue growth - monitoring and digitalization of seas and oceans - marine robotics	14
shipping - energy efficiency - renewable and free energy solutions	11
shipping - design & retrofitting - new design	10
shipping - design & retrofitting - manufacturing - modular shipbuilding	10
ports - waste management	10
ports - digitalization - port logistics processes and data	10
regulatory issues - other	10

Most of the innovation projects of the last decade specifically focus on the shipping industry. This certainly applies to projects in the FP7 and the H2020 programmes and to a lesser extent to the CEF and Interreg programmes.[28]

[27] Blue Growth is the EU's long-term strategy to support sustainable growth in the marine and maritime sectors as a whole.
[28] For more information, please see chapter 4 of Lasting deliverable 1.2.

Under the shipping umbrella, the topics design, manufacturing and retrofitting feature at the top. Projects within this category focus on innovations designed to reduce the emission of GHG of both existing and new vessels through, for example:

- innovative coatings
- after-treatment systems
- new ship designs
- improved propulsors
- energy systems
- innovative manufacturing methods

In addition to design, manufacturing and retrofitting, innovations focussing on social aspects, ports, hinterland transport and blue growth also play a substantial role.

Projects focusing on social dimensions cover the following aspects:

- raising awareness regarding training opportunities in the waterborne sector
- creation of new jobs in light of circular energy models
- design an interactive team-training software platform
- establishing a centre of excellence in the field of Marine Electrical Engineering
- enhance cross-fertilization and synergies between research in the different transport modes

Projects focussing on innovations in the port area cover a quite diverse set of topics, examples are:

- upgrade of transport links between ports
- assessing Robotic Container Management Systems (RCMS)
- designing, demonstrating, and evaluating integrated sets of sustainable mobility measures in port cities
- developing berthing aid and drift monitoring systems
- facilitating the update of Onshore Power Supply in port areas

Projects oriented towards hinterland transport have also an important place in the top 25 and cover aspects such as:

- developing and expanding inland navigation for the industry
- enhancing the transport planning competences
- developing systems to provide a secure and privacy-aware framework allowing confidential, distributed and edge enabled security services
- developing intelligent transport system applicable to multiple transport modes

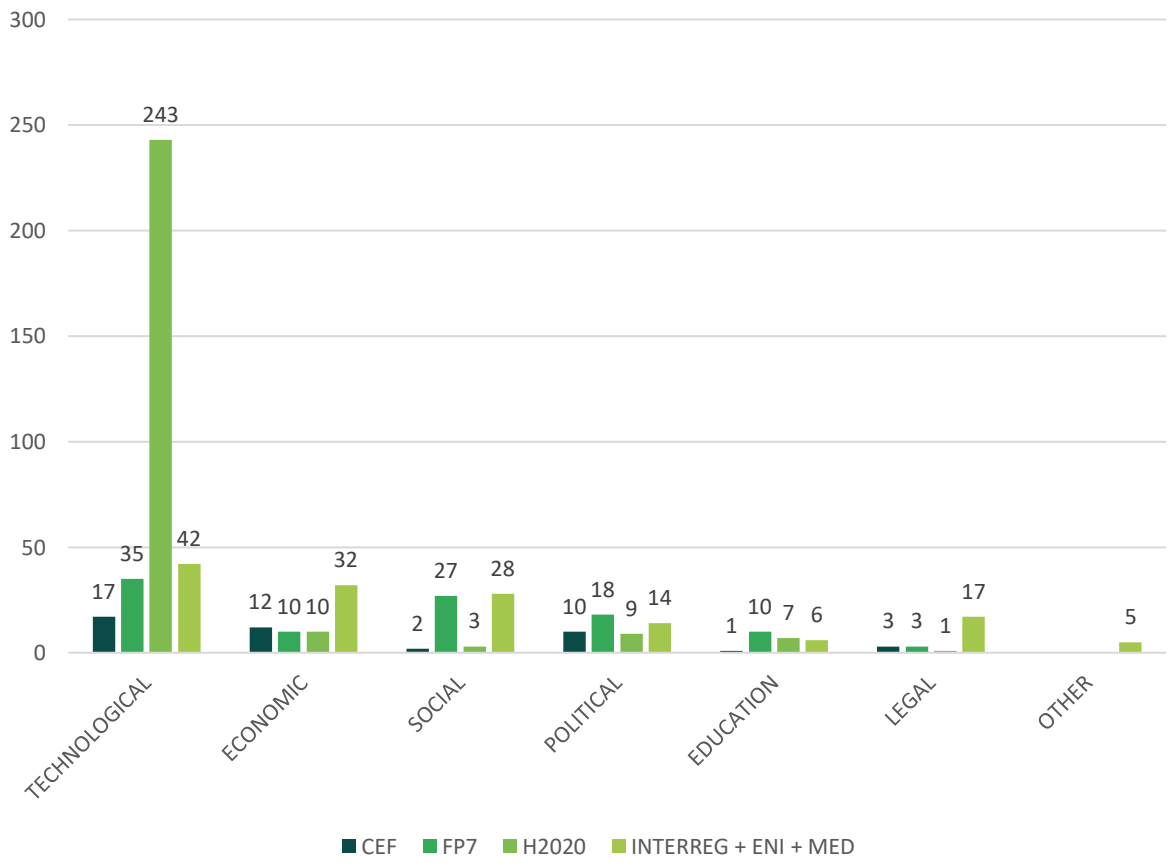
Lastly, there are a lot of finished and ongoing projects in the field of blue growth. Some examples of topics covered in these projects are:

- realization of coastal blue energy system
- increase navigation safety

- hydrographic surveying of the Baltic Sea
- establish a pioneer pilot infrastructure capable of demonstrating key enabling robotic technologies for inspection and maintenance of offshore wind farms
- developing a passive bistatic radar based on Galileo transmissions for maritime surveillance

The motivation for the given innovation topics can be of technological, economic, social, political, legal, education or other nature. Following the analysis (cf. figure 3 below), technological motivation is by far the most important driver for all programmes, especially for H2020 projects, followed by economic and then social drivers. The outsized share of technological motivations compared to other motivations is likely explained by the fact that project participants within a H2020 programme are primarily focused on achieving a technological breakthrough and/or gaining a technological competitive advantage.

Figure 3: Motivation for the focus in the innovation need



3.2. Future state of innovation needs

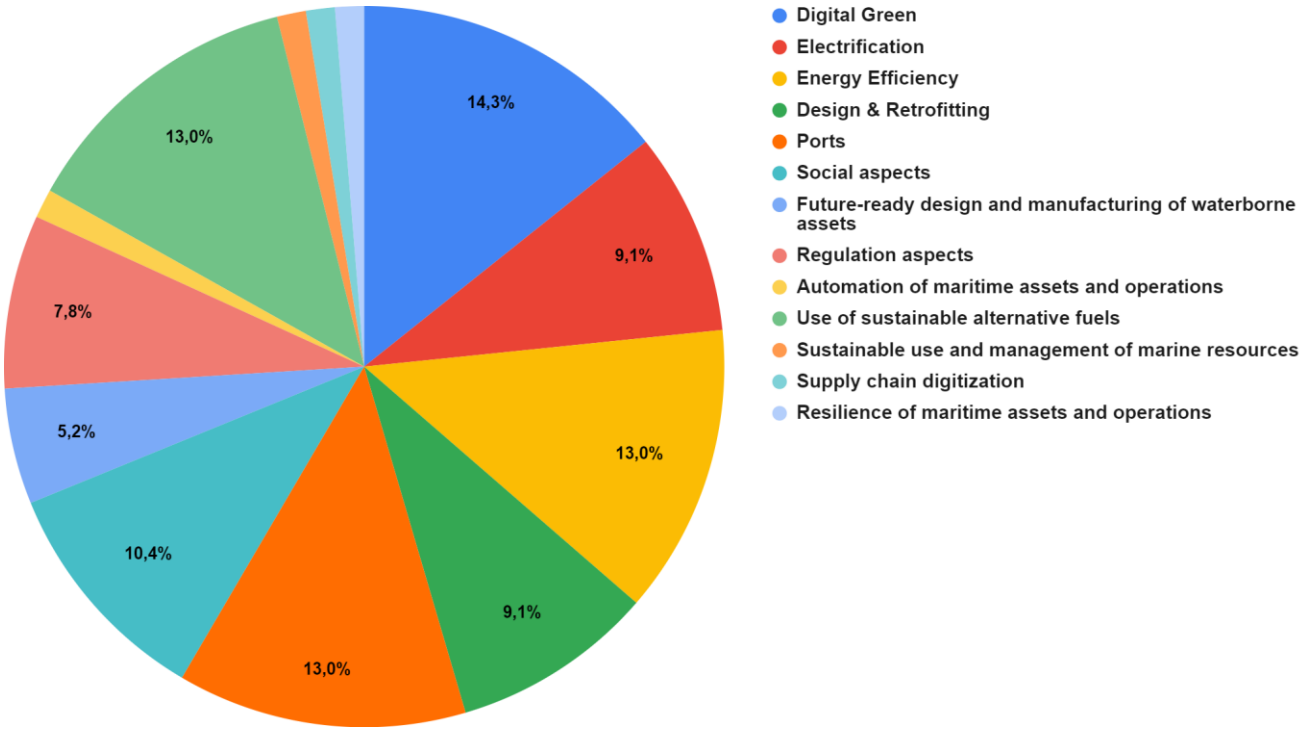
Given the current state of affairs based on the 565 innovation projects analysed, a second analysis is undertaken concerning the future state of innovation needs and the corresponding conditions. By subsequently contrasting these two analyses and comparing the two states, the gap between the current and future state of innovation needs can then be established and clarified. The analysis of the future state of innovation needs is conducted based on questionnaire results and in-depth interviews with experts form the waterborne transport community, based on the perspective of the four groups of actors identified in chapter 2.2. The questionnaire and interview structures can be found in Annex I and II.

3.2.1. TRANSPORT OPERATORS

Questionnaire results: main innovation topics

Figure 4 below provides an overview of the main future innovation topics from the perspective of the category of transport operators. The overview is based on the results of the questionnaire.

Figure 4: Innovation topics of focus transport operators



The main innovation topics of interest are:

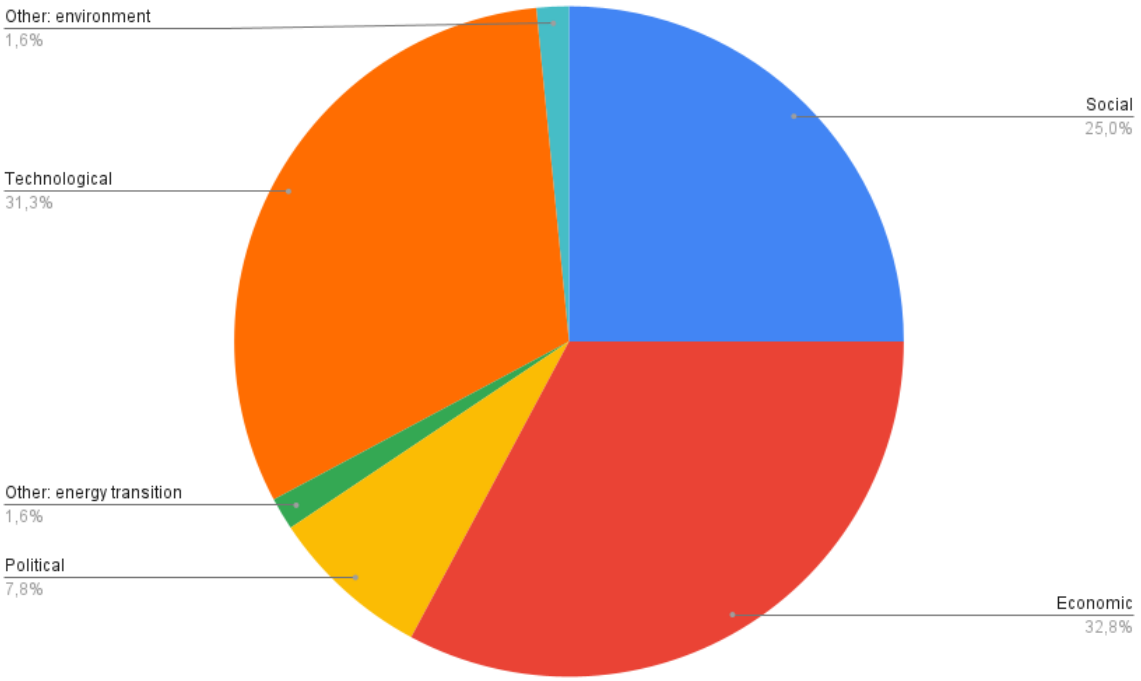
1. Digital green (14,3%);
2. Use of sustainable alternative fuels (13%);
3. Energy efficiency (13%);
4. Ports (13%);

5. Social aspects (10,4%).

It can be seen that the top 5 topics of interest cover almost 2/3 of the whole spectrum of replies (though some other reply options are connected to them) and have fairly similar percentages. This shows a quite uniform and not a too wide spread in the interests and needs of transport operators.

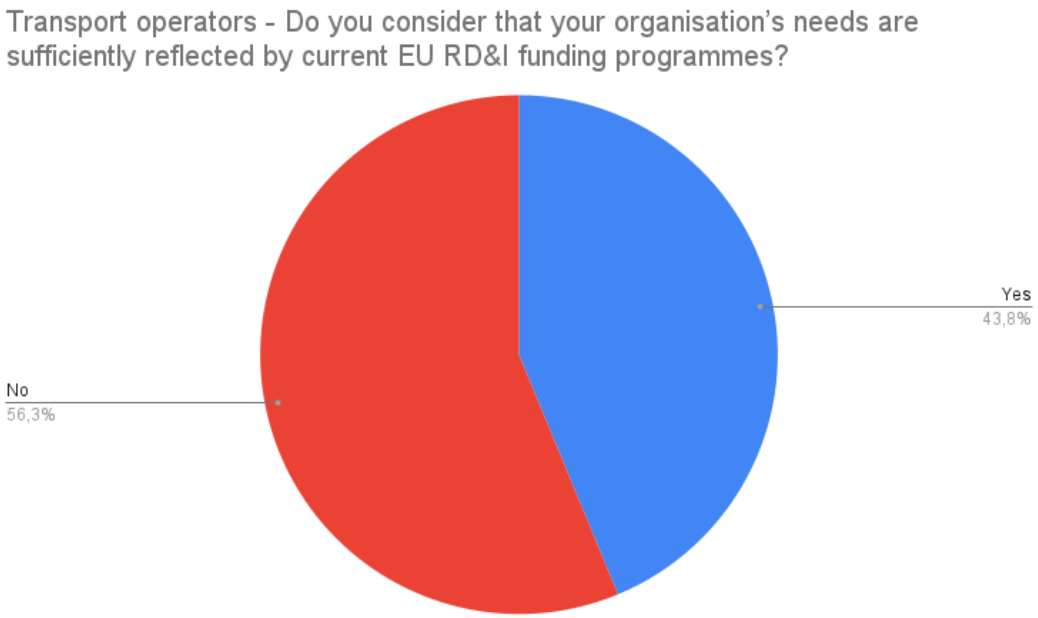
The motivations for the focus on these innovation topics are illustrated in Figure 5 below. As can be derived from the visual, the economic, technological and social factors are the key driving forces. Political motivations are found to be a less strong, but nevertheless noteworthy driver. The environment and energy transition were also mentioned as alternative motivations. Although the environment as motivating force did not feature as prominently as could be expected by the current socio-political climate, it could be subsumed in the social motivation given that as improving the environment (e.g. by reducing air pollutant emissions) has social benefits (e.g. for the health).

Figure 5: Transport operators' innovation motivation



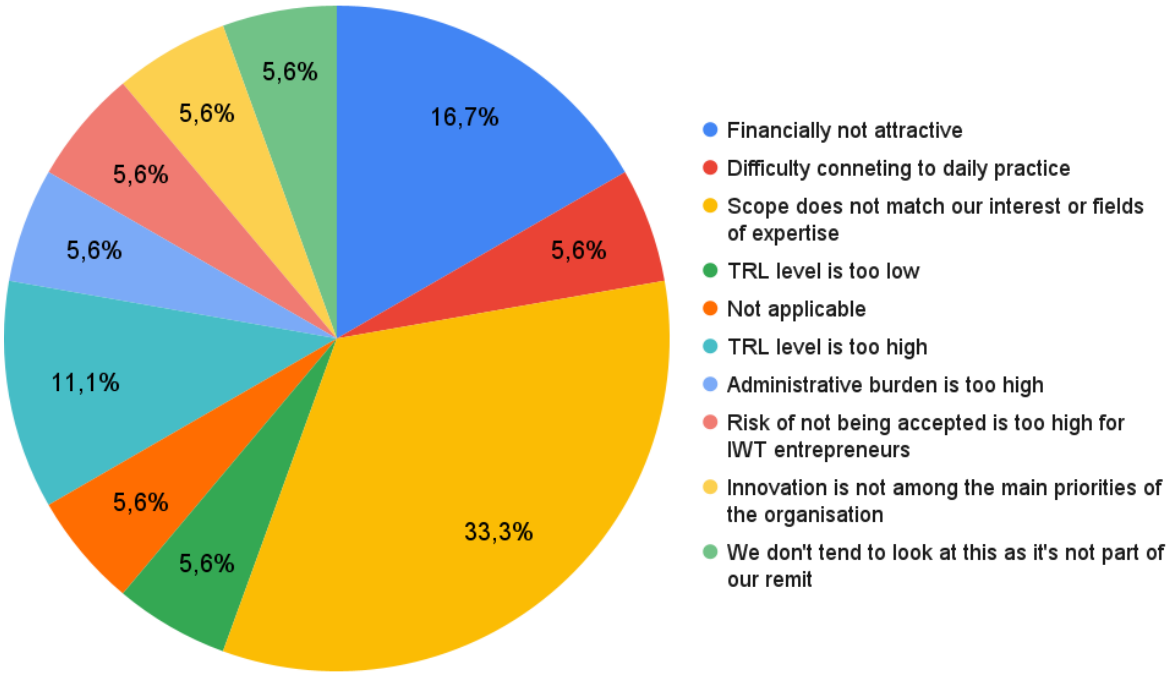
Given the innovation topics of interest and the needs in this respect, the respondents were asked whether their organisation's needs were sufficiently reflected by the current EU RD&I funding programmes. As illustrated in Figure 6 a slight majority answered that the needs are not sufficiently reflected.

Figure 6: Reflection transport operators' needs in programmes



The reasons for this are presented in the figure below. The most important reason indicated in the response to the questionnaire are the fact that the scope of the RD&I funding programmes does not fully match the interest or fields of expertise of the respondent's organisation. Part of the reasons come from a more systemic factor: operators in general, and smaller operators in particular, have a narrower involvement in RD&I (technical) activities due to the nature of their business than other stakeholders. The second reason relates to aspects of financing, i.e. that the projects under the funding programmes are financially not attractive for the organisations. It is a common problem for small and medium transport operators, and not only from the waterborne transport sector, as they do not have high-enough profit margins and extensive RD&I departments to participate in such activities. A third reason is that the associated technology readiness levels (TRL) are too high. This is the result from the questionnaire, it should be mentioned though that transport operators are in general interested in higher TRL solutions that are closer to the market. This is also raised during the in-depth expert interviews and is mentioned in the next sub-chapter. The other explanations given for why technology operator's needs were not sufficiently reflected by current EU RD&I funding programmes are distributed equally.

Figure 7: Reasons why transport operators' needs are not sufficiently reflected by current EU RD&I funding programmes



However, an interpretation may be that the HEU and the other EU funding programmes of this MFF have just begun, the respondents may not yet be aware of all the details and opportunities that are or will be available, which might (negatively) impact their perception. It is also clear that:

- Their numerous main points of interest were only partly covered by past RD&I funding, especially if we look at the list of Top 25 innovation topics, hence a negative experience;
- The HEU will provide good coverage of their first 4 topics of interest, especially given the new Zero Emission Waterborne Transport (ZEWT) co-programmed partnership (cPP). Other funding programmes will also cover these points.

Consequently, the rather negative outlook from the transport operators, while a reality, should be significantly off-set by the new (HEU) funding covering RD&I waterborne transport activities.

Additional insights from expert interviews

Six organisations have been selected, based on the stakeholder analysis, to be interviewed in the category of transport operators and a more in-depth discussion has been held with these parties. Two of the interviewees highlighted that there is first and foremost a need for clarity and predictability in the sector, most of all regarding policy certainty. They expressed the need for clear regulations and clear supporting policies for the energy transition that ensures a level playing field on a global level. Furthermore, policies supporting certain greening technologies should not change in ways and with timings that result in the setting back of proven and validated technologies that contribute to reducing emissions, for instance as is the case with liquid natural gas (LNG). Especially in the case of maritime

transport, there should also be an improved alignment between the EU and IMO to avoid overlapping rules.

All interviewees highlighted the need for clean technologies to comply with the (future) emission reduction regulations. There is a need for new engines, eco-friendly propulsion systems and new sustainable fuels. However, vessel operators have to cope with the question about what the fuel(s) of the future will be. There is currently no silver bullet nor one-size-fits-all solution, resulting in questions regarding which technologies are suitable and affordable for the greening objective. There are a number of developments (i.e. studies and pilot projects with vessels), but will they also break through in terms of adapted and/or new legislation, investments in infrastructure and economies of scale leading to increased affordability, leading to mass adoption and scale?

It was frequently mentioned that financial support is needed for the greening objective. Ship owners face significant investments and there is a need for change in terms of financing and grants. For example, the EIB must become more accessible to SMEs and offer also small(er) amounts of financing. Grants should be more accessible for SMEs as well for entities in the scale-up phase.

Digitalisation is also emerged as an important theme from the round of interviews, though less prominently than greening. Vessel operators often hear that they need to digitalise. However, it is not always apparent to them how to digitalise and what to do in that respect. In the digitalisation process, vessel operators are faced with a multitude of systems, software and platforms (CoVadem, Blackbox Pro, etc.). Yet digitalisation has to be manageable and there is a need for harmonisation and standardisation. At present, there are too many digitising initiatives, without alignment and little cooperation. Furthermore, with digitalisation the challenges are not so much technological – from a technical point of view, it is no problem to achieve smarter logistics processes through transparency, ERP systems and ETA calculations –, but rather financial. Ship owners and operators are not always able to dedicate financial resources to digitise logistical processes and link it to a business case. Companies are either not aware of the benefits and/or there are no real direct economic benefits of digitizing certain processes (or benefits are found at other places than the investor). The benefits can be therefore rather indirect, i.e. improved services towards the customer, which may or may not result in positive returns.

(One of) the interviewees highlighted the importance of infrastructure. A proper fairway and access to ports and port basins are part of the transport mode infrastructure. Reliable planning, reliable sailing schedules and deliveries in time, are consequences of it and will increase the industry's biggest concern – reliability.

Following the highlighting of the above general points and priorities by the interviewees, focus was then put on the question whether EU funded RD&I projects actually reflect the needs and challenges faced by the sector and whether this information is available, which resulted in the below explicated variety of insights. Three of the interviewees indicated that there is in general a match between the sector needs and the EU RD&I projects. On a macro level, there is fairly a match in the project topics, i.e. in the topics the sector focuses on and the topics covered in the research/grant programmes. But in terms of TRL and specific scope, mismatches occur. Two interviewees mentioned that parties like

vessel owners usually need higher TRL level solutions closer to the market, especially given the climate goals that are approaching fast. Of further concern was the importance of having a broad perspective reflected, including that of shipowners and SMEs, seeing as the waterborne transport sector consists of many of them and they are not necessarily represented in the (bigger) projects.

Almost all interviewees agree that the information made available by EU RD&I projects is not accessible enough for the average transport operators. An average shipping company does not have an R&D department or subject matter experts that could facilitate the extraction of the relevant information from innovation projects. The information often forms part of complex reports and the English language oftentimes appears to be a bottleneck for especially the smaller SMEs. It is a struggle for the average vessel operator to retrieve the appropriate and relevant information for their own specific case (e.g. information with regards to greening for the type of vessels they operate) out of such publications in the absence of a priori knowledge and/or supporting, appropriate knowledge and expertise to assess such reports. Relevant information from these projects does not reach the transport operators' group in a proactive way. There is no "easy to read and understand" information source, an approach that could enable easy access to the highlights and key findings of any project.

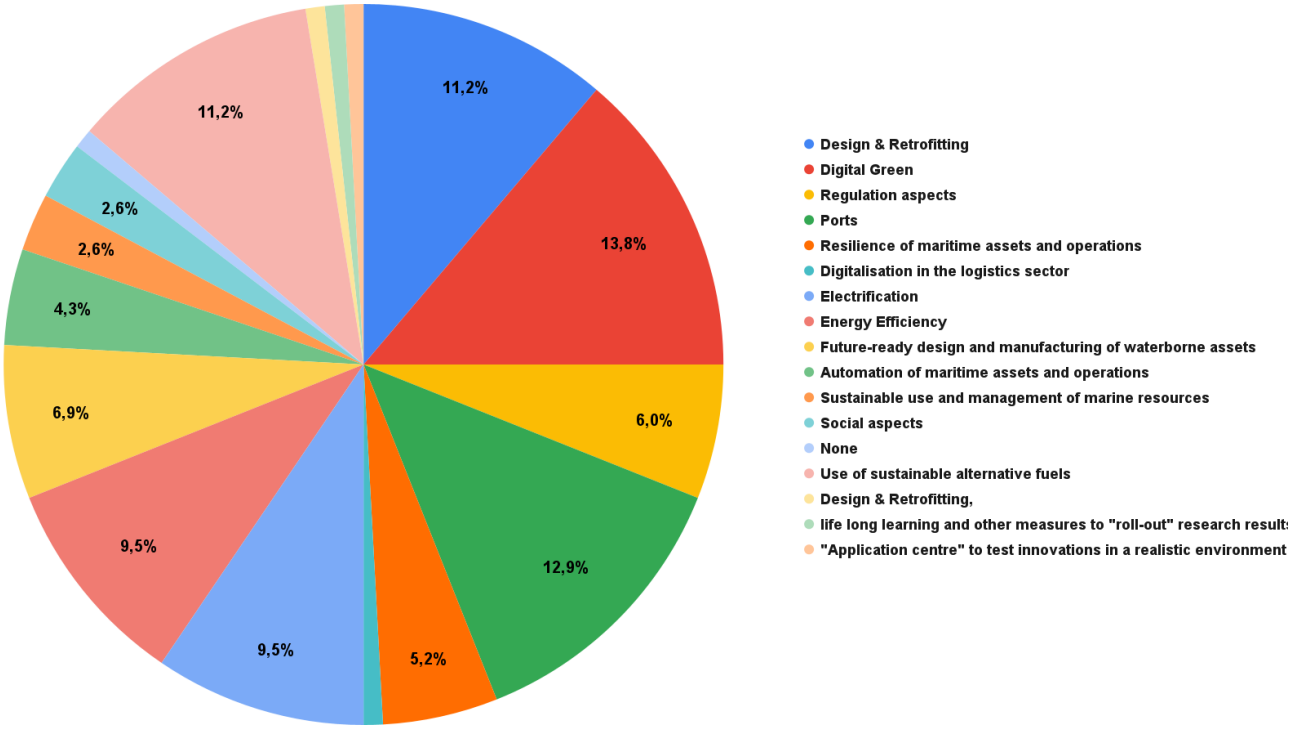
It could also be helpful to know more about rejected project proposals in European RD&I programmes and the reasons for rejection. Once made publicly available, other organisations can learn lessons from this.

3.2.2. TECHNOLOGY SUPPLIERS

Questionnaire results

Figure 8 below provides an overview of the main future innovation topics from the perspective of the category of technology suppliers. The overview is based on the results of the questionnaire

Figure 8: Technology suppliers' innovation topics of focus



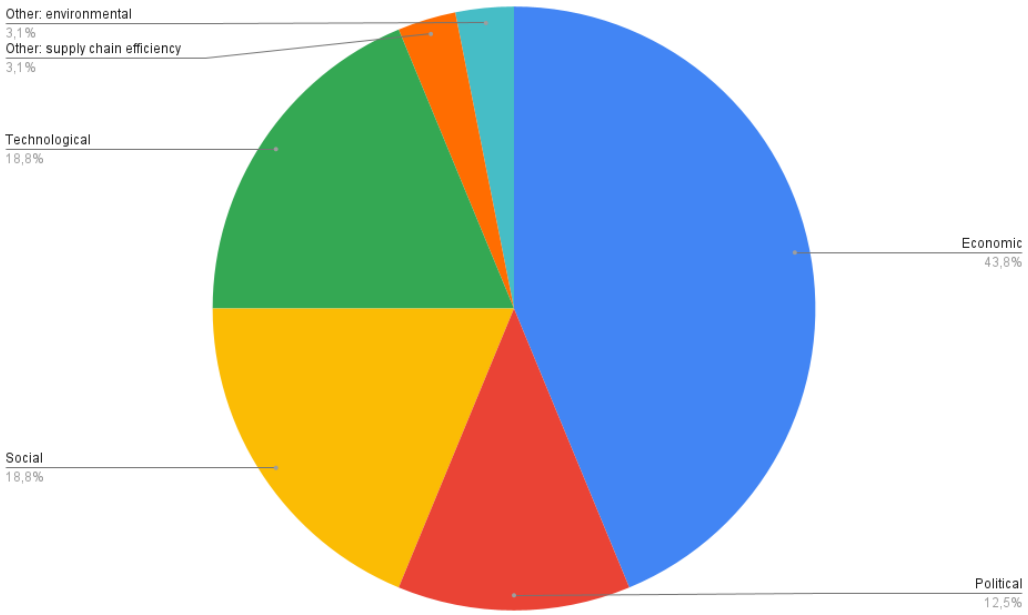
The main innovation topics of interest are:

1. Digital green (13,8%);
2. Ports (12,9%);
3. Design & retrofitting (11,2%);
4. Use of sustainable alternative fuels (11,2%).

These topics cover a little less than 50% of the spectrum of replies, testament to the complexity of the waterborne transport sector, even if some of the other topics indicated by the respondents can be linked to various extents with this Top 4. With only small differences in this ranking, there is a consistent overall interest in these topics within the industry for the longer term.

The motivations for the focus on these innovation topics are illustrated in Figure 9. It can be seen that the economic factor is by far the most important one, followed by technological, social and political motivations. The environment and supply chain efficiency were mentioned as additional motivations.

Figure 9: Technology suppliers' innovation motivation



Given the innovation topics of interest and the needs in this respect, the respondents were asked whether their organisation's needs were sufficiently reflected by the current EU RD&I funding programmes. As illustrated in the figure below, a slight majority answered that the needs are sufficiently reflected.

Figure 10: Reflection of technology suppliers' needs in programmes

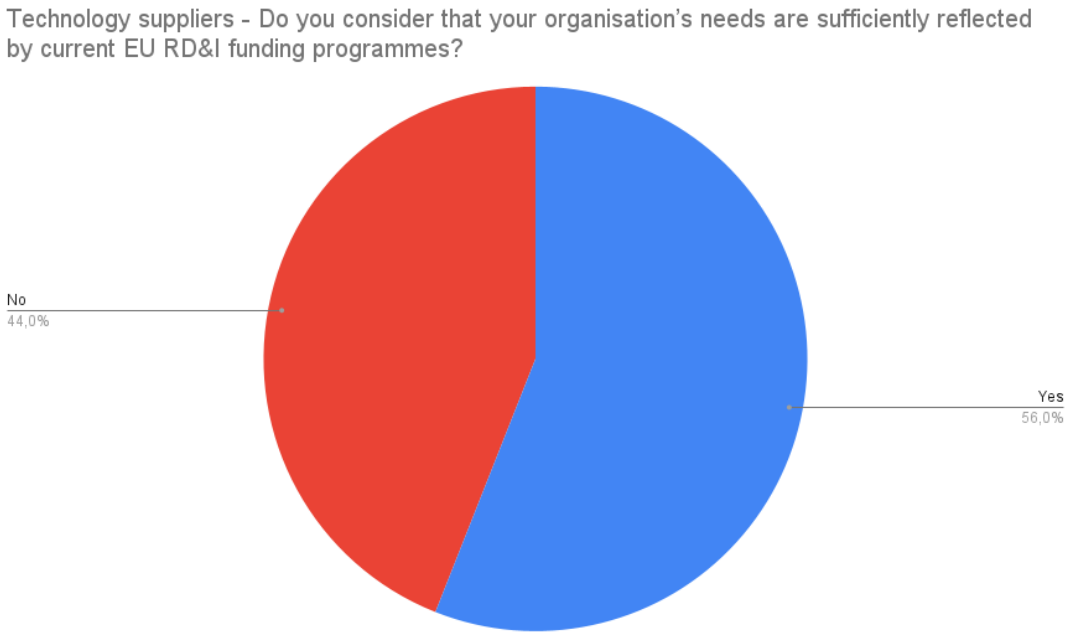
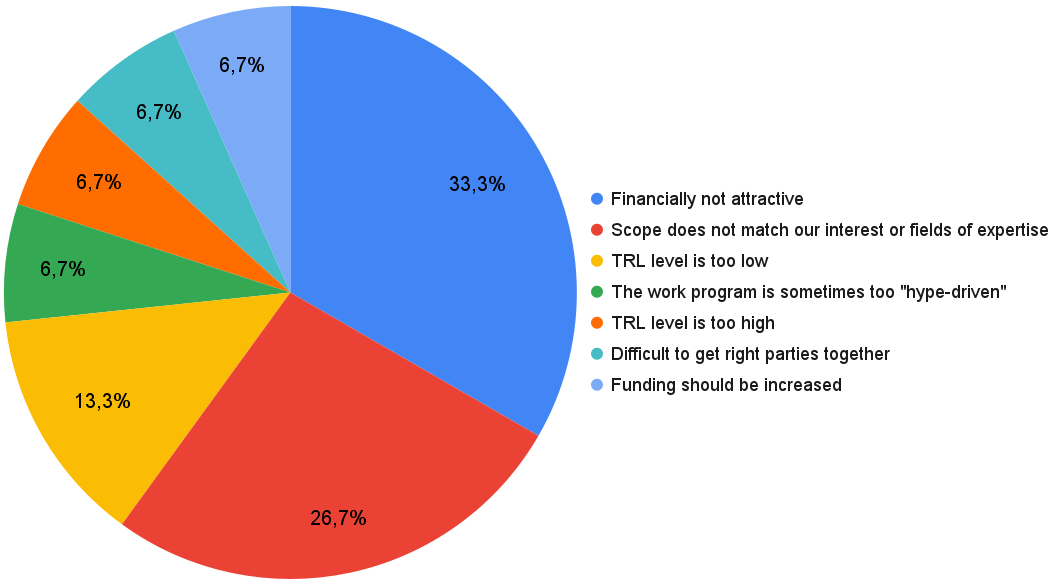


Figure 11 below illustrates why the technology suppliers' needs are not sufficiently reflected by the current EU RD&I funding programmes. The most frequent reason given among the questionnaire responses was that the programmes are financially unattractive. Ranking second, the respondents answered that the scope of the RD&I funding programmes does not match the interest or fields of expertise of their organisation. These two reasons ultimately account for more 60% of all answers. A third reasons is that the TRL level is too low. The remaining motivations have been assigned equal importance and are: a too high TRL level, difficulty to get the right partners together, an insufficiently high funding rate (related to financial attractiveness mentioned earlier) and the critique that the funding programmes are sometimes too "hype-driven": the sector needs not only to create new technologies, but also keep a leading position in Europe related to improving existing technologies in shipbuilding, equipment manufacture, etc.

Figure 11: Reasons why technology suppliers' needs are not sufficiently reflected by current EU RD&I funding programmes



However, it must be mentioned that as the HEU and the other EU funding programmes of this MFF have just begun, the respondents may not yet be aware of all the details and opportunities that are or will be available, which might (negatively) impact their perception. It is also clear that:

- Part of their main points of interest were significantly covered by past RD&I funding, especially if we look at the list of Top 25 innovation topics;
- The HEU will provide a very good coverage of all 4 topics of interest, especially given the new ZEWT partnership. Other funding programmes will also cover these points.

While the overall positive outlook of the industry is clear in this case, it may be interpreted that the negative replies are coming for two main reasons:

- An 'objective' one: overall, the industry is more and more focused on several topics, which are not covered by all companies. Consequently, some companies will be left out;

- A more subjective one: the discussions around the funding levels provided by the EU programmes, in particular for the higher TRL technologies.

Additional insights from expert interviews

Six organisations have been interviewed in the category of technology suppliers and a more in-depth discussion has been held with these parties.

The technology suppliers agree there is a strong push for decarbonisation and digitalisation/automation. There will be a need for new and retrofitted ships that can sail on alternative clean fuels, and operate in a more digital way to increase competitiveness and enhance ship operating efficiency. However, it is necessary to foster understanding among stakeholders and the public that current business models are going to change. In fact, current business models do not fully reflect the state of the technology already available, for instance investing in data transparency. Positive revenues on data sharing are uncertain since the party who invests in data transparency creates opportunities for other parties whereas the beneficiary is not always the one who does the actual investment since he or she does not possess the original data sets. Ship owners will also need new business models for the new fuels/techniques. On top of that, there is currently no sufficient development of land infrastructure and fuel availability, and this is a necessity to successfully undertake and manage the transition. Furthermore, there is also no regulatory framework for the new fuels, such as hydrogen (H2) which there is a lack of guidelines on how to build a H2 ship and which design options will be allowed by classification bodies for these innovative ships. Two of the interviewees highlighted that, according to their views, class societies and flag states do not have the required knowledge to outline and establish proper rules yet for the new fuels and technologies.

There is a strong push towards the energy transition, but there are still questions concerning topics such as fuel availability, bunkering infrastructure and forecast for costs of these fuels. Developing this will take time. Policy makers can incentivize the deployment of clean technologies, intervening with policy making initiatives that can solve the big question of who is paying for this transition, one respondent stated. Ship owners are only one actor in the sector and a green transitions as well as reducing emissions requires that all stakeholders in the value chain move in the same direction – ensuring this alignment is the challenge. To avoid disruption of competitiveness, the transition costs should also not be passed on to the end customer (i.e. EU citizens). Ensuring this requires complex policy making.

It has also been mentioned that the entire value chain needs to be taken into account to retain and improve the competitiveness of the European waterborne transport sector. If new technologies are developed but ships are built in the Far East, shipbuilding capacities and also other capacities, like equipment supplier capacities, are lost in Europe. This makes it also a social challenge in terms of jobs and skills.

Two of the interviewees also stress that actors in the waterborne transport industry need to cooperate more closely with each other in order to create critical mass in lobby efforts. This is necessary to adequately exchange information in regards to the new innovative techniques and fuels, and to foster the development of these technological solutions.

The question of whether there is an information gap was not answered unambiguously by the interviewees. There are interviewees who experience an information gap and interviewees who do not, i.e. a mismatch in what the sector needs and the contents of EU RD&I programmes and information flowing out of corresponding RD&I projects. The perception will obviously also depend on the type and size of organisation an individual is working for, i.e. whether it concerns an innovative OEM or small shipbuilder and whether the organisation has an own RD&I department.

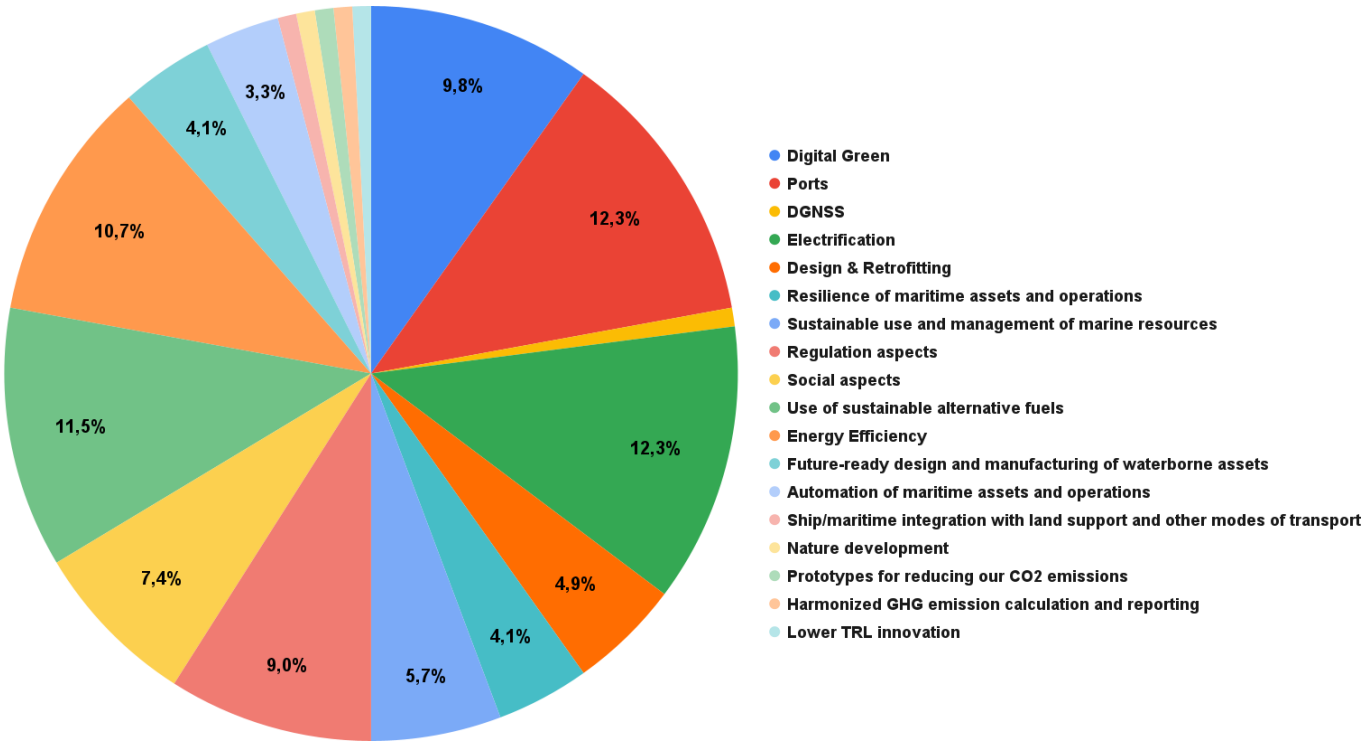
One observation though raised by one of the interviewees is that, especially given the latest climate objectives and corresponding technological developments, part of the EU RD&I programmes may become quickly outdated. The market is moving really fast, and what were relevant policy topics last year can be far less relevant this year. The turnaround time here can be a lot shorter than the usual standard for EU projects. It takes relatively too much time to go from an idea to an EU project call and project.

3.2.3. PUBLIC BODIES

Questionnaire results

Figure 12 below provides an overview of the main future innovation topics from the perspective of the category of public bodies. The overview is based on the results of the questionnaire.

Figure 12: Public bodies' innovation topics of focus



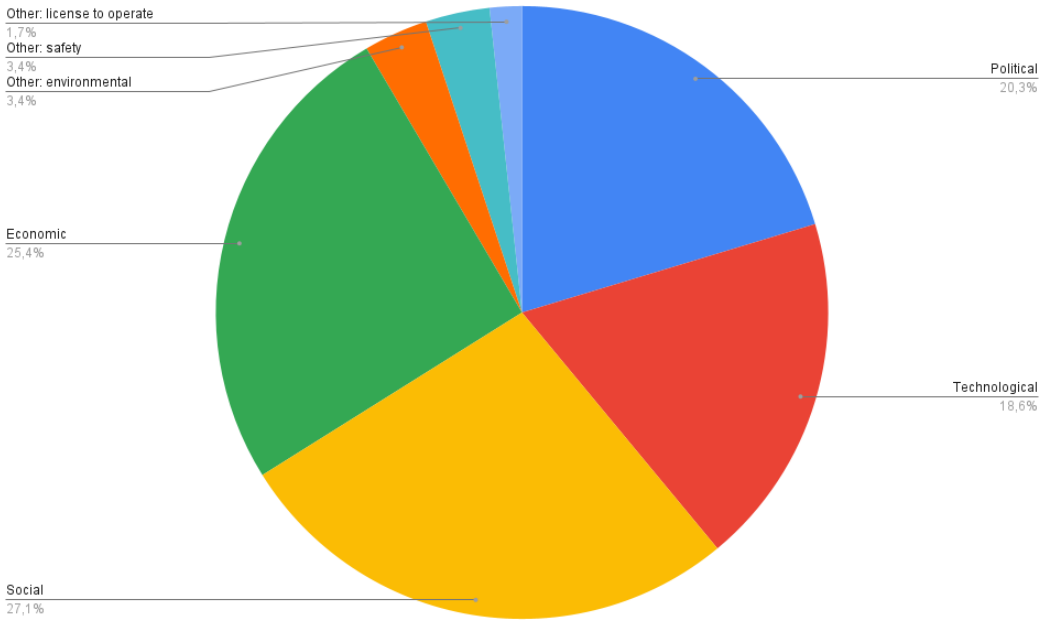
The main innovation topics of interest are:

1. Ports (12,3%);
2. Electrification (12,3%);
3. Use of sustainable alternative fuels (11,5%);
4. Energy efficiency (10,7%).

Just as in the case of the technology suppliers, these topics cover less than 50% of the replies, even if some of the other topics indicated by the respondents can be linked to a certain extent with this Top 4. However, it can be observed that there are in fact two main overarching topics of interest: the first is the energy one, followed by the 'ports'. Such a result can be explained both by the urgency of the first one, as well as by the different remits that the public bodies have, as compared to the private stakeholders.

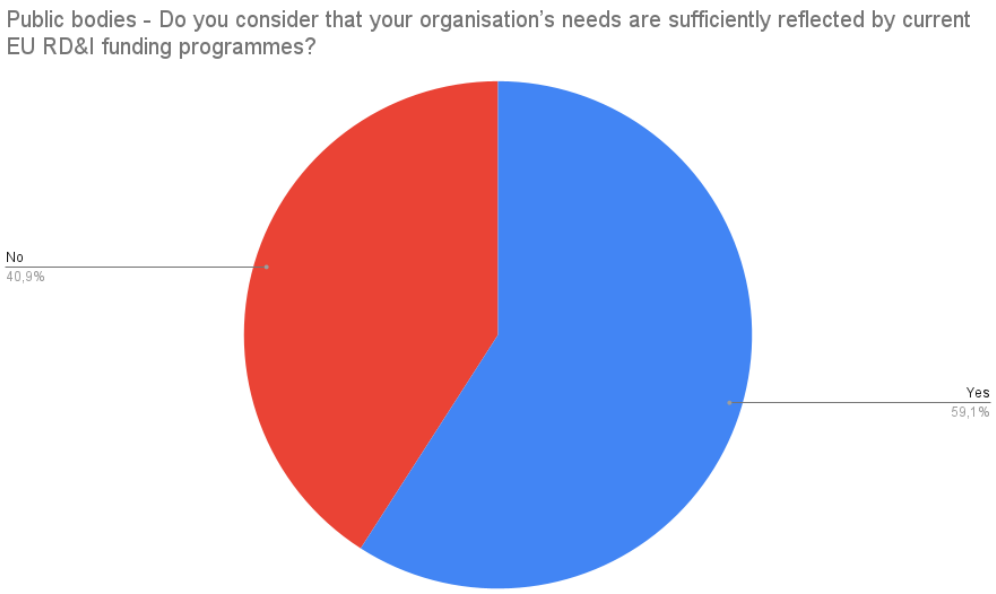
The motivations for the focus on these innovation topics are illustrated in the figure below. It can be seen that economics and the social aspect are playing approximately an equally important role. Politics comes next, technological motivations are fourth and other alternative motivations raised by the respondents are the environment, safety and the license to operate. This focus is also determined by the scope that the public bodies have, which is different in focus from that the private stakeholders.

Figure 13: Public bodies' innovation motivation



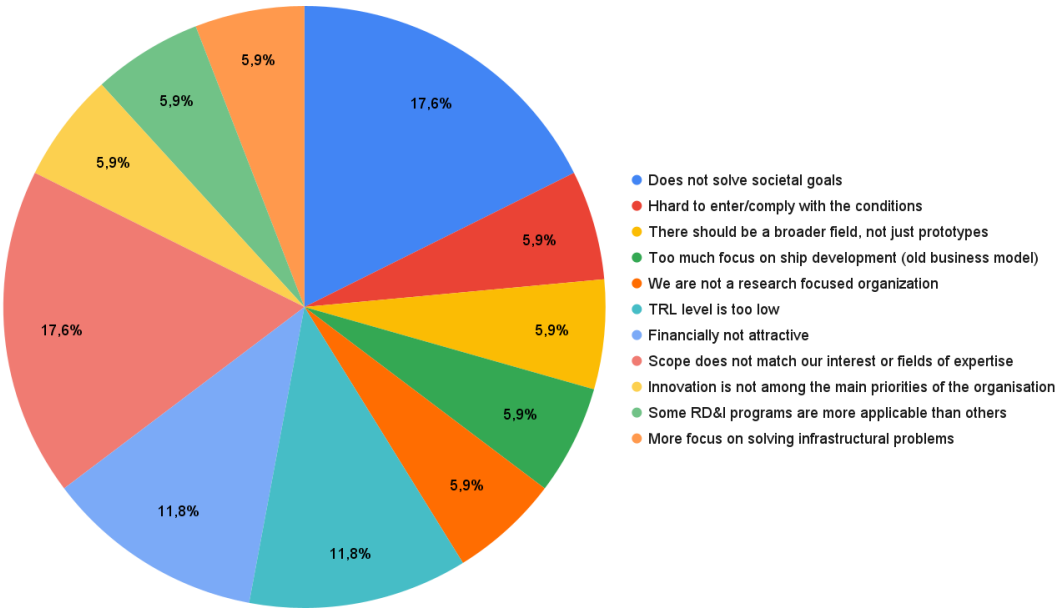
Given the innovation topics of interest to public bodies and the needs in this respect, the respondents were asked whether their organisation's needs were sufficiently reflected by the current EU RD&I funding programmes. As illustrated in the figure below, a majority of nearly 60% answered that the needs are sufficiently reflected.

Figure 14: Reflection of public bodies' needs in programmes



For the slightly more than 40% of respondents who indicated an insufficient match between the needs and the RD&I programmes, their reasons for doing so are illustrated in the figure below. In contrast to the first two groups of actors (transport operators and technology suppliers), the reasons given by public bodies are more evenly distributed. The motivations "Does not solve societal goals" and "scope does not match our interest or field of expertise" are equally the two most important ones, accounting together for just above one third of the responses. The financial unattractiveness and perceived low TRL levels are ranked 3rd and 4th with equal percentages and account together for nearly a quarter of the responses. There are seven other motivations that are seen as being equally important amongst themselves.

Figure 15: Reasons why public bodies' needs are not sufficiently reflected by current EU RD&I funding programmes



As in previous cases, the HEU and other EU funding programmes of this MFF have just begun, and it may be interpreted that the respondents may not yet be aware of all the details and opportunities that are or will be available, which might (negatively) impact their perception. It is also clear that:

- Their main points of interest were well covered by past RD&I funding, especially if we look at the list of Top 25 innovation topics;
- The HEU will provide a good coverage of their main topics of interest, especially given the new ZEWT partnership. Other funding programmes will also cover these points.

There is a clearly positive outlook in this sector, though accompanied by a relatively high level of negative replies. However, when looking closely at the reasons for these replies, it becomes clear that a large part of the answers are due to the lack of interest in or scope for the respondents. Many of the public bodies deal less with RD&I projects, and have a focus more on implementation/roll-out projects, in particular infrastructure. Consequently, it can be affirmed that the 'real' negative reply rate is lower than the one statistically recorded in this sample.

Additional insights from expert interviews

Nine organisations have been interviewed in the category of public bodies and a more in-depth discussion has been held with these parties.

Eight of the interviewees highlighted the energy transition/decarbonisation as the most important challenge and hence the need for cleaner vessels, technologies, fuels and corresponding infrastructure. Climate adaptation, especially in the case of IWT, is an additional need given the recent extreme low and high-water periods.

Every technology still has challenges, e.g. blending biofuels, hydrogen fuel cells integration on board, methanol, etc. There are also challenges on the side of alternative fuel production and supply. The

infrastructure needs to be considered as well, since at the present time there is no or insufficient infrastructure for these alternative energy sources. While several pilot projects are in action and it is foreseen, there will be no one-size fits all solution but rather a mix of multiple technologies. In some cases, the technology has reached maturity and is ready-for-use, however economic challenges to deploy and operate on these technologies in a cost-effective way remain.

The EU's goals are ambitious, and will force the sector to speed up its development of zero-emission options. 2050 seems a long way off in time, but in reality, as one interviewee stated, the sector has to 'run' to meet the 2050 targets in time. The question poses itself whether this rapid pace is possible, and whether it is feasible to have clean technologies and fuels available in the short run, which can be applied in a cost-effective way. An equilibrium between political objectives and the capabilities of the sector needs to be found.

There is a lack in financial capacity given the significant investments to be made to reach zero-emission waterborne transport. This concerns both the capital expenditure (CAPEX) and operational expenditures (OPEX), given that the fuel prices of alternative fuels are significantly higher than those of conventional fossil fuels. Consequently, there is no level playing field with conventional fossil fuels. Research is needed to help find affordable solutions. Taken into consideration should also be the fact that the waterborne transport sector consists of small SMEs that lack sufficient capital to make high investments in zero-emission techniques.

Digitalisation and automation of both the vessels and the overall supply chains appear to be a second important need. With the automation of vessels, the current challenges and needs predominantly lie in the field of regulations, whereas future fully AI-guided vessels still face both technological and regulatory challenges and needs.

Actors like infrastructure managers and class societies also need to digitalise and automate certain processes. There are the developments of remote inspection techniques and remote surveys. Classification societies must develop new tools and adapt their procedures to be capable of utilize these new products and methods.

As far as climate adaptation is concerned, specifically for IWT, examples have been given about the 2021 summer floods in Belgium and Germany, and this area of focus is becoming a crucial one. Innovative solutions for low water levels and preventing floods are needed. Innovation can focus on both vessels and infrastructure.

For the interviewed organisations, the EU RD&I programmes do reflect their needs. The information made available by corresponding projects is for some of the interviewees rather accessible, whereas for others it appears to be rather complex to obtain and extract the sought information. However, public bodies in general have access to relatively more information from partner organisations in the direct business circle or through other platforms, advisory boards, stakeholder groups, etc. than other groups of actors surveyed in this report.

There may be a lack of information of some relevant RD&I that may come from other sectors like land/road transport. An inventory (website) of relevant developments, projects and pilots undertaken

for other transport modes (automation, zero-emission) would be very welcomed to not only follow these links, but also to filter them and analyse the relevance of these technologies for waterborne application.

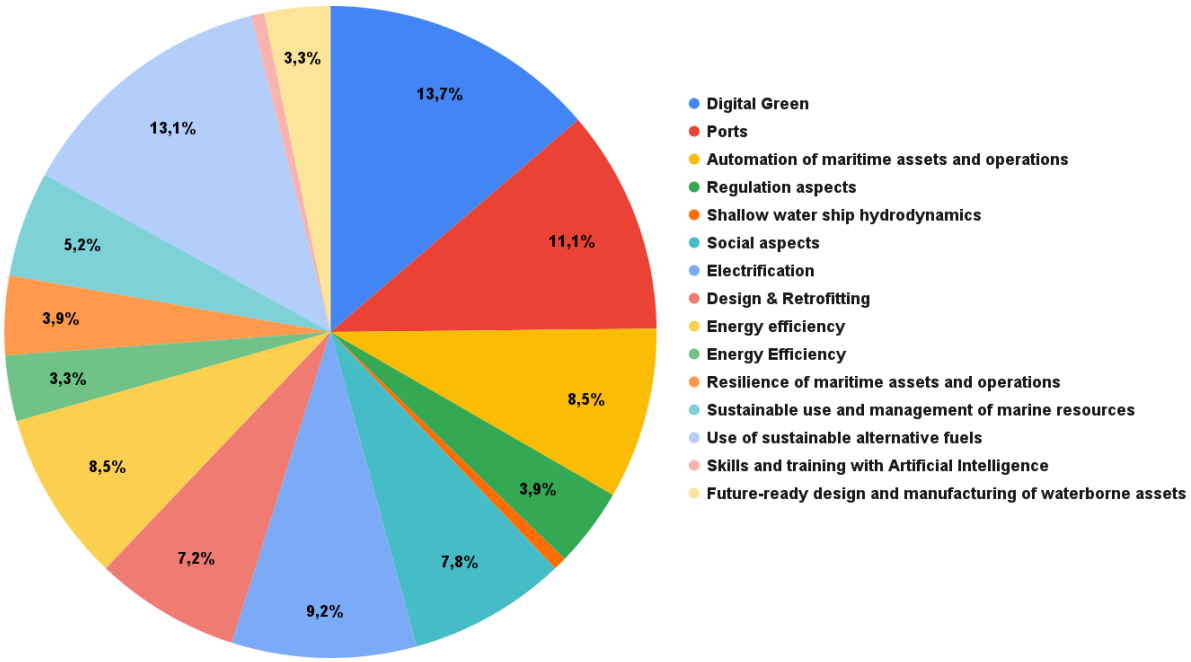
One of the interviewees stressed that there was not much H2020 research for the IWT segment. It was marginal when compared to the maritime sector. The very few projects are small and there is not much dissemination and uptake after the lifetime of the projects. The IWT needs to be better informed about the opportunities that WAT TP is offering in terms of RD&I, starting from the exchange of information with other waterborne transport stakeholder, going through the possibility to create consortia with these stakeholders, and culminating with the involvement in the ZEWT-related activities.

3.2.4. RESEARCH BODIES

Questionnaire results

Figure 16 below provides an overview of the main future innovation topics from the perspective of the category of research bodies. The overview is based on the results of the questionnaire.

Figure 16: Research bodies' innovation topics of focus



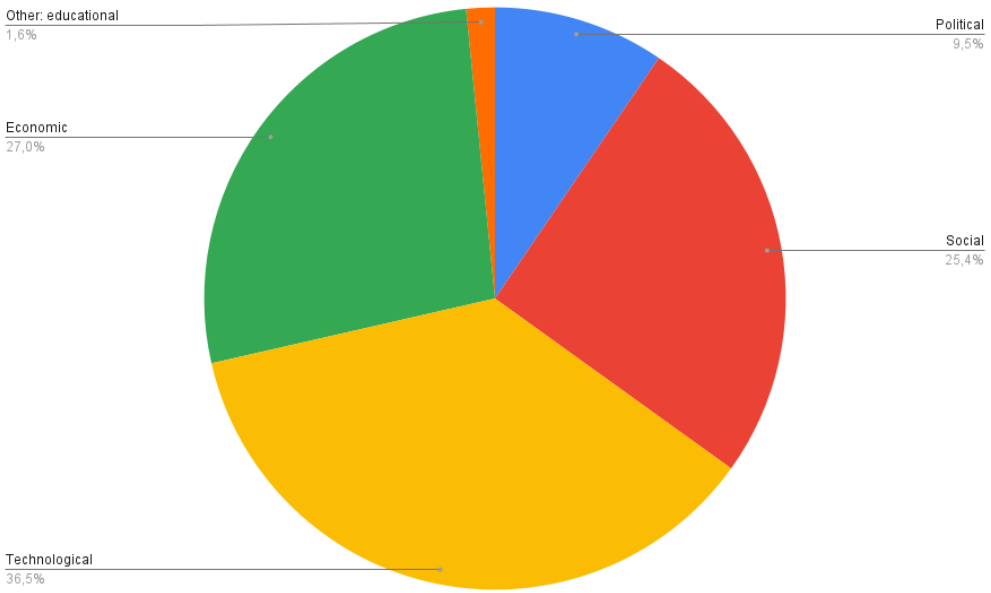
The main innovation topics of interest are:

1. Digital green (13,7%);
2. Use of sustainable alternative fuels (13,1%);
3. Ports (11,1%).

The motivations for the focus on these innovation topics are illustrated in the figure below. As can be seen from the visual, the technological motivation is clearly the most important one. Social and economic motivations are of almost equal importance and account for approximately half of the responses. Political motivations were raised as less significant motivations (1 in 10 responses) for the innovation focus on the specific topics, while educational considerations were the least indicated motivating force.

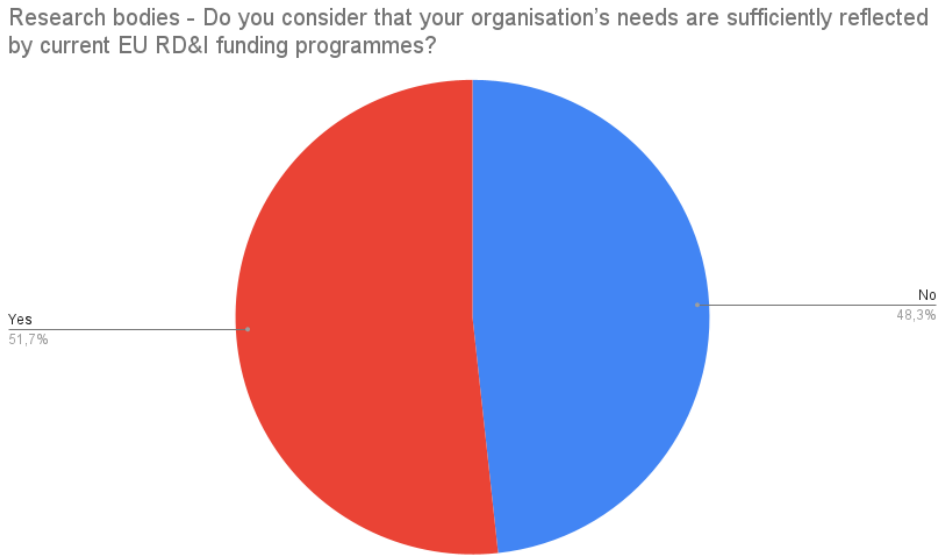
Here the main topics cover only slightly above 1/3 of all the replies, even if some of the other topics indicated by the respondents can be linked to a certain extent with this Top 3. This is to a certain extent normal, given the fact that the research bodies cover all the segments of the waterborne transport sector, not just the most pressing issues. However, it also shows the large heterogeneity of the research community, which will trigger very diverse and sometimes partly contradictory answers.

Figure 17: Research bodies' innovation motivation



Given the innovation topics of interest from the perspective of research bodies and the needs in this respect, the respondents were asked whether their organisation's needs were sufficiently reflected by the current EU RD&I funding programmes. As illustrated in the figure below there is a very slight majority – close to 52% – indicating that their needs are sufficiently reflected.

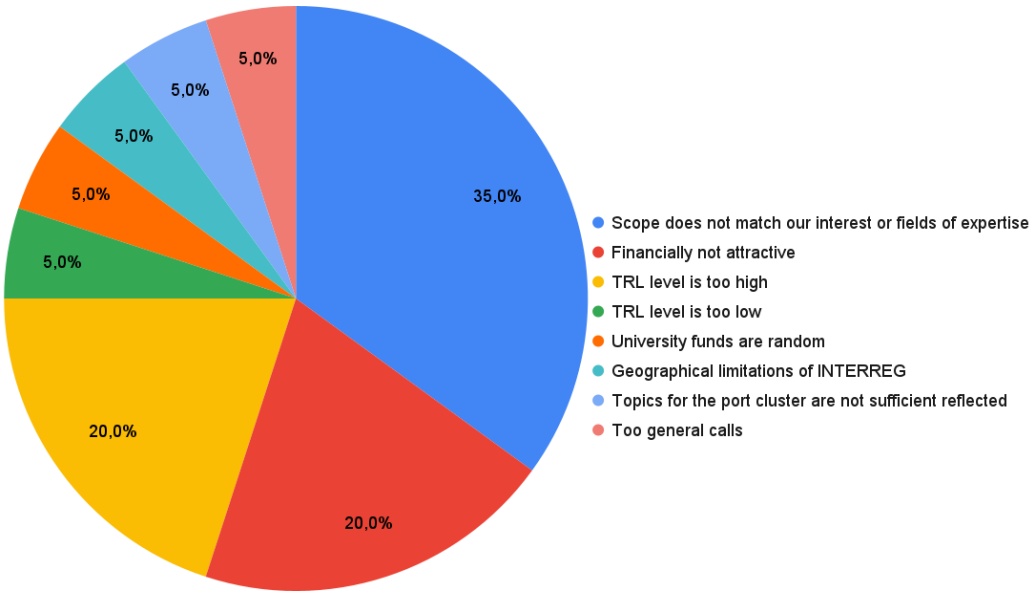
Figure 18: Reflection of research bodies' needs research in programmes



The reasons given by the respondents who indicated that their needs were insufficiently met are shown in the figure below. 35% of the responses indicated that the scope of the EU RD&I programmes does not match the interest or field of expertise of the research bodies. Given the wide variety of the research community, this answer is to be expected, as the existing and foreseen projects have not covered and will not cover all topics related to waterborne. Moreover, it can also be the case that the way in which some aspects are covered by project calls can prevent research bodies from applying to them, even if they do cover that topic in their activities. The financial unattractiveness (20%)[29] and too high TRL levels (20%) together accounted for 40% of the responses. The importance of the other five motivations are equally distributed amongst themselves.

[29] Research organisations are normally 100% reimbursed, but this does not apply to the private and commercial research organisations that also often participate in EU funded RD&I projects.

Figure 19: Reasons why research bodies' needs are not sufficiently reflected by current EU RD&I funding programmes



As in previous cases, the HEU and other EU funding programmes of this MFF have just begun, and it may be interpreted that the respondents may not yet be aware of all the details and opportunities that are or will be available, which might (negatively) impact their perception. It is also clear that:

- Their main points of interest were fairly well covered by past RD&I funding, especially if we look at the list of Top 25 innovation topics;
- The HEU will provide a very good coverage of their main topics of interest, especially given the new ZEWT partnership. Other funding programmes will also cover these points.

Although there is an overall positive outlook, the negative reply rate is statistically very high. However, as mentioned before, the first reason is due to the wide range of research interests from the sector. Given the need of the EU to focus its funding to more pressing issues at regional and Union-level, it is normal that some topics or approaches will receive less funding than others. And while this aspect should not be overlooked by both the EU and national officials in charge of RD&I activities, it should also 'soften' the negative perception that is statistically registered.

Additional insights from expert interviews

Seven organisations have been interviewed in the category of research bodies and a more in-depth discussion has been held with these parties.

At a general level, it is mentioned that zero-emission and digitalisation/automation are the main technological challenges and needs faced by the waterborne transport sector.

At a more abstract level, there is an important observation for specifically the IWT sector. The IWT sector is currently fragmented and a consolidation is needed for a stronger position in the value chain and provide better services in the logistics system.

As far as the energy transition for the whole waterborne transport sector is concerned, an important question is how quickly and cost-effective the sector can make a switch to energy neutrality while remaining competitive with other modes.

The sector deals with a technological challenge in a very broad sense. It is not only about the technological solutions themselves, but also about their affordability and the competition with other modes, e.g. the competition with a zero emission unmanned trucking.

There are also too many siloed technologies. There are platforms for biofuels, for batteries, for hydrogen, etc. Everyone has their own solutions and approaches, however there is a need for them to be brought together. The combination of techniques and fuels that can lead to zero-emissions in a cost-effective manner needs to be found.

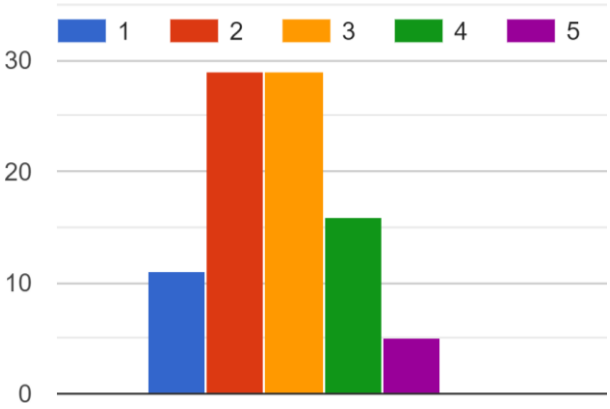
There is also a bottom-up challenge. Legislation and regulation always lag behind. Governments should proactively provide more space in laws and regulations for innovation. Governments should also challenge the market for innovations

With regards to the EU RD&I projects and the needs and challenges faced by the sector, it has been remarked that a lot was learnt from completed EU projects. However, given the new challenges ahead, mainly as far as the energy transition is concerned, there is a need for new projects and perhaps programmes that will contribute to successfully addressing the new needs and tackling the challenges that the sector is facing.

4. Information gaps

Building on the analysis in the previous chapter, the report now turns to the study and consideration of the information gaps as regards the innovation needs of the waterborne transport sector. The question of information gaps was also explicitly addressed in both the questionnaire and the interviews. The result of the questionnaire are represented in the figure below.

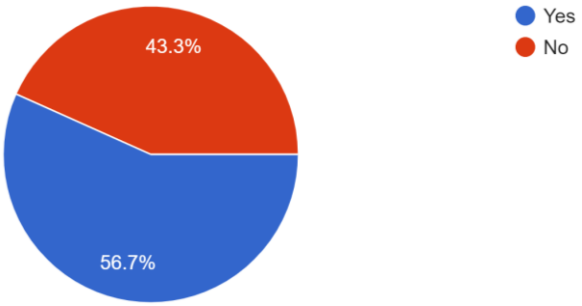
Figure 20: Information gap regarding innovation needs – questionnaire results. (1 being strongly agree and 5 strongly disagree)



As figure 20 illustrates, the majority of respondents indicate that there is an information gap concerning innovations and technological solutions needed to contribute to political objectives and societal expectations.

More than half of the questionnaire respondents state that the dissemination activities of EU RD&I projects do not live up to their expectations.

Figure 21: Expectations from dissemination activities of EU RD&I projects



The information of and related to these projects does not adequately reach – or not to a sufficient degree – the waterborne transport stakeholders. This was also raised during multiple interviews. Many of the questionnaire respondents indicate that it is difficult to find project results and that there

is low visibility of the project consortia (e.g. during fairs and events). It appears to be difficult for project consortia to reach the wider audience.

Respondents also indicate that the project outputs like reports are often complex and abstract, and not easy to read and understand for SMEs. Among SMEs such as small ship owners and technology providers there is also a perceived lack of visibility on projects in the field and a low scale-up and roll-out in the industry of EU RD&I projects in the waterborne transport sector. Interviewees also expressed that there is a need for more tangible presentations or exhibitions showing real-life applied research results.

Frequently raised observations and suggestions by the interviewees are as follows:

- Information is widely available, but not in a coordinated way and it is difficult for an organisation to filter out the relevant information. It appears that the Commission database of EU-funded research and innovation projects (CORDIS) and the Transport Research and Innovation Monitoring and Information System (TRIMIS) cannot offer a solution in this regard either. While these databases provide comprehensive project information, they do provide less comprehensive information on the content of said projects. Additionally, the search function should be improved and information could be organised in a better way through, for example, an innovation roadmap/radar or funnel.
- Information does not reach the right people. New communication campaigns may help in this respect.
- There is information available on technical aspects, but not much on the economics and business models for technical innovations. Also, there is not much information on the uptake of certain innovations following EU RD&I projects despite organisations having a great need for information in the uptake phase, in which innovations are applied (for a longer period) in a real (business) environment.
- Especially for organisations in the transport operators category, it appears that there is a lack of “easy to read & understand” information sources like project factsheets. SMEs in this category such as small vessel owners/operators do not have the time and capacity to search for relevant information and assess it for their specific case. Organisations like industry associations and other non-profit organisations should play a stronger role in this respect, i.e. in communicating information towards the sector in an easily accessible and understandable way, preferably in their own (national) language.
- Especially organisations in the research category state that much of the critical information from RD&I projects are not made public, which renders it difficult to follow up on the detailed results of previous projects.
- EU RD&I projects’ websites should be better structured and provide more information. These websites should also remain online and accessible for a longer period of time after the project end.

It must be noted that there is a need to better inform the different actor groups in the waterborne transport sector about the new (HEU) funding for RD&I at European levels, in particular the ZEWT partnership, which addresses their needs better than FP7 and H2020. It is here also that, through their

involvement, they can help shape many of the HEU calls for waterborne. The key advantage of ZEWT is that (i) it covers some of the priorities underlined by **all four main categories** that have been approached in the framework of this exercise, and (ii) **enables the participation of all these four stakeholder categories in its activities** – to define the calls for projects, to compete for these projects and, should they win, to implement them.

In addition, other funding sources for RD&I activities apart HEU and their conditions also need to be brough to the attention of all the stakeholder categories, in order to alleviate (part of) their RD&I needs.

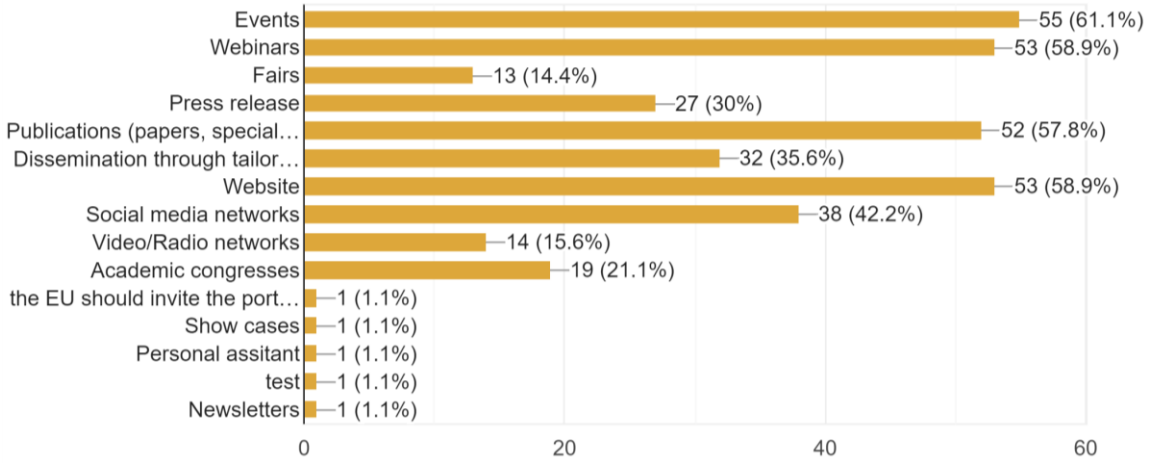
Looking closer at the information from cap. 3, we can distil a number of other information gaps that would need to be addressed:

- Companies, in particular SMEs, may not be (fully) aware that business models are going to change due to the climate (and circular economy) targets, and this could happen at a very fast pace. Also, they may not be aware of RD&I activities in this direction. Such a situation actually raises a two-fold problem: the need for more RD&I activities in this direction coupled with better informing the waterborne transport community about such types of calls;
- There is a partial mismatch in RD&I activities and implementation between the public bodies and the private companies (in particular the industry), hence some opinions that there is too much RD&I focused on ships. The mismatch at the RD&I level could then generate a more troublesome one in terms of mature technologies, e.g. the shore-side vs the ships / off-shore parts of the waterborne transport sector. Another information gap which could be inferred in this case is the potential alignment on topics and TRL levels between the operators and the public authorities, which could solve some problems on both sides;
- A two-fold information gap is also in connection to the societal aspects. On the one hand, while the authorities pay the most attention to such topics in RD&I aspects, many of the companies are less aware of them, hence sometimes the lower degree of cooperation and lack of opportunities. On the other hand, it could be a mismatch in perceptions, as some companies (mostly the operators) can be very interested in societal aspects, but are not aware of the other stakeholders' interests and/or these funding opportunities.

It is in such cases that LASTING can and will play a crucial role in bridging information gaps between the members of the waterborne transport community in a clear, structure and pro-active approach, both through the activities developed in WP1, including this deliverable, and the communication campaign for the ZEWT partnership.

Continuing with the information from the questionnaire and following the previous perceived information gaps and the need for easier access to and increased proactive distribution of information, the next figure provides on overview on how information related to EU RD&I projects should reach the waterborne transport stakeholders.

Figure 22: Preferred communication channel(s) for orientation on waterborne research projects



Events, webinars, publications and websites are the most preferred communication channels for orientation on waterborne research projects. A selections of best practice examples of dissemination activities of certain EU RD&I projects are as follows:

- Realisation and Demonstration of Advanced Material Solutions for Sustainable and Efficient Ships (RAMSSES) Joint conference and dissemination measures;
- WATERBORNE platform;
- European Inland Barging Innovation Platform (EIBIP);
- Alliance for Logistics Innovation through Collaboration in Europe (ALICE);
- EU Research and Innovation Days;
- Dedicated webinars open to the industry, such as the ones from AUTOSHIP and AEGIS;
- Physical demonstration of project results;
- Stakeholders Committees to involve industry decision makers into the project results.

In addition, Annex V illustrates some quality websites, congresses, etc. used to disseminate the results from research project(s) stated by the respondents of the questionnaire.

5. Conclusion

Stakeholders in the waterborne transport sector are in general aware of the political objectives and societal expectations to reduce emissions, and are working towards zero-emission in 2050. However, since reliable and long-term information as regards CAPEX, OPEX, fuel availability and infrastructure is unavailable and/or not reaching the sector's stakeholders on channels and in a form suitable to their needs, there remain open questions for the sector on how to accomplish the 2050 objective and which fuels and techniques will be suitable and wise to invest in.

In regards to the innovation needs and technological solutions needed, the topics digital green, sustainable fuels and ports appear to be relevant for all stakeholder groups that shared their perspectives in the questionnaire. Public bodies pay relatively more attention to electrification, probably related to electrification innovations at the shore side like cold ironing, exchange of modular batteries, etc. Technology suppliers pay far less attention to innovations in the field of social aspects. It appears that the topic automation of waterborne assets and operations has mainly priority for research bodies and far less for the other actor groups.

The questionnaire results show that, on average, the innovation needs of the technology suppliers and public bodies are clearly reflected in the EU RD&I programmes (respectively 56% and 59,1% of the responses) and to a lesser extent for the research bodies (51,7%). The transport operators on the other hand, state with 56,3% of the responses that the needs are not sufficiently reflected in the EU RD&I programmes.

However, when looking beyond the statistical image, the situation is more nuanced, as many of the negative replies stem from the following facts: some of the respondents are actually less interested in or have no RD&I activities; the RD&I interests are very wide but the funding programmes cannot objectively cover all possible waterborne topics or approaches to such topics; some stakeholders may not yet be aware of all the new funding opportunities as they are still in their beginning; etc. Depending on the group of stakeholders, a rough estimate of up to 20% of the negative responses could be considered as not applicable in a more in-depth evaluation.

The reasons why the more concrete needs are not sufficiently reflected in the EU RD&I programmes are overall mainly related to two aspects:

- the scope of EU RD&I funding programmes does not match the interest or fields of expertise;
- the projects under de funding programmes are financially not attractive.

These two reasons are cited by all four actor groups, although some count more than others. Especially the technology suppliers indicate the financial unattractiveness as the most important reason. The EU RD&I programmes may be financially unattractive since the programmes usually do not cover 100% of the costs, both personnel costs and investments. The mismatch in scope and interest is mainly important for the research bodies and transport operators.

The EU RD&I programmes may be financially unattractive since the programmes usually do not cover 100% of the costs, this concerns both the personnel costs as investments.

The transport operators clearly indicate that, given the 2050 objective, they need cost-effective solutions that can be adapted and or directly used by them. This means mass produced high TRL solutions that are cost-effective. This does not match with the low TRL projects from EU RD&I programmes such as H2020.

In addition to differences between the four actor groups related to the future innovation needs, there is also a contrast between the analysed future innovation needs and the current state of needs. For example, the innovation topics blue growth and hinterland transport are not as prominent in the questionnaire and interviews as they are in the analysis of the project database.

Furthermore, given the changed market conditions and policies, specific innovation topics such as after-treatment systems have no or a significantly smaller role to play in the future innovation needs compared to what they did in the last 10 years. Becoming zero-emission and mainly reducing the GHG emissions has the priority. In this respect, the recently published Fit For 55 package can be a strong push for innovation as an important political motivation, whereas the political motivation appeared to be of less relevance until now.

A slight majority of the questionnaire respondents indicates that there is an information gap concerning innovations and technological solutions needed to contribute to political objectives and societal expectations. There seems to be a mismatch between in what the sector needs and is looking for and both the content of EU RD&I programmes and the (amount of) information flowing out of corresponding RD&I projects. The information from these projects either does not, or does to an insufficient degree, successfully reach the waterborne transport stakeholders.

It is therefore clear that part of the waterborne transport community needs to be better informed of and involved in the opportunities provided through the ZEWT partnership and other funding sources at both EU an national levels. Only by having a wide understanding of the RD&I funding landscape – opportunities and conditions to benefit from these opportunities – can the stakeholders fully assess their situation and plan in the longer term. This work is what LASTING is in charge of, including through this WP and deliverable.

Furthermore, project outputs like reports are complex and abstract, and not easy to read and to comprehend for SMEs. A range of suggestions have been raised during the in-depth interviews with experts in the field to tackle this gap. Based on the interviews these are, for example:

- Work on easy to read & understand information sources, especially for SMEs, to disseminate EU RD&I project results or inform about project opportunities.
- Information does not reach the right people. New communication campaigns may help in this respect.
- There is information available on technical aspects, but not much on the economics and business models for technical innovations. Also, there is not much information on the uptake of certain innovations following EU RD&I projects. Organisations have a great need for

information in the uptake phase, in which innovations are applied (for a longer period) in a real (business) environment.

- Much of the critical information from RD&I projects are not made public, which makes it impossible to follow up on the detailed results of previous projects.
- Try to shorten the relatively long turnaround time needed to go from an idea to an EU project call and project, as the market itself is moving really fast.
- Better link to information from relevant RD&I that may come from other sectors.
- EU RD&I projects' websites should be better structured and provide more information. These websites should also remain online for a longer period of time after the project end.

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- https://ec.europa.eu/transport/modes/inland_en
- https://inland-navigation-market.org/wp-content/uploads/2020/09/CCNR_annual_report_EN_2020_BD.pdf

Interviews were conducted with the following organisations:

Transport operators
Danser Group
Fluvius Schifffahrts und Speditions
Grimaldi
Inland shipping cooperative NPRC
Royal Association of Netherlands Shipowners
Royal Belgium Shipowners association
Transport Trade Services

Public/ports/classification bodies
Bureau Veritas

Central Commission for the Navigation of the Rhine (CCNR)
Det Norske Veritas (DNV)

European Commission
Fundación Valenciaport

Hungarian Federation of Danube Ports / Centroport / Plimsoll
Port of Amsterdam

Port of Valencia
Swedish Maritime Administration

Technology suppliers
Asea Brown Boveri (ABB)
Corvus Energy
Fincantieri
Ship Design Group
Wärtsilä

Research bodies
Expertise and Innovation Centre inland Barging (EICB)
Fraunhofer

Logistikum - Department of Logistics at the University of Applied Sciences Upper Austria
MARIN
National Research Council (Consiglio Nazionale delle Ricerche, CNR)
SINTEF

the Netherlands Organisation for applied scientific research (TNO)

Annex I – Questionnaire structure

Due to its diversification an urgent need arises for a coordinated approach regarding Research, Development & Innovation (RD&I)-activities by and for the European waterborne transport sector. This way the sector should be enabled to achieve more of the political objectives and contribute even more to developing and implementing solutions for societal challenges, e.g. mitigating climate change by the transition towards zero emission waterborne transport.

To enable this more coordinated approach, the LASTING consortium is assigned with the task of identifying information gaps concerning: 1) innovation needs, 2) awareness of outcomes and 3) opportunities for participation in RD&I programmes.

Hence this questionnaire; the analysis of responses will be used as input for the development of an over-all communication strategy for a durable, lasting impact on the participation of and contribution by the
stakeholders of the European waterborne transport sector to RD&I activities. The questionnaire is divided into 4 main parts:
A – GENERAL INFORMATION – We would like to know more about your professional profile and organization. These data will be used to classify the inputs based on certain characteristics, e.g. seniority of the respondent and/or size of the organization. .
B – CURRENT STATE – The main objective is to explore the actual situation of the waterborne transport research community on fields such as: level of awareness of outcomes of research projects and activities and current opportunities for participation.
C – DESIRED STATE – The main objective of this part is to explore where you(r organization) would like to be and what would be needed to actually achieve that ambition. D – DISSEMINATION, COMMUNICATION AND OTHER ASPECTS– Last but not least we
would like to collect some additional information about best practices for informing, disseminating and presenting results of innovation projects. An additional question regarding mechanisms to support consortium creation will also be part of this part.

This survey consists of 35 questions and takes approximately 30 minutes to complete.

*Required
Name
Organization *
Telephone #
Position
Email Address
Organization Website

1) Where is the Headquarters of your organisation located? *

2) What is the size of your organisation? *

Mark only one oval.
Small enterprise (1-50 workers)
Medium enterprise (51-250 workers)
Large enterprise (>250 workers)

3) What type of organisation do you work for? *
Mark only one oval.
Classification society/insurance company
Public body – Administration
Public association
Research organisation/research centre
University
Shipping company/operator
Shipping association/working group
Shipyard
Maritime solutions/manufacturers and technology provider
Port Authority /Municipality
Port operator/port developer
Port association/working group
Port machinery manufacturer
Port services provider
Hinterland & Logistics operator
Maritime/Inland/Port ICT provider
Maritime/Inland/Port Energy provider
NGO
Trade Association
Other:

4) What waterborne transport segment(s) is most applicable to your organisation? *
Tick all that apply.
Long distance (e.g. intercontinental transport with deep sea ships)
Cruise (e.g. large seagoing cruise vessels carrying passengers)
Ferries (e.g. large seagoing RoRo ferries)
Short sea (e.g. short sea ships carrying freight)
Inland (inland vessels operating on inland waterways such as container vessels, tankers, passenger vessels, etc.)
Offshore (e.g. dredgers, SOV's, etc.) Other:

5) How many years of experience do you have in waterborne transport research? *
Mark only one oval.
0 - 5 years
6-10 years
11-20 years
More than 20 years

6) Does your company have a dedicated RD&I department? *
Mark only one oval.
Yes

No (continue with question 8)
7) If yes, how many employees work for the Research & Development or Innovation department?
Mark only one oval.
1 - 5
6 - 15
More than 15

8) Does your organisation have a yearly budget for Research, Development & Innovation? *
Mark only one oval.
Yes
No

9a) Does your organisation publish the research results of its projects in a dedicated Research Management System or repository? *
Mark only one oval.
No
Yes

9b) If yes, please specify

10) From your point of view, what are the suitable characteristics for a useful research management system tool(s)?

11a) What main innovation topics is your organisation currently focusing on? *
Tick all that apply.
Use of sustainable alternative fuels: upstream chain of sustainable alternative fuels Use of sustainable alternative fuels: storage of sustainable alternative fuels on board of ships
Use of sustainable alternative fuels: technologies required for using the sustainable alternative fuels (Internal Combustion Engines, Fuel Cells, etc.)
Electrification: energy models Electrification: energy storage Electrification: grid/shore side electricity
Energy Efficiency: design and operation integrations Energy Efficiency: energy efficiency technologies Energy Efficiency: renewable and free energy solutions Design & Retrofitting: new design
Design & Retrofitting: manufacturing Design & Retrofitting: retrofitting Digital Green: digitalisation
Digital Green: digital twin
Digital Green: zero-emission decision support systems Ports: bunkering sustainable alternative fuels
Ports: reducing emissions Ports: climate change resilience
Ports: digitalisation and automation in the port sector
Future-ready design and manufacturing of waterborne assets Automation of maritime assets and operations
Resilience of maritime assets and operations Sustainable use and management of marine resources
Regulation aspects
Social aspects Other:

11b) If your answer in Question 11a had multiple options, please specify which one best applies

12) What is the motivation for the focus on this innovation topic(s)? *
Tick all that apply.
Political Social Economic Technological
Other:

13) Has your company experience with EU RD&I project(s) specifically for the waterborne transport sector? *
Mark only one oval.
Yes No

14) Are you familiar with the EU's FP7, European H2020 and Horizon Europe research/funding programmes? *
Tick all that apply.
No
Yes, but I have not been actively involved yet Yes as participant
Yes as coordinator
Yes as coordinator and participant

15) If applicable, please select other EU funded programmes in which your company has been involved
Tick all that apply.
CEF
INTERREG /ENI/MED TEN-T
LIFE
Other

16) If applicable, please state the EU funded R&I project(s) in the field of waterborne transport your company is/was involved in:

17a) In your opinion, do you consider that your organisation's needs are sufficiently reflected by current EU RD&I funding programmes? *
Mark only one oval.
Yes No

17b) If you answered no, please select why not:
Tick all that apply.
Scope does not match our interest or fields of expertise Financially not attractive
Does not solve societal goals TRL level is too low
TRL level is too high
Innovation is not among the main priorities of the organisation.
Other

18) If applicable, what are in your opinion currently the main barriers when engaging in EU or national RD&I funding programmes or using similar financing products?
Tick all that apply.
Difficult to find complementary stakeholders for consortium Application procedures are unclear

Too strict timeframe & deadlines for project preparation Too long lead times between project initiation and rollout
Unwillingness to share internal know-how with potential competitors Project preparation and implementation rules are cumbersome
Lack of adequate type of financial support
Lack of a relevant area/topic for the needs of the sector
Lack of awareness of the funding programmes and financing products Limited internal financial resources to prepare & rollout a project
Limited internal human resources (technical capacity) to prepare & rollout a project Success rates are too low to be worth applying for funding
There is a higher preference for conventional financing due to attractive interest rates Other (please specify below)

19a) Please reflect on the following statement and rate the measures with grades between 1-5 (1 being strongly agree and 5 strongly disagree): *
Mark only one oval per row.
1 2 3 4 5
From my perspective,, there is a clear information gap concerning innovations and technological solutions needed to contribute to political objectives and societal expectations

19b) Please give further reasons/details (optional)

20) Are you aware of any specific funding opportunities for RD&I activities applicable for waterborne transport, other than European ones? *
Tick all that apply.
No
Yes, funding opportunities through national schemes Yes, funding opportunities through regional schemes Yes, funding opportunities through local schemes
Yes, through financing schemes provided by National Promotional Banks and Institutions

21) If applicable please name support programmes promoted by national research organisations/agencies in the field of waterborne transport and the corresponding responsible organisation(s).

22) What are your innovation priorities for the long term? *
Tick all that apply.
Climate neutral fuels and significant electrification of shipping
Increased overall energy efficiency and drastically lower fuel consumption of vessels Innovative port infrastructure to achieve zero-emission waterborne transport
Clean, climate-neutral, and climate-resilient vessels
Technological and operational momentum towards achieving climate neutrality and the elimination of all harmful pollution to air and water
Smart, efficient, secure and safe integration of maritime and inland shipping into logistic chains
Fully automated shipping and efficient connectivity Competitive waterborne industries
Other:

23a) Do existing EU funding programmes for RD&I in the waterborne transport sector or similar financing products sufficiently support your organisation in realising its long-term innovation priorities? *
Mark only one oval.
Yes No

23b) If no, please explain:

24) Please take a look at the following list of possible measures for improving the sector's participation in EU RD&I activities. Rate the measures with grades between 1-5 (1 being the most relevant/applicable and 5 the least relevant/applicable) *
Mark only one oval per row.
1 2 3 4 5
Simplification off the application process leading to elimination off unnecessary red tape ((from a complex and time--consuming process to a lean and faster one))

25a) Are there specific measures you deem necessary for improving your organisation’s participation in EU RD&I projects? *
Mark only one oval.
No Yes

25b) If yes, please explain:

26a) Are you currently using additional financial instruments to achieve further deployment of your research outcomes of projects which received funding under the H2020 programme? *
Mark only one oval.
No Yes

26b) If yes, please explain:

27) Other than financial what measures would be helpful for the further exploitation of your research outcomes?

28a) Do current dissemination activities of EU RD&I projects in general live up to your expectations?
Mark only one oval.
Yes No

28b) If no, please explain why:

29) If yes, could you please provide one or more examples of best practices of dissemination activities of certain EU RD&I projects?

30a) What communication channel(s) do you personally prefer for orientation on waterborne research projects? *
Tick all that apply.
Events Webinars Fairs
Press release

Publications (papers, specialised journals) Dissemination through tailored reporting Website
Social media networks Video/Radio networks Academic congresses
Other:

30b) Social Media Networks:
Tick all that apply.
LinkedIn Twitter Facebook
30c) Video/Radio networks
Tick all that apply.
YouTube TV
Radio

31a) What media channel(s) does your organisation prefer to disseminate the results from your research project(s)? (Multiple choice) *
Tick all that apply.
Events Webinars Fairs
Press release
Publications (papers, specialised journals) Dissemination through tailored reporting Website
Social media networks Video/Radio networks Academic congresses
Other:

31b) Social Media Networks:
Tick all that apply.
LinkedIn Twitter Facebook

31c) Video/Radio Networks
Tick all that apply.
Youtube TV
Radio

32) Could you please specify one or more quality websites, congresses, etc. used to disseminate the results from research project(s) in which you were involved?

33) Are you familiar with the partner search services provided by the EU for RD&I projects? *
Mark only one oval.
No - Continue with question 35
Yes, but I have not made use of this service yet Yes, I have made use of this service

34) How can the EU improve existing partner search services for you to find suitable project partners for EU RD&I projects?

35) Finally, would you like to share any additional thoughts with the LASTING team?

Annex II – Interview structure

Brief presentation of the LASTING project and consortium

LASTING will broaden engagement of the broader waterborne transport sector in European RD&I activities, by developing a communication strategy, and implementing a long-lasting communication campaign beyond the lifetime of this project, ultimately increasing, stakeholder engagement in the sector and thereby increasing impact of European waterborne transport RD&I

The project partners are SEA Europe (acting as the Secretariat of the Waterborne Technology Platform), Pro Danube Management GmbH (Inland Navigation & Waterway Management), Fundación Valenciaport (Port operations), Expertise- en Innovatiecentrum Binnenvaart (Inland Navigation & Greening the Fleet), Wegemt (Maritime Education and Research) and Burson Cohn & Wolfe (communications agency).

Does the interviewee agree with referring explicitly to the organisation/person?

Interview questions WP1.1

1. What are general needs faced by the waterborne transport sector in Europe?

2. Following the general needs of the sector, what are the technology challenges from your point of view in the sector?

3. Do you think there is an information gap in:
    a. The technological challenges or other innovation needs for RD&I faced by the sector and the available information on this topic (for example information made available by EU funded RD&I projects such as H2020 projects) ?

    b. The EU funded RD&I projects and the actual needs and challenges faced by the sector?

Interview questions WP1.2

4. Is your company using a key or interesting Research management information service or system to support your R&D&i department? If not, any ideas or experiences outside the company?

Interview questions WP1.3

5. You may know that there are various EU, national, regional funds to cover waterborne research. According to your experience - H2020, CEF, LIFE, INTERREG, etc. what is the most attractive one and why? What makes it particularly interesting for your company?

6. We see several EU funding programmes with the aim to meet the needs of the sector and overcome technological challenges, but not all the mechanisms get the attraction of the industry. Could you point out the possible reasons behind this issue?
7. What is your experience with H2020 projects?
8. How do you reflect on your participation or level of involvement in those projects? Could you provide some relevant benefits/take-aways?
9. In case of experience with any other RD&I funding programmes (e.g. LIFE, INTERREG, etc.) how do you assess your participation in those projects? Please mention a few benefits/take-aways.
10. Are you considering the participation of your company in next Horizon Europe/CEF II/Next Generation funding programmes? Why? How would you better make use of future project opportunities?
11. To further support the EU ambitions for the sector, what would be a good approach to raise the attraction of EU programmes for the companies in the sector? How to align the programmes according to the needs of the potential applicants fostering RD&I cooperation in the waterborne transport?

Annex III – Innovation projects

A total of 565 projects were analysed of which 103 FP7 projects, 273 H2020 projects, 144 INTERREG + ENI + MED projects and 45 CEF projects. The relevant funding schemes within the specific programmes are as follows:

Table 3: funding schemes within programmes

FUNDING SCHEME	CEF	FP7	H2020	INTERREG + ENI + MED	Total general
SME-1			91		91
ERDF				70	70
N/A				65	65
IA			57		57
RIA			51		51
OTHER		13	25	9	47
CEF	45				45
CP-FP		34			34
CP		27			27
SME-2			20		20
CSA		1	16		17
BSG-SME		12			12
CSA-SA		10			10
ERC-STG			7		7
SME-2b			6		6
CSA-CA		6			6

Figure 23 provides an overview of the number of projects per nationality of the project coordinator.

Figure 23: No of projects per nationality of the coordinator

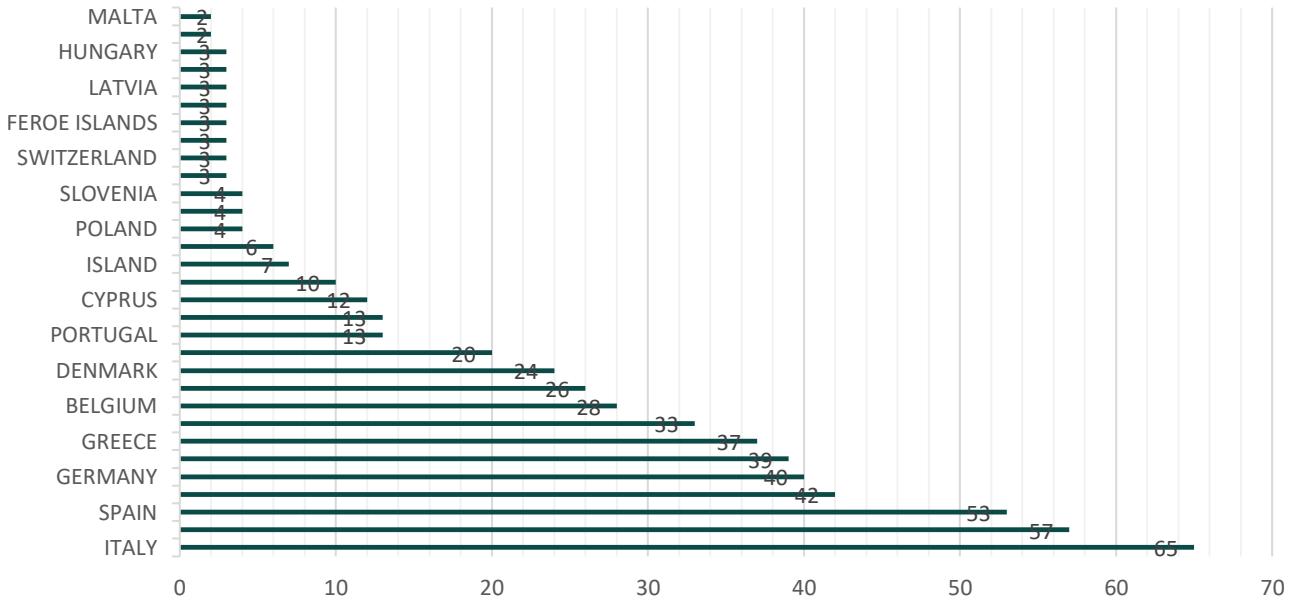


Figure 24 provides an overview of the number of participants per project in all considered programmes. It can be seen that most of the projects had only 1 project participant. This was mainly the case in H2020 projects.

Figure 24: Number of participants per project (all funding programmes)

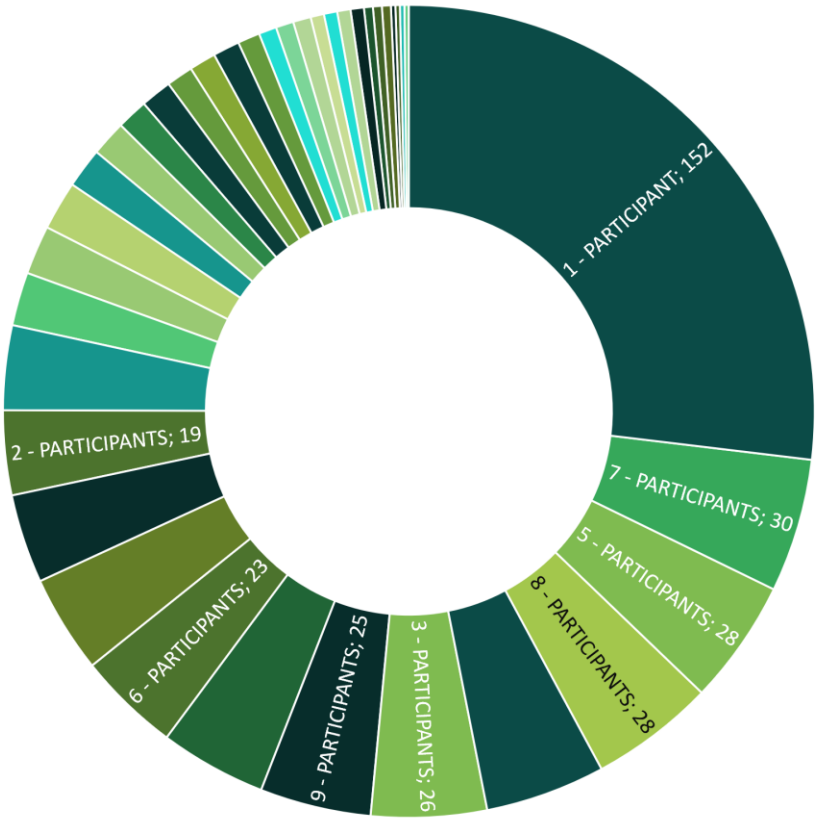


Figure 25 provides an overview of the sector orientation, i.e. the sector of orientation in the analysed projects. As one project may have an orientation on multiple sectors, a division has been made between the 1st, 2nd and 3rd sector of orientation in a project.

Figure 25: Sector orientation - top 25

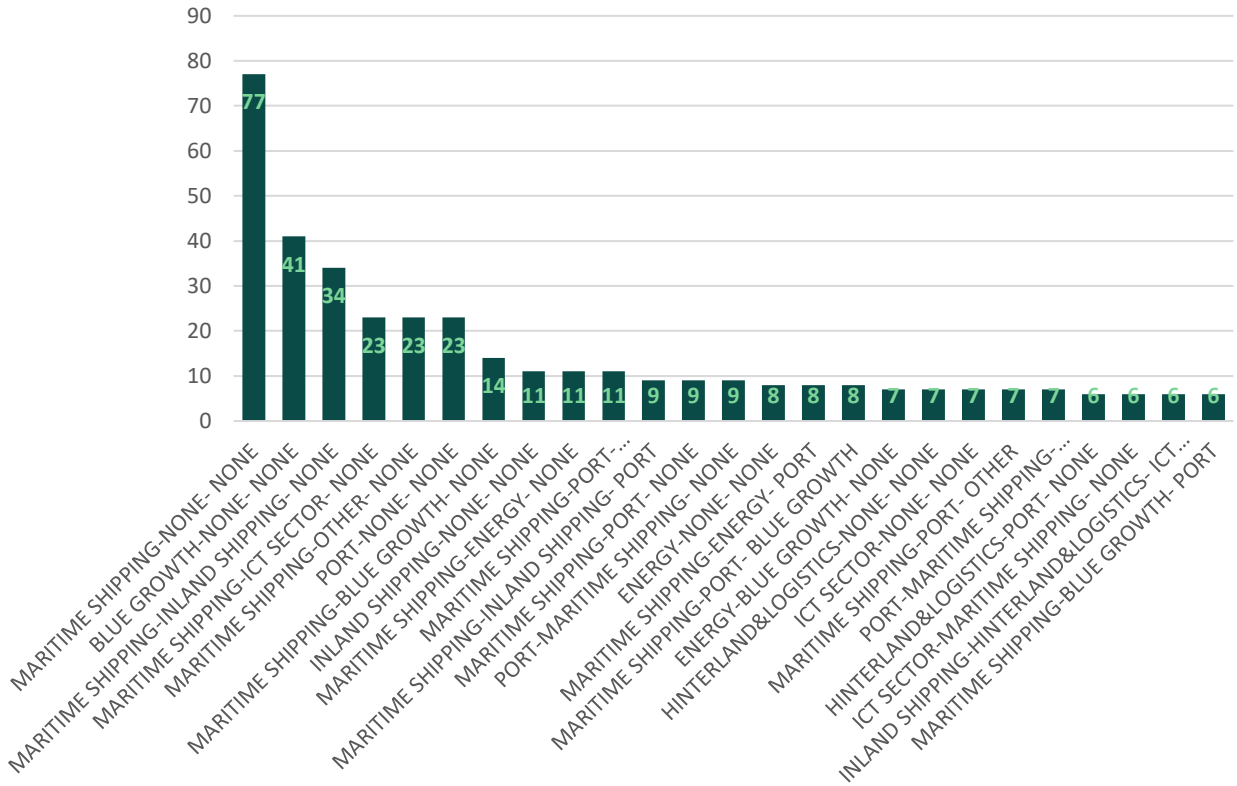


Figure 26 provides an overview of the waterborne transport segments that are applicable in the considered innovation projects, with a division in the 1st, 2nd and 3rd market segments of orientation. It can be seen that in the first category the most projects do, surprisingly, not focus on the listed waterborne transport segments but rather on aspects in the field of, for example, blue growth, ports and social aspects (e.g. job requirements).

Figure 26: Market segments – top 25

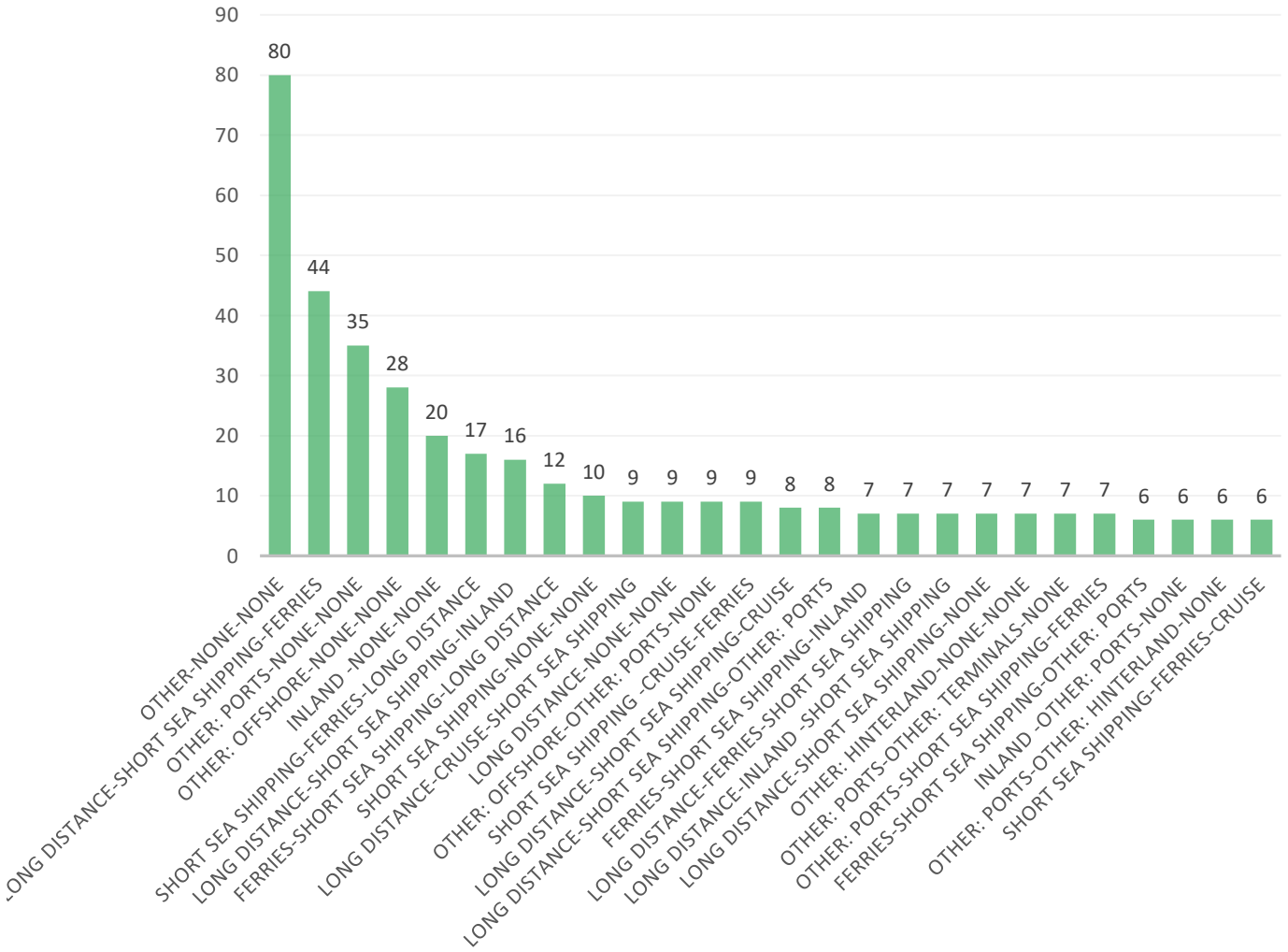


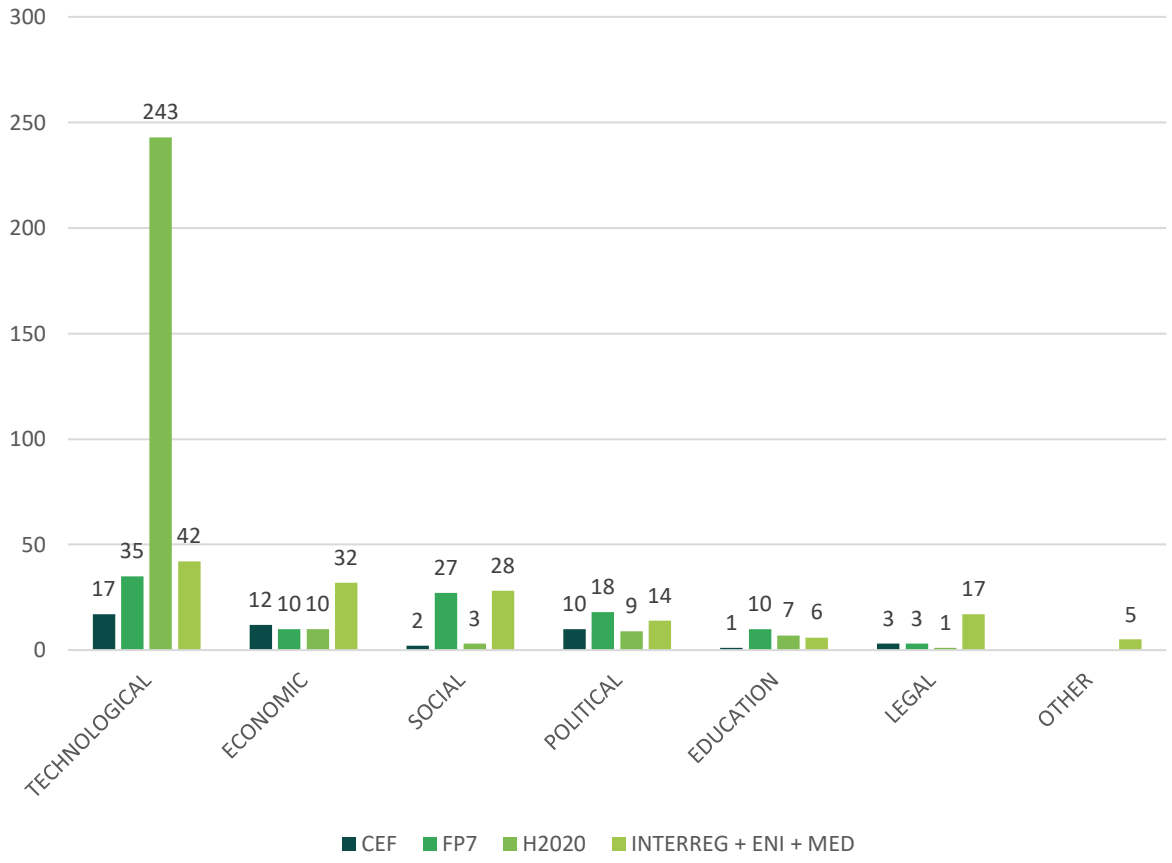
Table 5 provides a top 25 overview of the foremost innovation focus topics in the analysed projects across all considered programmes. It can be seen that most of the focus is oriented at specifically shipping. This also applies to projects in the H2020 programme. Perhaps surprising though, also a lot of past H2020 projects tend to focus on blue growth.

Table 4: Top 25 innovation topics of projects

1ST INNOVATION TOPIC	Total general
SHIPPING - DESIGN AND MANUFACTURING OF MARITIME ASSETS - MATERIALS	29
SHIPPING - DESIGN & RETROFITTING - RETROFITTING - MODULAR DESIGN AND GREEN TECH	24
HINTERLAND TRANSPORT	24
SHIPPING - AUTOMATION OF MARITIME ASSETS AND OPERATIONS - PRODUCT APPLICATIONS AND BUSINESS MODELS (AUTOMATIC PROCESSES ONBOARD, BUSINESS MODELS, UxV, ROUTE OPTIMISATION, COLLISION AVOIDANCE, ETC.)	22
SHIPPING -RESILIENCE OF WATERBORNE ASSETS AND OPERATIONS - OPERATIONAL PRACTICES	22
SOCIAL ASPECTS - JOB REQUIREMENTS AND HUMAN FACTOR	22
SHIPPING - ENERGY EFFICIENCY - ENERGY EFFICIENCY TECHNOLOGIES	21
BLUE GROWTH - SEAS AND OCEANS FOR CO2 NEUTRALITY - OCEAN ENERGY	21
PORTS - PORT OPERATIONS OPTIMISATION	19
BLUE GROWTH - MONITORING AND DIGITALIZATION OF SEAS AND OCEANS - DIGITAL OCEAN	18
SHIPPING -RESILIENCE OF WATERBORNE ASSETS AND OPERATIONS - EMERGENCY RESPONSE MEASURES	17
PORTS - BUNKERING SUSTAINABLE ALTERNATIVE FUELS	16
PORTS - REDUCING EMISSIONS - MONITORING SYSTEMS	16
SHIPPING - DIGITAL GREEN - DIGITALIZATION - MONITORING AND BIG DATA COLLECTION	15
SHIPPING - USE OF SUSTAINABLE ALTERNATIVE FUELS - POWER CONVERSION - INCLUDING INTERNAL COMBUSTION ENGINES AND FUEL CELLS	15
SHIPPING - AUTOMATION OF MARITIME ASSETS AND OPERATIONS - PRE-REQUISITES FOR AUTOMATION (SECURITY, CONNECTIVITY, SENSORISATION)	15
SHIPPING - USE OF SUSTAINABLE ALTERNATIVE FUELS - FUEL SCENARIO - upstream chain of sustainable alternative fuels	14
SHIPPING - DIGITALIZATION - ZERO EMISSION - DECISION SUPPORT SYSTEMS	14
BLUE GROWTH - SUSTAINABLE USE AND MANAGEMENT OF MARINE RESOURCES - MARITIME SPATIAL PLANNING AND MARITIME SURVEILLANCE	14
BLUE GROWTH - MONITORING AND DIGITALIZATION OF SEAS AND OCEANS - INTELLIGENT SENSING EVERYWHERE AND TOOLS FOR DIGITAL TRANSITION	14
BLUE GROWTH - MONITORING AND DIGITALIZATION OF SEAS AND OCEANS - MARINE ROBOTICS	14
SHIPPING - ENERGY EFFICIENCY - RENEWABLE AND FREE ENERGY SOLUTIONS	11
SHIPPING - DESIGN & RETROFITTING - NEW DESIGN	10
SHIPPING - DESIGN & RETROFITTING - MANUFACTURING - MODULAR SHIPBUILDING	10
PORTS - WASTE MANAGEMENT	10
PORTS - DIGITALIZATION - PORT LOGISTICS PROCESSES AND DATA	10
REGULATORY ISSUES - OTHER	10

There are different motivations for the focus on these listed innovation topics with variances across the different considered programmes. Within H2020, there is a clear technological motivation. Achieving a technological development, for commercial and/or social purposes, seems to play a very significant role for organisations that initiated H2020 projects in the recent period.

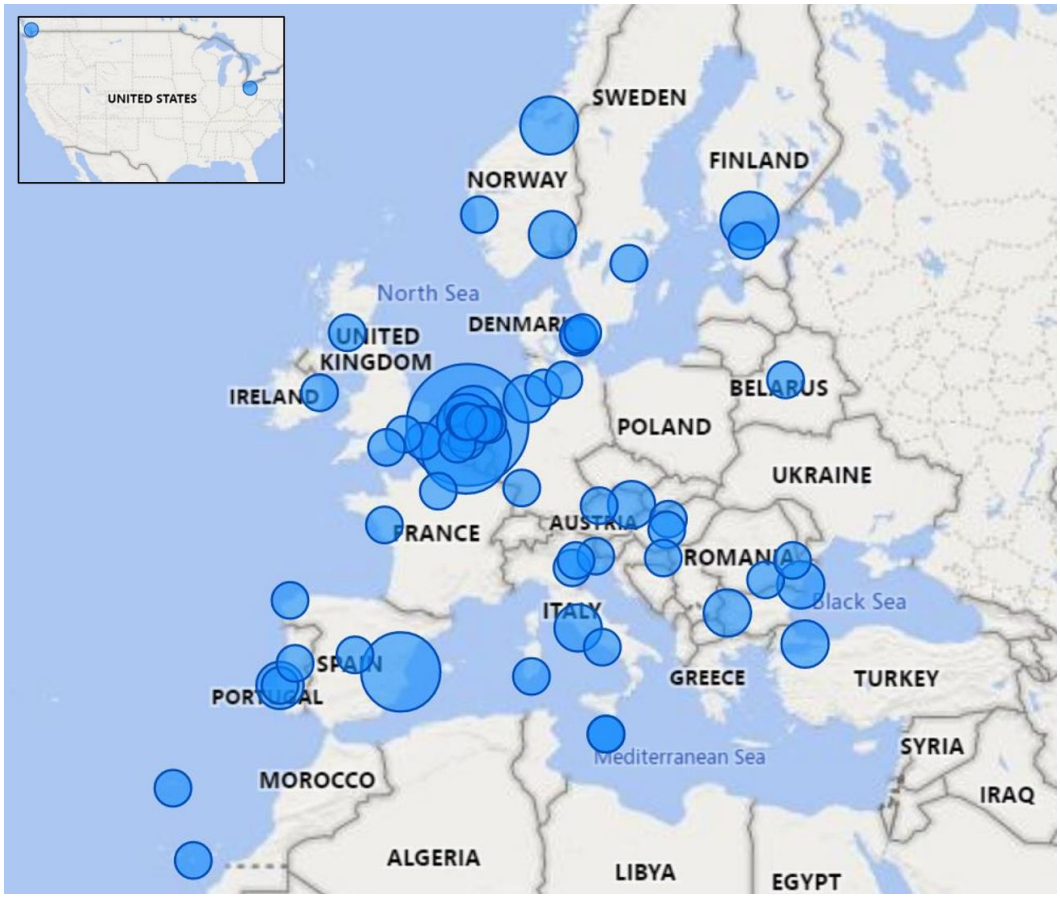
Figure 27: Motivation for the focus on the innovation need



Annex IV – Questionnaire respondents

The questionnaire[30] was widely distributed by the project partners, via social media and direct mail. In total 90 responses were received from a variety of persons and organisations across Europe and even some few organisations with a seat in the United States.

Figure 28: Geographical overview questionnaire responses



Source: own elaboration based on questionnaire results

Note: The figure shows the headquarters of the organisations the respondents work for. The figure shows a wide distribution of cities in Europe, however with a clustering in North-western Europe.

[30] Please see Annex I for the questions that were addressed in the questionnaire.

Figure 29: Type of organisations

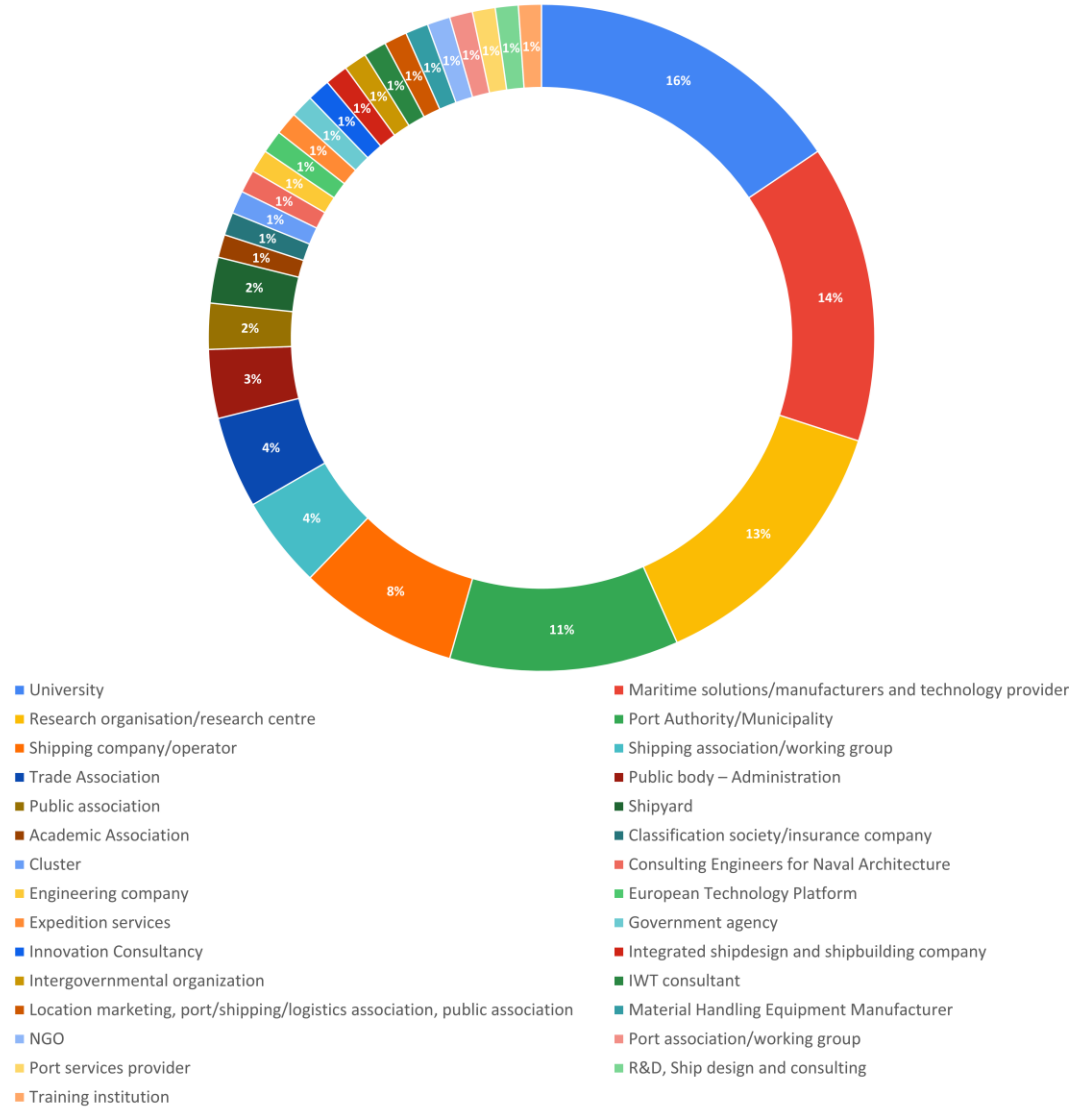


Figure 29 provides an overview of the type of organisations the respondents work for. The top 5 organisations making up more than 60% of the responses is presented in Table 5.

Table 5: type of organisation respondent is working for

	Type of organisation	% of responses
1.	University	16%
2.	Maritime solutions/manufacturers and technology provider	14%
3.	Research organisation/research centre	13%
4.	Port Authority/Municipality	11%
5.	Shipping company/operator	8%

Research-oriented organisations such as universities and research centres are together responsible for nearly 30% of the responses.

The listed organisations almost always focus on multiple segments of the waterborne transport sector. In 19% of the responses, the respondents indicated that their organisation is focussing on all 6 waterborne transport segments (Long distance, Cruise, Ferries, Short sea, Inland and Offshore). The top 13 makes up 75% of the responses, as presented in Table 6 below.

Table 6: Overview – most applicable waterborne transport segments

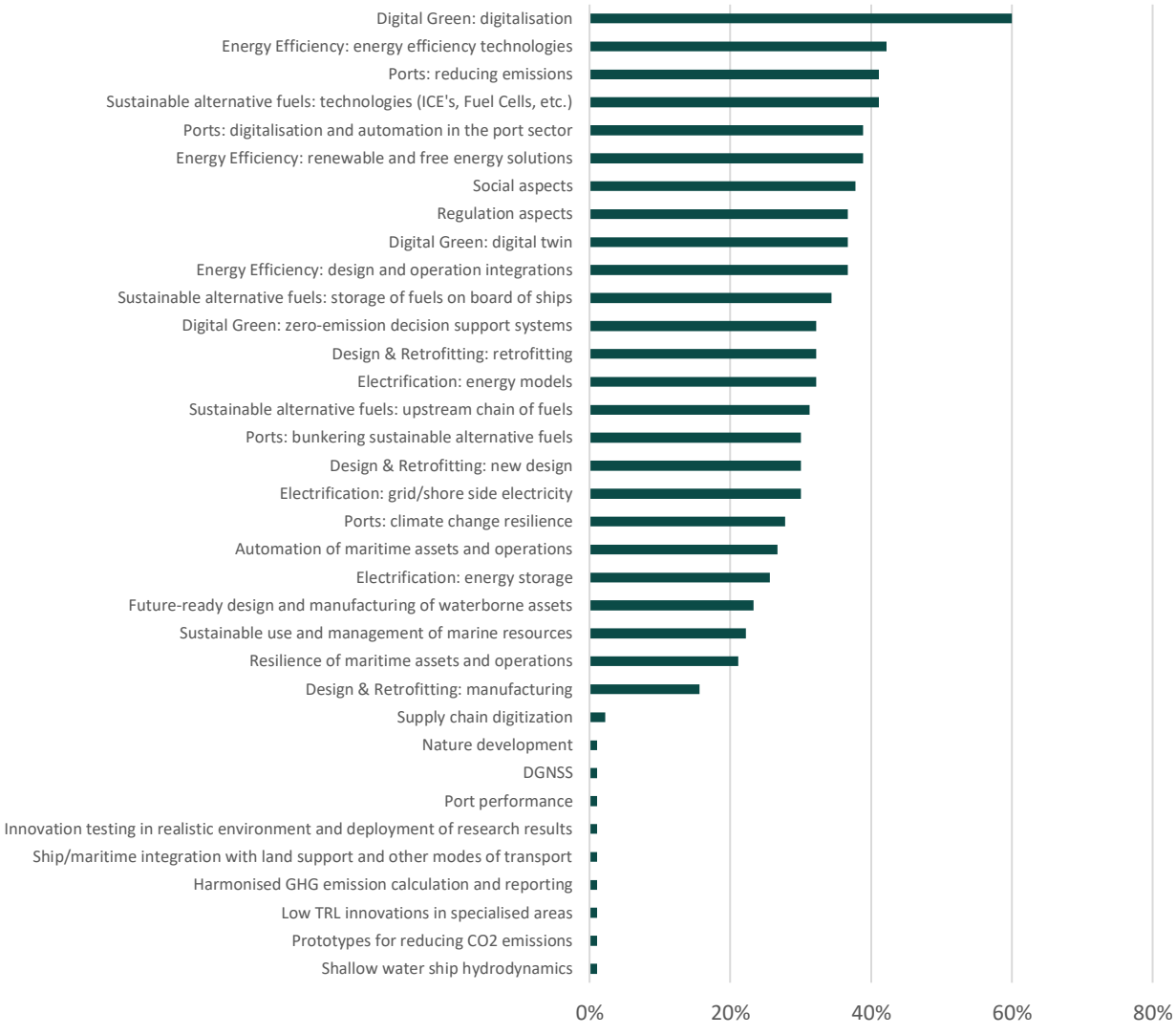
Transport segment	Percentage
Inland	20%
Long distance, Cruise, Ferries, Short sea, Inland, Offshore	19%
Long distance	6%
Long distance, Cruise, Ferries, Short sea	5%
Cruise, Ferries, Short sea, Offshore	3%
Long distance, Cruise, Ferries, Short sea, Inland	3%
Long distance, Cruise, Ferries, Short sea, Offshore	3%
Long distance, Short sea, Inland	3%
Long distance, Cruise, Ferries	2%
Long distance, Ferries, Short sea	2%
Long distance, Short sea, Inland, Offshore	2%
Short sea	2%
Short sea, Inland	2%
Cruise	1%
Cruise, Ferries, Short sea, Inland	1%
Cruise, Ferries, Short sea, Inland, Offshore	1%
Cruise, Inland	1%
Ferries	1%
Ferries, Short sea, Inland, Offshore	1%
Long distance, Cruise, Ferries, Offshore	1%
Long distance, Cruise, Short sea	1%
Long distance, Cruise, Short sea, Inland	1%
Long distance, Ferries, Short sea, Inland, Offshore	1%
Long distance, Ferries, Short sea, Inland, Offshore	1%
Long distance, Short sea	1%
Long distance, Short sea, Offshore	1%
Short sea, Inland, Offshore	1%
Short sea, Offshore	1%
Cruise, Ferries, Short sea, Offshore, Mega Yacht, offshore platforms, naval vessels, main equipment systems, repair and refitting, post sale services	1%
Ferries, Short sea, Inland, Work Ship - Military Ship	1%
Long distance, Cruise, Ferries, Short sea, Inland, Offshore, inland shipping and rail	1%
Long distance, Cruise, Ferries, Short sea, Inland, Underwater vehicles surveying and robotics	1%

Long distance, Short sea, Inland, Operations in ports, logistics nodes and transhipment	1%
Yachting	1%
Ports	1%
Container terminal equipment	1%
Cabotage	1%
Training	1%
Training institution	1%

IWT is in first place with 20% of the responses, meaning that 20% of the respondent's organisation are exclusively focusing on IWT. However, the remaining combinations in the list don't always include inland and are rather oriented at the maritime sector. Short sea and deep sea, individually or in combination, are the most common in the table.

The questionnaire results provide a good overview of the innovation topics that organisations in the waterborne transport sector are currently focusing on. One of the multiple-choice questions in the questionnaire offered the option to indicate what the main innovation topics are that the organisation is currently focusing on. Figure 30 below illustrates the results and provides an overview of the topics that have been raised.

Figure 30: Innovation topics



The motivation for the focus on these innovation topics stems from a number of factors. The following combinations of motivations were raised the most in the questionnaire:

Table 7: Motivations

Motivation	Count
Social, Economic, Technological	14
Technological	11
Political, Social, Economic, Technological	10
Economic, Technological	10
Economic	9
Social, Economic	5
Social	4
Social, Technological	3
Political, Social, Economic	3
Political	3
Political, Social	2

In addition to the available aforementioned options (political, social, technological and economic), respondents had the opportunity to raise other or additional options. Table 8 provides an overview of these other and/or additional motivations.

Table 8: Other motivations

Motivation	Count
Technological, More efficient logistics chains	1
Technological, Experience	1
Social, Economic, Technological, we want to help in the Climate Change battle	1
Social, Economic, Technological, have a best and good life future	1
Social, Economic, Improve the competitiveness of the port cluster	1
Political, Technological	1
Political, Social, License to grow - License to operate	1
Political, Social, Environment	1
Political, Social, Economic, Technological, Environmental	1
Political, Social, Economic, Technological, Educational	1
Political, Social, Economic, Environmental, Safety	1
Political, Economic, Technological	1
Political, Economic, environmental	1
Permanent research topics	1
Improving supply chain efficiency and sustainability	1
Energy transition	1
Economic, Technological, the drive to really achieve zero emission inland shipping	1
Economic, Technological, safety	1

Annex V – Best-practice dissemination examples

Some quality websites, congresses, platforms, etc. used to disseminate the results from research project(s) stated by the respondents are as follows:

- International Conference on Ocean, Offshore, and Arctic Engineering - https://asmedigitalcollection.asme.org/OMAE
- Symposium of Marine Propulsors - https://www.marinepropulsors.com/
- Terminal Operations Conference Europe - https://www.tocevents-europe.com/en/About/about-toc-europe.html
- International Conference on Maritime Technology and Engineering
- International Congress of the International Maritime Association of the Mediterranean - http://www.imamhomepage.org/
- TEN-T Days - https://2020.tentdays.eu/2020/home
- Transport Research Arena - https://traconference.eu/
- Pro Danube, Danube Conference - https://prodanube.eu/
- International Symposium on Practical Design of Ships and Mobile Units
- Regular meetings of the Romanian Shipbuilders Association
- VSM Information Newsletter - https://www.vsm.de/en/services/publications-and-media/newsletter?page=1
- The European network for lightweight applications at sea - www.e-lass.eu
- Innovation projects of Fincantieri - https://www.fincantieri.com/en/innovation/innovation-projects/
- Center of Maritime Technologies gGmbH - www.cmt-net.org
- Sea Traffic Management - https://www.seatrafficmanagement.info/
- CLIN ROBOTICS - www.cliin.dk
- RIS COMEX - www.riscomex.eu
- IALA Standard - https://www.iala-aism.org/product-category/publications/standards/
- Blue Week, Royal Institute of Naval Architects conferences - https://www.rina.org.uk/
- Danube business talks - https://www.danubebusinesstalks.org/
- Seatrade Rivercruise Convention - https://www.seatrade-europe.com/
- https://www.schuttevaer.nl/
- Nieuwsblad Transport - https://www.nt.nl/
- Intermodal Europe - https://www.intermodal-events.com/en/home.html
- International Marine Design Conference - https://imdc2022.org/
- World Conference on Transport Research - https://www.wctrs-society.com/
- International Association of Maritime Economists - https://iame2021.org/
- IAMOT - https://iamot2021.org/
- Computer Applications and Information Technology in the Maritime Industries - http://www.compit.info/
- Society of Naval Architects and Marine Engineers - https://www.sname.org/
- Institute of Marine Engineering, Science & Technology - https://www.imarest.org/
- DIMECC - https://www.dimecc.com/dimecc-services/one-sea-ecosystem/
- Baltic Marine Environment Protection Commission - https://helcom.fi/about-us/
- PIANC Smart Rivers Conference - https://www.pianc.org/pianc-smart-rivers-conferences

- PIANC World congress - https://www.pianc.org/upcoming-pianc-world-congress-1
- Blue Med - http://www.bluemed-initiative.eu/
- MLBKT congress
- Digital lifebelt workshop
- SMM - https://www.smm-hamburg.com/
- Donso Shippingmeet - https://donsoshippingmeet.com/
- International Offshore Wind Technical Conference – https://event.asme.org/IOWTC
- European Wave and Tidal Energy Conference - https://ewtec.org/
- International Society of Offshore and Polar Engineers – https://www.isope.org/
- Computational Methods in Marine Engineering – https://congress.cimne.com/marine2021/frontal/default.asp
- Connecting EU - https://www.connectingeuinsights.net/
- TOC Worldwide - https://www.toc-events.com/en/toc-digital.html
- Greenport - https://www.greenport.com/
- LinkedIn - https://www.linkedin.com/
- Navalia - https://www.navalia.es/en/
- Composites World magazine - https://www.compositesworld.com/
- Maritime Journal - https://www.maritimejournal.com/
- Cordis - https://cordis.europa.eu/
- EU LNG Breakthrough project - www.lngbinnenvaart.eu
- EU project Logistar - https://logistar-project.eu
- EU MITIGATE project - https://web.archive.org/web/20181113062024/http://www.mitigateproject.eu/
- EU Green c ports project - https://greencportsproject.eu/
- EU Ruby project - https://www.rubyproject.eu/
- EU h2ports project - https://h2ports.eu/
- EU TARGET project - http://www.targets-project.eu/