D 3.3 Results of the first consultation phase: Trends and drivers for change
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1. Introduction

STEERER (Structuring Towards Zero Emission Waterborne Transport) will coordinate the establishment and communication of a Strategic Research and Innovation Agenda¹ and an Implementation Plan towards zero-emission waterborne transport, in cooperation with all key stakeholders needed to facilitate the transformation to clean waterborne transport. In the definition of STEERER, as well as cutting greenhouse gas emissions, all harmful environmental emissions, water pollution and noise emissions have to be eliminated. STEERER’s mission is to bring the various initiatives and sectors’ stakeholders together to join forces for a combined effort with the maximum impact for the climate, people’s health and Europe’s economy.

STEERER is coordinated by the Waterborne Technology Platform (SEA EUROPE is responsible for its secretariat), counting with the participation of a total of seven partners from six EU countries.

Figure 1: STEERER’s Partners

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

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

The consortium will function as a Secretariat, where the broader expertise is involved in the Scientific Committee (SC) and the Green Shipping Expert Group (GSEG)\(^3\) to be established by the project.

STEERER is funded by the European Commission research and innovation programme Horizon 2020, with an investment of 1,5 million euro over the course of 36 months, starting in December 2019. STEERER will play an important role in the preparation and execution of the candidate co-programmed Partnership on Zero-Emission Waterborne Transport to be established in the context of the new programme for Research and Innovation currently under negotiation: Horizon Europe.

\(^3\) https://www.waterborne.eu/projects/coordination-projects/steerer/green-shipping-expert-group/member-list?view=members
2. The STEERER Consultation process overview

The STEERER project heavily relies on the involvement of a broad spectrum of experts and stakeholders with the aim to discuss and validate the work carried out by the project consortium.

During the first months of the project implementation, STEERER managed to establish the three main consultation bodies to serve this purpose: (1) the Scientific Committee (SC); (2) the Green Shipping Expert Group (GSEG); (3) the Broader Group of Stakeholders. Their composition and main functions are the following:

(1) The Scientific Committee (SC) consists of experts nominated by carefully selected stakeholders, supporting project partners through the provision of scientific advice, in the consolidation of various inputs and in the preparation of agendas and meeting documents for the Green Shipping Expert Group.

(2) The Green Shipping Expert Group (GSEG) consists of experts nominated by carefully selected stakeholders, as well as representatives of the European Commission Services. The GSEG will be beneficial in exchanging opinions, experiences, best practices and other relevant issues between the different segments of waterborne transport. The work in the GSEG will contribute to the exchange of information, allow identifying possible synergies, creating the economies of scale (when involving more segments) and as well common motivation towards a “long-term vision for a prosperous, modern, competitive and climate-neutral economy by 2050”. It is therefore the key consultation body created by the STEERER project, and it is expected to continue as a legacy of the project after its end.

(3) The Broader Group of Stakeholders encompasses all stakeholders with major interests in waterborne transport or those that might be affected by it: industry, transport operators, cities and regional authorities, research institutes, citizens’ organisations, etc. They are consulted in the course of the project through interviews, ad hoc meetings, and online surveys.

The overall STEERER consultation process is divided in four clearly defined phases, each having specific objectives and expected results:

- Presentation of the state-of-play in waterborne transport and discussion about potential drivers of change that would enable to move towards zero-emission waterborne transport by 2050.
• Discussion about possible future scenarios at different time-horizons (25-30-50), potentially reaching consensus over the definition and quantification of the respective targets to be achieved.

• Work on a common vision, identifying areas of intervention and priorities to achieve the targets as well as threats and opportunities for the waterborne transport sector.

• Discussion on a draft version of the STEERER (Strategic R&I) Agenda and Implementation Plan to amend them as appropriate and reach consensus.

The following figure represents the overall process, the activities envisaged, and the actors involved.

Figure 2. STEERER Consultation process overview.

To set the frame for starting the consultation process we have:

• Organised an Open Call for the establishment of the Scientific Committee (SC) and the Green Shipping Experts Group (GSEG);

• Organised the Selection process and consolidation of the SC and the GSEG.
a. Open Call for the Green Shipping Expert Group

The Open Call was announced to invite the key stakeholders of the waterborne transport sector to apply for the GSEG, which was defined as follows:

The GSEG is the key consultation body created by the STEERER project. The group will be at the core of the experts and stakeholders’ consultation process during the project’s duration and will remain as a legacy of the project after its end.

The GSEG consists of a limited number of key experts (40 individuals) representing the broader waterborne transport sector representatives of the European Commission, National and European relevant initiatives as well as a number of sector frontrunners combined with the organisations needed to get the broader sector involved will be part of the GSEG.

The main objective of the GSEG is to agree upon the input to the Waterborne TP regarding the development and update of the Strategic Research and Innovation Agenda of the cPP ZEW and its implementation plan. In order to be able to reach this objective, a number of key items will have to be discussed and agreed upon by the members of the GSEG:

- To agree upon the emission targets in 2025, 2030 and 2050;
- To prioritise research and innovation needs per segment of the waterborne transport sector;
- To identify possible elements of the implementation plan;
- To agree upon the input for the update of the SRIA cPP ZEW.

To be able to reach these objectives, the following documents will be prepared by the STEERER Consortium and the Scientific Committee which will be discussed during meetings of the GSEG:

The GSEG main tasks were defined as follows:

- Participating in four face-to-face workshops and on-line surveys, in line with the STEERER consultation process (Fig 1);
- Providing inputs to online consultations to a broader group of stakeholders, which would include on-line questionnaires.

In total, 51 applications were received for the GSEG through the Open call, and 40 experts were selected for the GSEG following the criteria presented in the next section. The other experts were included into the broader list of stakeholders.
b. Selection process and final composition of the GSEG:

The STEERER Consortium took the following criteria into account when assessing applications for the GSEG to establish a qualified and balanced group of experts:

- Proven and relevant competence and experience obtained by exercising activities that are directly associated with (the greening of) different segments of the waterborne transport sector (maritime shipping and/or inland navigation), including at European and/or international level;
- Capacity to participate effectively within the group and as an individual represent the expertise shared by stakeholders in their category of profiles;
- Ensuring European added value;
- Hierarchical level in the organisation and/or capacity to undertake the expected duties.

When defining the composition of the GSEG, the STEERER Consortium aimed to ensure a high level of expertise, broad stakeholder engagement, including, academia, NGO’s and authorities, as well as a balanced representation of relevant fields, while taking into account the specific tasks of the group, the type of expertise required, the relevance of the applications received and broad geographic balance.

The final composition of the GSEG consists of 40 individuals, i.e. experts, representing a well-balanced mix of different sectors of the broader waterborne transport sector. Geographic balance was also ensured.

The GSEG members’ list was published on the official web-site of the project:

2. The first phase of the consultation process

The first phase of the consultation process has been successfully concluded, and the main results reported in the following chapters.

The steps to organise the first part of the consultation process of STEERER consisted of:

- Organisation of the first meeting of the GSEG;
- Off-line consultation (via mail) on the trends, drivers and their impact on the waterborne transport sector with the members of the GSEG;
- Open consultation (via an online survey) with a broader list of stakeholders to assess the identified trends in terms of their importance and uncertainty.

a. The first meeting of the Green Shipping Expert Group

The four face-to-face workshops were planned to take place between April 2020 and April 2022; however, they were postponed because of the COVID-19 pandemic.

The first meeting was organised on Zoom on December 16\textsuperscript{th} 2020 (3 hours), as presented in the Agenda of the meeting (Annex 1).

All members of the Green Shipping Experts Group took part to the meeting and actively contributed to its success. Representatives from the Waterborne Technology Platform and the European Commission also participated to the kick-off of the STEERER consultation process and presented the Co-Programmed Partnership on Zero-Emission Waterborne Transport (CPP ZEWT), under preparation in the framework of Horizon Europe. The alignment of STEERER with the CPP ZEWT was announced to be key for the future development of both initiatives, in their common efforts to support the European Union towards the transition to a climate-neutral continent, as announced in the European Green Deal.

The first meeting was also the occasion for ISINNOVA, responsible for the overall consultation process, to present to the GSEG members the different steps of the process, which will run according to the foresight methodology and scenario building approach. The foresight methodology is used to anticipate plausible futures, investigate uncertain changes, and adopt a long horizon time, for instance 5-25 years.

In the first step, the aim was to look at global and general trends and seeds of change that might (or might not) affect the waterborne transport sector in the future. The trends have been previously
defined by the consortium, according to five categories following the STEEP method: social, technological, economic, environmental, and political. About five trends for each category were presented to the audience to be further discussed in break-out sessions and validated.

**List of participants according to the STEEP groups – Annex 2.**

**b. Off-line consultation with the GSEG**

After the participatory exercise that took place during the GSEG kick-off meeting, the STEERER consortium consolidated the results of the groups discussion and send the preliminary results to the GSEG members to collect their feedback.

Responses received by the GSEG were quite positive and a number of suggestions and further inputs were provided to help the STEERER consortium in the consolidation of the results and compilation of the present deliverable.

**c. Open consultation**

An open consultation with the broader list of stakeholders was organised in the form of an online survey. The aim was to evaluate the main trends relevant for the waterborne transport sector, which wereidentified in cooperation with the GSEG.

The survey was open for almost four weeks; and it was promoted through:

- the newsletter of the STEERER project,
- the newsletter of Waterborne Technology platform,
- the project’s social media, such as Twitter and Linkedin,
- the partners’ networks.

In total 40 responses were collected in this period of time, with more than 200 “views” of the survey (meaning that some audience opened the link but did not reply to the survey). This indicates a good outreach of the survey despite the response rate is lower than the “view” rate. Indeed, the survey required rather high level of expertise and also more than 20 minutes for responding. However, a positive aspect is that almost all respondents entered their name and organisation (which was not obligatory) and they all show high-level expertise in the waterborne transport sector, which confirms the relevance of the survey’s results.
Following the foresight process – a methodology which allows to shape alternative plausible futures – the respondents were asked to evaluate each trend on two key criteria: Impact and Uncertainty.

The impact and uncertainty criteria were defined as follows:

• **Impact** - The concept of impact encompasses that of importance and of expected effect. In practice, a trend will have a strong impact if its future development is likely to generate or considerably accelerate significant change.

• **Uncertainty** – the concept of uncertainty relates to the difficulty to predict the trend, whether it will become robust, its direction, its speed of development. The concept of uncertainty is directly instrumental in assessing the role that future strategic choices, investments, or R&D activities can play in orienting and steering change in the most desirable direction.

The survey indicated that the data will be treated confidentially, and that the results will be reported on an aggregated level without any identification possible.

Please see the survey in Annex 3 and the results of the survey in Chapter 4.
3. Results from the consultation with the GSEG

The consultation with the Green Shipping Experts Group helped identifying a total of 26 trends relevant for the waterborne transport sector, which have been organised according to the STEEP method (Social, Technological, Economic, Environmental and Political).

a) **Social Trends (ST)**

| ST 1. Demographic change and migration: an increasingly developed world population demanding more trade towards different parts of the world. |
| ST 2. Increasing awareness of the environmental impact of transport influencing decisions of customers to buy locally / travel differently. |
| ST 3. Continuous evolution of consumption and shopping patterns influencing production and transport requirements (e.g. online shopping). |
| ST 4. Increasing social pressure to address Climate Change, air pollution and biodiversity. |

b) **Technological Trends (TT)**

| TT 1. Higher (energy) efficiency through increasing economies of scale in the entire waterborne transport sector (vessel size, ports, etc). |
| TT 2. An increase of the capacity of the inland waterways throughout Europe combined with clean power generation. |
| TT 3. Increasing need for a coherent sustainable alternative fuel supply network. |
| TT 4. Increasing importance of standards and interoperability. |
| TT 5. Declining energy storage costs (e.g. batteries). |
| TT 6. An increasing role of local governments being first movers in innovative/green ship operations. |
| TT 7. European maritime technology is leading innovation. |
c) Economic Trends (ET)

<table>
<thead>
<tr>
<th>ET 1</th>
<th>An increasing importance of the green transformation as European industry is recovering from the COVID-19 pandemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 2</td>
<td>Increasing investments to explore green opportunities within new markets</td>
</tr>
<tr>
<td>ET 3</td>
<td>Increasing green shipping business opportunities</td>
</tr>
<tr>
<td>ET 4</td>
<td>Insufficient public funding to support the transition to zero-emission ships in ports and operations combined with more costly sustainable alternative fuels</td>
</tr>
</tbody>
</table>

d) Environmental Trends (EnvT)

<table>
<thead>
<tr>
<th>EnvT 1</th>
<th>Increasing temperatures and sea level rise</th>
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</thead>
<tbody>
<tr>
<td>EnvT 2</td>
<td>An increase of fluctuating water levels of the inland waterways throughout Europe.</td>
</tr>
<tr>
<td>EnvT 3</td>
<td>More extreme weather events.</td>
</tr>
<tr>
<td>EnvT 4</td>
<td>Growing concerns on the environmental impacts of feedstocks for the production of biofuels which may challenge ecosystems.</td>
</tr>
<tr>
<td>EnvT 5</td>
<td>Increasing air pollution concerns within cities as well as sensitive nature areas (Natura2000)</td>
</tr>
</tbody>
</table>

e) Political Trends (PT)

<table>
<thead>
<tr>
<th>PT 1</th>
<th>An increasing number of European and international policies to reach SDGs and achieve emission targets.</th>
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</thead>
<tbody>
<tr>
<td>PT 3</td>
<td>Increased environmental ambitions (GHG, emissions to air and water) backed by regulations, market measures, incentives and industry initiatives.</td>
</tr>
<tr>
<td>PT 4</td>
<td>An increased political focus on the use of Inland Waterway Transport (IWT), coastal SSS and rail to carry inland freight, backed by EU policies.</td>
</tr>
<tr>
<td>PT 5</td>
<td>Continuing two speed approach with Europe taking the lead in cutting emissions.</td>
</tr>
<tr>
<td>PT 6</td>
<td>China’s raising leadership in the world-wide geopolitical context.</td>
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</table>

The GSEG also provided useful ideas on the identification of the main drivers of change and the potential impact on the waterborne transport sector for each trend, which is presented in the following sections.
Social Trends

ST 1. DEMOGRAPHIC CHANGE AND MIGRATION: AN INCREASINGLY DEVELOPED WORLD POPULATION DEMANDING MORE TRADE TOWARDS DIFFERENT PARTS OF THE WORLD.

Short description: With significant changes ahead in the structure of the world’s population, such as demographic change and migration, demography is set to remain one of the main factors shaping global trade flows. The demographic growth comes together with the growth of wealth and increase of income classes, which leads to higher consumer spending and stronger need for transportation. For long, Europe had a position at the centre of the global trading system. The rise of Asia’s population prefigured its role at the heart of the global economy in the future, changing the trade patterns. (Harding 2017)

Drivers:

- **Continued population growth in Africa, Asia and South America** - Africa’s population is expected to double by 2050 (Sub-Saharan Africa’s population is growing at 2.7% a year, which is more than twice as fast as South Asia (1.2%) and Latin America (0.9%)). (The Economist 2021)
- **Urbanization processes** - share of people in urban areas is expected to be 60% in 2030.

EU specific drivers:

- **Longer life expectancy** - Life expectancy for Europeans has increased by about 10 years. Even considering the COVID-19 crises which exposed greater risk for elderly, it is still expected that the overall positive trend on life expectancy will remain.
- **Fewer births** - in the last 50 years the average number of childbirths per women decreased. Women also in average give birth to their children later in life.
- **An ageing population** - European population is getting older: the median age increases and may reach 49 in 2070.
- **Mobile Europe** – Movement of people in or out of Europe also determines the demographic change. The long-term trend is stable and shows positive net migration, i.e. more people moved into the EU than left.
- **Population size** – The trend of European population growth is set to continue till 2025, when it is expected to have plateau and then decrease after 2030.

(The Impact of demographic Change, 2020)
Impact on the waterborne transport sector: With population growth, the trade flows will be increasing as well, with shift towards countries with high growth rates, leading to the boost of world trade. “Regional trade (e.g. between China, India and Indonesia) and inter-regional trade (e.g. between Africa and Asia) between the growing countries will increase the most.” Shipping activities will be concentrated in these regions in the future and harbors will be further upgraded into regional and global trade hubs. (McLeman, 2021)

ST 2. INCREASING AWARENESS OF THE ENVIRONMENTAL IMPACT OF TRANSPORT INFLUENCING DECISIONS OF CUSTOMERS TO BUY LOCALLY / TRAVEL DIFFERENTLY.

Short description: Consumers are becoming more aware of the environmental footprint of transport which is reflected in a change of their consumption habits. The tendency to buy local is a recent phenomenon, which became much stronger with the COVID pandemic. As a result, people tend to rely less on global trade, preferring to pay more for clean local products and services. ‘Localism’ is forecast to be a major post-pandemic trend, which might lead to changes or even disruptions in supply chains in the future.

Drivers:

- Increased coverage of green campaigns, particularly relevant for young citizens.
- Protectionism encourages local production through indirect subsidies from consumers to producers to drive local farmers and businesses
- COVID-19 crisis which has driven a surge in “localism” around the world, with a lot of consumers now preferring to buy goods and services from their own country.

Impact on the waterborne transport sector: The waterborne transport sector is becoming more socially and environmentally responsible, in order to react on regulatory pressure but also on the market demand for lower environmental impact in the entire value chain. For example, by adopting voluntary standards on emissions levels or safety. More stringent regulations will follow. In addition to regulation, it is likely that marked based mechanisms for lower emissions will further expand. Examples today include the Poseidon Principles and Sea Cargo Charter, leading to the waterborne transport sector needing to be compliant to both market and regulatory demands.
ST 3. CONTINUOUS EVOLUTION OF CONSUMPTION AND SHOPPING PATTERNS INFLUENCING PRODUCTION AND TRANSPORT REQUIREMENTS (E.G. ONLINE SHOPPING).

Short description: Anything, Anytime, Anywhere – Consumers strive for convenient solutions in all aspects of their lives. On-line shopping is on the rise, further boosted by the general lockdowns during the COVID pandemic. These changes in consumer behavior will influence all the actors in the value chain, including transportation (Monitor Deloitte, 2020).

Drivers:

• **Busy lifestyles and higher incomes** – having very busy working schedules, more consumers order food delivery and in general have more out of home consumption including to-go snacking. Also, with intense rhythms consumers order clothing more often on-line.

• **Decreasing household sizes** – single-persons’ small households are increasing, and there is little space for food storage. That is why consumers need to do more often micro-shopping, often on-line and last-minute.

• **Decreasing stocks for the shops** – the stocks are getting smaller in shops, which requires constant transportation of new items.

• **Urbanization** – increasing density and number of people in urban areas require more efficient ways of shopping, such as home-delivery

**EU specific driver:**

• **Aging population** – Elderly people demand close-to-home shopping, medicine and food delivery services.

(Monitor Deloitte, 2020)

**Impact on the waterborne transport sector:** The need of fast deliveries will activate new forms of transportation which in the waterborne transport sector could boost the deployment of innovative small vessels - autonomous vessel units for ordering products, such as for example in Amsterdam. For larger vessels this trend will probably increase the overall transport volumes in line with increasing global trade.
ST 4. INCREASING SOCIAL PRESSURE TO ADDRESS CLIMATE CHANGE, AIR POLLUTION AND BIODIVERSITY.

Short description: Social pressure may have a great effect on addressing climate change. The demand for sustainable behavior from citizens to business and institutions slowly becomes a common behavior, and makes these structures to follow these sustainability norms and, thus, reduce the emissions (Global Institute of Sustainability and Innovation, 2016). This has been noted especially at the EU level, with different citizens’ actions determining a response from national and EU policy makers towards adopting more ‘green’ policies in the last years.

Drivers:

- **Growth of movements around the climate change**, which includes increased collective action of nongovernmental organizations and active citizens.
- **Growth of media addressing the topic of climate change** – Media has a crucial role in influencing awareness, attitudes and knowledge on climate change. (Mavrodieva et al. 2019; Junsheng et al. 2019)
- **Increased awareness** of climate change, which includes “climate literacy” of citizens acknowledging the need to sustainably manage the limited resources.
- **Young citizens** - they are not only aware of the climate change and feel the pressure to address it but also have readiness for this change.
- **Increased citizens’ pressure through various means** in order to achieve more environmental-friendly political action. This has been translated first in the positions of different think tanks, NGOs, etc. towards ‘greener’ policies and the national and EU levels.

Impact on the waterborne transport sector: Social pressure to address climate change influences the waterborne transport sector towards a reduction of the carbon footprint of the world’s waterborne transport fleets. “A whole host of technologies are being explored including low carbon fuels, more streamlined hulls, more efficient propeller design, improved voyage planning to make savings on fuels, better hull coatings and even air cushions to reduce friction”. (Go-Maritime, 2015)

With decarbonization being a main target, the operators need to ensure that they stay up to date and comply with new regulations on environment. There are also optimization processes: from improving the logistics to optimizing the chains for ports and ships (Meidanis, 2019).
Regarding regulations at the international level, in April 2018, the International Maritime Organisation (IMO) adopted an initial climate change strategy under which international shipping must reduce the GHG emissions by at least 50% by 2050.

Thus, IMO identifies 4 major pathways towards emissions reductions:

- energy efficiency;
- sources of energy;
- fuels with low carbon;
- new technologies (reliability, regulatory constraints, cost).

Regarding regulations at the European level, political decision-makers have cited citizens’ concerns and actions as part of the motivation for proposing far-reaching environmentally-friendly policies and legislation that are interconnected, such as the European Green Deal, the Climate Law and, most recently, the ‘Fit for 55 package’. As these measures are connected to other trends and drivers, they are explained in more detail further below, in the most relevant cases.

**Inland navigation specific:** inland navigation is amongst others regulated by the CCNR (Central Commission for the navigation of the Rhine) as well as at European level. In the Declaration signed in Mannheim on 17 October 2018, the transport ministers of the Member States of the CCNR (Germany, Belgium, France, Netherlands, Switzerland) reasserted the objective of largely eliminating greenhouse gases and other pollutants by 2050.

In regards of regulations at European level, an additional driver is needed for the inland navigation sector: a reliable and uniform certification is needed applying not only for EU countries but also for neighboring countries. Vessels, certified in non-EU countries, can navigate free of charge on the river Danube without complying with EU measures.
b. Technological Trends

**TT 1. Higher (energy) efficiency through increasing economies of scale in the entire waterborne transport sector (vessel size, ports, etc).**

**Short description:** Efficiency improvement is a continuous process in shipbuilding, ship equipment and ship operations, which translates into optimized profits and reduced environmental impacts. Bigger ships lower the impact per transported ton of cargo or per passenger and provide for economy of scale, as long as they are technically feasible. However, growing markets (GDP growth with world population growth at the same time) and adapted infrastructure are required to allow for this type of efficiency improvement.

**Drivers:**

- **Regulations:**
  - Regulations (IMO and EU) require reduced emissions, which can be achieved including through energy efficiency measures
  - The CII, EEXI, EEDI, SEEMP require better ships “every year”
  - Taxes, ETS are announced as incentives to become more efficient, i.e. if emission taxes are introduced, then transport becomes more expensive, which would lead to use of more efficient measures, energy efficient technical and operational solutions and sustainable alternative fuels.

- **Synergies with the power sector** – in technology development as well as exhaust gas cleaning and clean fuels.

- **Social responsibility** of ship owners/operators and the need for improving the image of waterborne transport towards sustainable transport.

- **Financial motivation** of ship owners – higher profits from more efficient ships.

- **Booming markets,** meaning GDP growth with world population growth at the same time.

- **Technical possibilities:**
  - Energy converters market is adapting – offering dual fuel engines, hybrid energy systems, etc.
o More energy efficient technical and operational solutions for the categories of bigger ships, such as larger cruise ships & larger container vessels

Impact on the waterborne transport sector:

Building larger ships requires huge investments which is giving the market leaders a competitive advantage over newcomers (such as largest ports in Asia, Korea and China for shipbuilding). Europe will most probably not reenter the bulker and container shipbuilding market and remain leader in high complex, high value-added ship types. Also, big ships require big ports which would concentrate congestion in few port areas in the world, and intensify short sea shipping and inland waterway transport around them. However, it is expected that the more energy efficient equipment will at least consolidate, if not increase, the market share of EU companies. This will also help reduce the (initially) estimated need for green energy and/or clean fuels for the maritime sector, which will lead to lower costs and a lower burden in terms of energy production and infrastructure.

Note: It is important to note that in terms of energy efficiency, maritime transport is far less energy intensive than road transport. Taking into account that there is no surplus of green electricity today, and there won’t be anytime soon, it makes maritime transport more sustainable and better off in the pathway towards zero emissions.

Risks: Large ships will require larger ports capable of handling this type of ships, which is a risk for the European market, because only few of European ports have this technical capacity, which adds to the financial pressure for (part of) the waterborne transport sector, because only a few of the EU ports have this technical capacity at the moment.

TT 2. An increase of the capacity of the inland waterways throughout Europe combined with clean power generation.

Short description: Inland waterway transport plays an important role for the transport of goods in Europe, including country specific differences within the total transport volumes. More than 37,000 kilometers of waterways connect hundreds of cities and industrial regions. 13 Member States have an interconnected waterway network. There is an important potential for increasing the modal share of inland waterway transport. (Mobility and Transport – EC, 2020). This trend is particularly relevant for Eastern Europe and Saint Canal in France. Navigability will be improved
particularly on the Danube. There are projects currently running to upgrade the locks to go down to Serbian-Romanian section, which has a rather long-term perspective.

Drivers:

- **Growing trade** while **limited transport possibilities** where waterway is the ‘last’ available source;
- There are huge **unused infrastructure capacities for inland navigation**, for example approx. only 10% of the capacity is used on the Danube.
- Countries opt for their own clean power generation and inland waterways can function as transport route of high and heavy / oversized equipment to build up the applicable facilities (e.g. wind turbines) or as a source of clean power generation.
- Inland waterways can also function as transport route for clean energy carriers.
- **Cruise market is growing** (mainly in the western part of the EU, but also on the Danube).

**Impact on the waterborne transport sector:** In order to achieve sustainable transport at EU level, the inland waterways should be more strongly involved. Inland waterway transport is still underused in most parts of the EU, while it has a high potential to play an increasing role in moving goods to the hinterland and in linking the European seas”. Huge opportunities also exist for inland waterway transport on new markets like circular economy (wastes) or continental containers.

Note: It will be a challenge for waterborne transport to remain competitive from an economic and an environmental point of view against road transport that has a faster uptake on technological trends (e.g. automation) – at least faster than waterborne transport. One of the main explanations is the shorter life cycle of the road transport fleet. Freight transport by road is managed by relatively large companies, leasing trucks for 4-7 year and changing them afterward with new ones incorporating the latest technologies. This process is completely different for inland waterway transport companies, which are traditionally small, and family based, with limited R&D budgets and limited capacity to invest. There are twelve thousand vessels in Europe, and hundreds of thousands of trucks.

(Mobility and Transport – EC, 2020).

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4 The actual lifetime of a truck is up to 15 years, in service with smaller companies, though the drive for innovation is indeed pushed by the bigger companies.
TT 3. INCREASING NEED FOR A COHERENT SUSTAINABLE ALTERNATIVE FUEL SUPPLY NETWORK.

Short description: Today the transitional-alternative fuel available for maritime, particularly for bigger ships, is LNG. It is a fossil fuel; however, it has significant less (approx. 80% as compared to oil based alternatives) CO₂ emissions, compared to conventional petroleum fuels. However, a major challenge for LNG are the methane emissions, which represent a more potent GHG contributor than CO₂ (though shorter-lived). These emissions can also be calculated as CO₂ equivalent. Yet progress has been made in RD&I terms to address this problem for new engines, and also during operations. This means that LNG can certainly contribute to achieving the 2030 targets, though it cannot do so as the only less polluting solution; to a lesser extent, LNG can even contribute to the 2050 targets, provided that the overall transition from fossil fuels to clean propulsion systems is done fast enough. It took approximately 15 years and significant investments to take LNG to the current level, with the possibility to bunker it and shipowners willing to use it on a large scale. (See Figure 3 - Ports where LNG infrastructure is already available).

However, methanol has the potential to become one of the alternatives, alongside, among others, ammonia and hydrogen in the nearest future as most ports have already the necessary infrastructure to store it and use it (since methanol is liquid, basically diesel infrastructure can be used/adapted). It is also clean as LNG in terms of emissions and mostly fossil based. (See Figure 4 – Ports where Methanol infrastructure is already available).

In addition, there is an increasing use of batteries and shore power while attempting to provide the electricity from the shore directly, so there is no direct emission inside the harbor. More and more ships start to hybridize. Short distances ferries have a strong trend towards battery electric drives, particularly in Norway (See Figure 5 – Ports where Batteries and shore power infrastructure is already available).
Even though batteries and shore power infrastructure is already available and growing, there are still technical challenges to take into account, especially when it concerns the high power, high autonomy vessels, but also the bigger seagoing ships. The increasing public and private RD&I
efforts in this direction, together with the more stringent and binding climate targets at the EU level, will most likely ensure that this type of infrastructure will expand in the coming years.

*Figure 5 Ports where batteries and shore power infrastructure is available. (Source: Alternative Fuels Insight – DNV-GL)*
Figure 6. Current uptake of alternative fuels and technologies in shipping: there are two ways to make ships clean – by using the clean fuel, or to clean exhaust gas. As the figure below shows - today most of ships sailing with “dirty” fuel but they install the scrubbers to clean the exhaust gas.

Figure 7 demonstrates that LNG is the most affordable fuel and explains why shipowners are willing to shift to LNG. At the same time, methanol and ammonia have almost same price. However, the implementation of methanol is much cheaper than the implementation of ammonia. The good news is that most sustainable alternative fuels have seen a dip in their prices, which will encourage an earlier adoption. And due to the on-going RD&I efforts and the stricter emissions targets enshrined in the EU legislation, this trend will only continue. The exception appears to be in the case of biofuels, which continue to remain very expensive, and therefore hardly used by the waterborne transport sector.

(Source: ICIS, DNV-GL)
Drivers:

- A number of relevant EU policies are going to be updated in this period, mostly through the ‘Fit for 55 package’\(^5\), the most important being:
  
  o The Renewable Energy Directive\(^6\). It will set an increased target to produce 40% of the EU energy from renewable sources by 2030. All Member States will contribute to this goal, and specific targets are proposed for renewable energy use in transport, heating and cooling, buildings and industry. To meet both climate and environmental goals, sustainability criteria for the use of bioenergy are strengthened.

  o The FuelEU Maritime Initiative\(^7\), which will stimulate the uptake of sustainable maritime fuels and zero-emission technologies by setting a maximum limit on the greenhouse gas content of energy used by ships calling at European ports.

  o The Energy Taxation Directive\(^8\), which proposes to align the taxation of energy products with EU energy and climate policies, promoting clean technologies and

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\(^5\) EU economy and society to meet climate ambitions (europa.eu)


\(^7\) FuelEU Maritime – green European maritime space | European Commission (europa.eu)

\(^8\) Revision of the Energy Taxation Directive (europa.eu)
removing outdated exemptions and reduced rates that currently encourage the use of fossil fuels.

- The Deployment of Alternative Fuels Infrastructure Directive (AFID)\(^9\).
- **Lack of engines** for alternative fuels. There is a need for the alternative energy converters to use alternative fuels. However, there is very limited offer for this. Such, methanol engines are entering the markets now, and only few are available since last year. Moreover, there is currently only one supplier who offers the methanol engines in the world.
- **A driver for maritime to utilize** a lower quality side stream from high quality fuel production.
- **Technologies** related to application of renewable energies.

**Impact on the waterborne transport sector:**

There is a general lack of infrastructures for a quick uptake of sustainable alternative fuels in the waterborne transport sector.

For LNG, some local authorities deny building permissions as they consider it not green enough. In Western Europe (Cologne), there is only one fixed bunkering station for LNG for the Inland Waterway Transport sector. In general, alternative fuels need expensive infrastructure (for instance, to cool down hydrogen you need facilities at \(-254\) degrees, \(-163\) degrees for LNG). One positive aspect is that parts of the LNG-related infrastructure can be used in the future, with some adaptations (investments), for other fuels such as hydrogen. Consequently, LNG will be a rather short-term transition fuel for the 2050 targets.

Methanol is liquid and thus easier to handle, and existing infrastructure is suitable for it. However, the methanol needs to be produced from renewable energy sources, as the fossil-based methanol is ultimately responsible for similar or higher GHGs as compared to fossil fuels directly used by the ships today. Other types of alternative fuels can be even ‘cleaner’ but require new (and expensive) infrastructure.

The positive aspect is that prices for both the new fuels and their associated infrastructures, though higher at this moment, are set to decrease in the near future, following the example set by the batteries (see TT 5 below).

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\(^9\) Revision of the Directive on deployment of the alternative fuels infrastructure | European Commission (europa.eu)
Also, safety aspects are important. For example, ammonia is very toxic, and leakage would create enormous problems – though it is traded globally and hence has an existing world-wide infrastructure which can facilitate some level of uptake.

However, the waterborne transport sector is adapting to the ‘new reality’ and has started to invest in more than one alternative fuel to reduce air pollutant emissions. On the vessels side, companies need to be strategic on where to invest as investment decisions are made for 30-40 years.

This adaptation of the European waterborne transport sector will be defined by the aforementioned new or updates EU policies (AFID, RED, etc.) which will bring more clarity both in terms of the decarbonization (technical) choices and the investments required.

**4. INCREASING IMPORTANCE OF STANDARDS AND INTEROPERABILITY.**

**Short description:** Interoperability, which refers to the possibility of systems to connect with one another even if they were developed by different manufacturers, is a crucial part for the future development of the waterborne transport system. Standardization processes are necessary for interoperability and for providing safe, sustainable and efficient waterborne transport services and operations.

**Drivers:**

- Safeguarding investment in infrastructure (LNG bunkering, cold ironing, ...)
- Bunkering guidelines
- European (world)-wide trading, require the need to match for different types of ships manufactured in different countries.
- Cases where standardization is needed:
  - There is an urgent need for standards for LNG bunker barges, because clutch on one side and pomp on the other side need to match in order to be able to use the infrastructure.
  - Similar case with “port plug” for shore power, because often the electricity network is different (voltage and frequency). But they need to be connected – there is a need for converging of the board network with port network.
  - There is also a need to standardize how to account for emissions of fuels over the value chain of fuels. Standardized LCA is needed.
Impact on the waterborne transport sector: The regulatory framework will be constantly updated to ensure sustainable standards in terms of technical and environmental requirements for the sector. Safety standards are going to be of high importance specifically for dangerous cargo, such as ammonia and hydrogen. The standardization process is expected to be long, such with LNG this process took approx. 15 years - long time is needed for standards to implemented.

- On Investment level – There is a need of global standard for technology for creating bigger market.

Inland navigation specific: Since new technologies are very expensive, standardized battery containers coupled with innovative finance instruments could be a solution. This would make it possible for inland shipowners to rent the battery container rather than buying a fixed battery for one-two million euros. This would change the market immediately.

**TT 5. Declining energy storage costs (e.g. batteries).**

**Short description:** Prices for energy storage are going down, because of ever-stringent regulations set by the EU in terms of emissions, economy of scale and competition with existing technologies. This process was triggered by e-cars development, which decreased the costs of batteries in order to enter the market. Prices are expected to further drop thanks to the use of 60-70 % of recycled batteries, following a circular economy approach.
Drivers:

- Political push for Battery Electric Vehicles (BEVs)
- Economy of scale, political demand for BEV, subsidies
- Small electric ferries boom

Impact on the waterborne transport sector: The Impact of this trend is rather limited for now: there are a number of hybrid ships with small batteries on board in Europe as well as several fully electric ships (and some in Korea, Japan and China). More hybrid ships will enter the market, together with fully electric-powered ships and affordable batteries will allow more efficient propulsion while alternative fuels are still expensive. However, RD&I is still needed in this field, as the capacity and performances offered by current batteries are still far from meeting the demand of many waterborne transport operations and the costs are still significantly high.
Example: The world’s largest electric ferry named ELLEN completed its first voyage with passengers in August 2019 in Denmark. It is sailing between the southern Danish ports of Fynshav to Soby, on the island of Aero. The e-ferry is capable of carrying 30 vehicles and 200 passengers and is powered by a battery “with an unprecedented capacity” of 4.3MWh, according to Swiss battery maker Lechanché which provided the system. (Aero Island, 2019)

Comments:

• However, it is important to keep in mind that the raw materials needed to produce the batteries are limited by their low rate of extraction. The decarbonization process will require almost all the available materials. This leads to competition for batteries but also for other fuels. That is why other options for energy sources will have to be considered.

• For the entire economy it is important to have a smart distribution and usage of clean energy and simultaneously improve the efficient use of (sustainable) energy, as energy efficiency is very important in using sustainable fuels. It makes a difference where to spend it.

**TT 6. AN INCREASING ROLE OF LOCAL GOVERNMENTS BEING FIRST MOVERS IN INNOVATIVE/GREEN SHIP OPERATIONS.**

**Short description:** Local governments are often the first buyers of new technologies; they pioneer new solutions to reduce emissions. Sweden is an example of this trend – it has zero emission waterborne transport with proper infrastructure thanks to the commitment of local governments, which made the country becoming a role model for the global shipping community for green shipping. Most governments in Europe already use green standards for contracting: Amsterdam, Rotterdam, and inland lakes (Bavaria) become zero emission areas. They provide goods to the city centers respecting the highest environmental standards. The European Green Deal further stimulated this trend

**Drivers:**

• Regulatory push
  - Climate targets (Paris Accord, EU Green Deal)
  - IMO/EU air pollution regulations
• The willingness of regional/local public bodies to take the lead in climate-related measures, which can also ensure a competitive advantage for the local economies

• Small ferries (non-IMO) are getting alternative propulsion systems installed

**Impact on the waterborne transport sector:** Local governments by implementing these measures accumulate knowledge and become the first drivers, i.e. by their initiatives they can ‘convince’ ship operators to use new technologies. For governments it is often easier to take the financial risks in investments, while private companies would be out of market in case something went wrong. By demonstrating good business cases, the local governments will encourage private companies to invest and use new technologies while at the same time creating markets for the private companies to develop and compete.

**EUROPEAN MARITIME TECHNOLOGY IS LEADING INNOVATION.**

**Short description:** The European maritime technology sector is a key industrial sector for Europe and is still leading innovation worldwide – despite the many difficulties the sector has been confronted with, specifically protectionist policies from Asian competitors. Research, development and innovation (RD&I) is essential for the European waterborne technology sector and it is where it invests almost 10% of the industry’s sales.

When considering complex ships, whenever there is something new and innovative, it comes from Europe. Examples are the light weight applications in Sweden, the 70 m long carbon vessel, to demonstrate the new materials. These examples are becoming a breakthrough for the global market.

**Drivers:**

- The EU’s forthcoming regulations and market measures with respect to decarbonization targets for the waterborne transport sector;

- Passenger demand for green holidays on cruise ships;

- All new ordered Cruisers are LNG powered - for the cruise liners IMO regulating the use of LNG, since then 95% was all LNG.

**Impact on the waterborne transport sector:** The European maritime technology will represent the forefront of innovation in safety standards, enabling the application of new materials and ensuring
a safe “marinization” of innovative technologies. This way, the European maritime technology will both respect and influence the global process of policy making and setting the regulatory frameworks at IMO, CESNI, CCNR, UN-ECE. Moreover, the position of EU shipyards and technology suppliers shall be strengthened by delivering safe and secure ships and vessels, primarily for complex or critical ships and vessels and for new business models (Waterborne, 2019).

C. Economic Trends

ET 1. An increasing importance of the green transformation as European industry is recovering from the COVID-19 pandemic

Short description: The economic recovery of Europe following the COVID-19 pandemic will be a green recovery. The green transition will on the one hand mitigate climate change, and on the other serve to enhance or increase the competitiveness of Europe’s economic base.

Drivers:

Many governments have included "green" recovery measures in their policy packages designed to address the short- and medium-term socio-economic impacts of the pandemic. (OECD 2021)

Impact on the waterborne transport sector:

Since, the European maritime technology sector is world leading in greening technologies, the “green recovery” has the potential to enhance and/or increase its competitiveness, and offer the possibility to re-enter lost markets. However, strong financial incentives are needed to foster this transformation. Governments are pushing for a strong recovery and this is a huge opportunity for the sector to set the focus and to push for the green transformation by incentivising green investments for and by the European waterborne transport sector.
Inland navigation specific:

Inland navigation will have more difficulties in the recovering process, since it is a smaller sector with reduced financial possibilities. The emission targets have been set, but the existing engines are not meeting the new requirements yet. The inland market is so small that OEMs do not yet provide the equipment fulfilling the requirements and needs of the sector. Therefore, possibilities of greening are significantly more limited than for maritime shipowners, which is the reason why the IWT sector has more challenges. Generally, the inland shipping industry tries to adapt maritime technologies for their vessels. Or lately also form the automotive sector, for example with marinized EURO6 truck engines. In addition, the interests of the inland navigation sector are not well represented in the political agenda.

ET 2. Increasing investments to explore green opportunities within new markets

Short description: Big funds stop to invest in old technologies and start to invest in green technologies stimulating the development of new markets.

Drivers:

- Investors have fear to invest in stranded assets, which lead to high risk of no value in the future. That is why green options are the preferred ones.

- Investment companies are on the stock market and, thus, they are (also) interested in selling their shares. Since buyers are interested in future-proof investment funds, companies focus on green investments to meet the demand.

- New Taxonomy regulation\textsuperscript{10}, designed to help meet the EU’s climate and energy targets for 2030 and reach the objectives of the European Green Deal.

Impact on the waterborne transport sector: In line with the trend, investments are oriented towards green technologies also in the waterborne transport sector. The trend largely differs according to the alternative energies considered, as to grow into these new markets, ship building has to meet new requirements. From the financial perspective there is a solid trend to be considered for the waterborne transport sector overall. However, the trend does not apply for inland navigation. With

\textsuperscript{10} EU taxonomy for sustainable activities | European Commission (europa.eu)
hardly any investments, the sector is still far away from being considered as new market opportunity.

A relatively new market in the waterborne transport sector is offered by the offshore windfarms, with a strong focus on the CO₂ reduction and progress towards green solutions. Offshore wind is an opportunity for the shipping industry to increase its decarbonization. In general, these new opportunities can generate new businesses and new markets (new type of vessels, such as hydrogen carriers or offshore support type of activities).

**ET3. Increasing Green Shipping Business Opportunities**

**Short description:** Because of regulations and consumers demanding emission-free ships and green requirements in public procurement of transport services, the demand for green ships is increasing, opening new business opportunities.

**Drivers:**

- **Bottom-up:** consumers are strongly pushing for green shipping, and their demand is strong enough to make ship building meeting their request.

- **Top-down:** governments require greening measures over the entire supply chain with strong regulations (EU and IMO).

**Impact on the waterborne transport sector:** On the one hand, the development and production of sustainable alternative fuels will have an impact on the waterborne transport routes, and different types of cargo will enter the market creating new business opportunities. On the other hand, customers will increasingly demand products with a green footprint. The way shipping is doing the business is largely influenced by the consumer side. Big companies transporting large volumes can push waterborne transport towards the green transition. And customers (shippers, cargo owners) will push for ships with a green footprint, whether that push comes directly and increasingly from consumers remains to be seen.
ET 4. INSUFFICIENT PUBLIC FUNDING TO SUPPORT THE TRANSITION TO ZERO-EMISSION SHIPS IN PORTS AND OPERATIONS COMBINED WITH MORE COSTLY SUSTAINABLE ALTERNATIVE FUELS

Short description: Despite the strategic importance of the European waterborne transport sector, public funding linked to the green recovery of Europe will be dispersed among different industries. This process is combined with the necessity to use sustainable alternative fuels, which are more costly than fossil fuels.

Drivers:

- **Top-down:** for most politicians the waterborne transport sector is not a priority area to invest in because of the voters’ low awareness of the sector. In terms of publicity and costs of investments, road, rail or air transport are seen as more ‘profitable’ as compared to waterborne transport; the investments needed for inland waterways on the other hand can be lower or similar.

- **Bottom-up:** Public funding for greening the waterborne transport sector is limited because consumer demand for green footprint is concentrated mainly on the transportation of final products: when we transport products such as shoes or clothes, green sensitivity of the citizens might be high. However, the transported volume is largely made up of other materials such as bauxite which leaves much stronger footprint, but consumers are not aware of it. Thus, the consumer side does not “push” enough for greening the sector “stimulating” public funding.

Impact on the waterborne transport sector: Economic incentives are necessary to help the transition towards sustainable alternative fuels and electrification because they are more costly. In addition, with the diversified waterborne transport sector, and the competition with other industries when it comes to sufficient quality and quantity of sustainable alternative fuels, public support will be indispensable. This will regard both the development as well as the deployment of technologies to ensure the use of sustainable alternative fuels (including electrification) by ships and in ports. Indeed, new business model are essential since the process needs to be economically viable.

However, there is another trend that can be observed. The global private sector is starting to influence the speed of the change. Banks are directly speaking to operators, networks of stakeholders are joining forces to reduce uncertainty and shipping companies are knocking on the
doors of private funders. While there will still be an important role from the public authorities in all scenarios, the market has shown that it can move without waiting for the state to finance the initial move.

d. Environmental Trends

ENV T 1. INCREASING TEMPERATURES AND SEA LEVEL RISE

**Short description:** Climate change is leading to a further increase of temperatures, and thereby a significant increase of the sea level. Sea level is rising because of two mechanisms. First, as the oceans warm due to an increasing global temperature, seawater expands—taking up more space in the ocean basin and causing a rise in water level. The second mechanism is the melting of ice over land, which then adds water to the ocean (NOAA's National Ocean Service 2009).

**Drivers:**

- **Global warming** is the primary cause of the current sea level rise. Human activities, such as burning coal and oil and cutting down forests, have increased atmospheric concentrations of heat-trapping gases and caused the planet to warm by 1.4 degrees Fahrenheit since 1880.

- **Rising temperatures** are warming ocean waters, which expand as the temperature increases. This thermal expansion was the main driver of global sea level rise for 75 - 100 years after the start of the Industrial Revolution, though its relative contribution has declined as the shrinking of land ice has accelerated.

- **Land ice—glaciers.** Ice caps, and ice sheets are shrinking at a faster rate in response to rising temperatures, adding water to the world's oceans. As the rate of ice loss has accelerated, its contribution to global sea level rise has increased from a little more than half of the total increase from 1993 - 2008 to 75 - 80 percent of the total increase between 2003 – 2007 (UCS, 2013).

**Impact on the waterborne transport sector:** Sea level rise will have an impact on both ports and inland waterways (fluctuating water levels), and without mitigation measures, this will negatively impact the competitiveness of European waterborne transport. Investments will be needed to adjust the transport infrastructures.
At the same time, the ice melting will give the possibility for ships to travel over the European northern seas, which would be accompanied with new exploitation of oil and gas in arctic areas, specifically in the northern coast of Russia. Likewise, as climate change progresses, new cross-arctic shipping routes will open, which would decrease the distance from Europe to Asia by 1/3. It is expected to have the Nordic passage before 2030. Climate change allows these new routes, and because of shorter distances, emissions will be reduced. However, it is important to note the high ecological risks of melting the cross-Arctic routes, as well as the high risks of ships to get “trapped” in the ice. New technologies for different ice classes and ice breakers will be needed, along with new safety measures.

**ENV 2. AN INCREASE OF FLUCTUATING WATER LEVELS OF THE INLAND WATERWAYS THROUGHOUT EUROPE.**

**Short description:** The inland water levels are increasingly fluctuating due to climate change, as it was already seen in the main inland waterways in Europe during the last summers.

**Drivers:**

- **GHG emissions**—according to climate scenarios, periods with low water levels in the European waterways are likely to occur more often and become more serious during the summer because of GHG emissions.

**Impact on the waterborne transport sector:** Inland waterway transport carriers will experience more severe restrictions on the load factor of their ships, which implies a stronger reduction in transport capacity in the market. This also influences the possibility to install certain zero-emission technologies onboard. Transport prices will rise under such conditions. Increased transport prices trigger adaptation. Carriers will have the opportunity to shift from inland waterway transport to alternative transport modes in periods with low water levels, however this might lead to higher GHG emissions, especially if cargo is shifted to trucks (Jonkeren, et al. 2013).

If low water levels will become a standard, some big companies may reconsider the way they transport the goods. Also, changes in transport costs may lead to relocation of certain economic activities in the long run (Jonkeren, et al. 2013).
Increasing number of vessels, able to operate on low water levels, will be appearing on the market, such as "low water runners" or "shallow draft vessels". These vessels have less capacity and are smaller, and will need more energy per tkm, which is negative in terms of emissions and economic competitiveness compared to other transport modes.

**EnvT 3. More extreme weather events.**

**Short description:** Scientific studies indicate that extreme weather events such as heat waves and large storms are likely to become more frequent or more intense with human-induced climate change. More intense and frequent oceanic storm, flooding events, ice storms, tornado and hurricanes will be observed (EPA 2021).

**Drivers:**

- **Climate change** is associated with widespread changes in weather patterns and leads to extreme events in the oceans and rivers.

**Impact on the waterborne transport sector:** This trend will negatively impact waterborne transport routes as well as port infrastructures. The constant storms will lead to redirection of ships along more secure routes, which often will be longer ones. Frequent extreme weather events will require different protection of vessels including different rules to design the vessels for stability and for protecting the cargo. In addition, ship sides can be damaged by the loss of containers, because they cannot be easily seen. Environmental risks are even higher if there is dangerous cargo on board.

**Inland navigation specific:**

Heavy rains can also impede the loading and unloading operations at inland ports without covered berths/weather-independent terminals. This leads to undesired waiting times and increased costs, and can influence the quality of the cargo.

Also, access to some regions can be blocked when the river is frozen and there are not enough ice breakers.
**EnvT 4. Growing concerns on the environmental impacts of feedstocks for the production of biofuels which may challenge ecosystems.**

**Short description:** Whilst currently biofuels might be considered as a sustainable alternative fuel, in the nearby future the growing concerns on the environmental impact of the feedstock to produce biofuels will hamper its further deployment into the variety of sectors. This will not only affect biofuels, but equally other sustainable alternative fuels, since the sustainability will be defined taking the Life Cycle Approach into account.

**Drivers:**

- **New restrictions for the use feedstocks** for the production of biofuels – The Renewable energy directive (2009/28/EC) regulates the development of biofuels from more sustainable stocks. It is even expected that from a certain moment, it will be possible to develop biofuels only from sustainable stocks. There will be e-fuels instead bio-fuels. This could also maintain or even increase the already high prices of biofuels.

**Impact on the waterborne transport sector:** Biofuels are already actively used in some European countries, even though at a small scale. For example, Finland has started using only biogas for the waterborne transport sector. Together with Shell, Van Oord is testing the use of biofuel on its fleet. This test fits in with the ambitions of both parties to reduce the CO₂ emissions in the waterborne transport sector. At the same time, experts agree that demand of fuel for waterborne transport by far exceeds the possibilities of biofuels, specifically for the third and fourth generation. On top of that, the deployment of biofuels is hampered by their high prices.

**EnvT 5. Increasing air pollution concerns within cities as well as sensitive nature areas (Natura2000)**

**Short description:** Besides eliminating GHG emissions, eliminating air pollution from all types of transport will become increasingly important, more specifically in urban areas as well as in sensitive nature areas. New approaches to urban development are already being implemented, including increasing activities for promoting recreation areas in the cities.

**Drivers:**

- **New approach to urban development** - urban development has been viewed as a major threat to biodiversity. Whilst this remains true, the paradigm is changing and cities are
perceived as a possible safeguard for biodiversity. Also, rich urban areas can help in improving the quality of life and sustainability of the cities themselves.

- **Increasing activities for promoting recreation areas** in the cities - Biodiversity-rich green spaces can help making cities more sustainable, livable and resilient in many ways. They offer solutions to many urban environmental problems, such as pollution, noise, heatwaves, floods, and provide ample opportunities for recreation, relaxation and social interaction, as well as for education and discovery.

- **The new European Green Deal** launched in December 2019 is also intended to improve the environmental conditions in the cities and protect sensitive areas. In the coming years it will be important to ensure that green spaces are also made biodiversity-rich and that biodiversity is put on the same footing as green infrastructure in urban development and regeneration programs. (EC 2020) In this case the EU’s Sustainable and Smart Mobility Strategy is crucial, as transport is one of the main sources of air pollution in and around cities, and it provides measures that benefit the development of the waterborne transport sector.

**Impact on the waterborne transport sector:** This trend will provide the waterborne transport sector with a competitive advantage compared to other modes of transport, since it is expected that (some segments of) waterborne transport will become emission free earlier than others. This is specifically relevant for the emission-free ports, ‘the last mile’ or the equivalent (probably, not for all operations), as a ‘local’ competitive advantage. Californian ports are good examples of how air quality can be improved in port cities, and they offer a learning experience for other port cities. However, the real trend setters are Seattle and Vancouver for their strictest rules for ships: they have a control system even for underwater noise not to disturb the water ecosystem. In these cities CO2 emissions are measured in both the harbors and the cities.

In Europe, Scandinavian countries are developing new unmanned electric barges to cross a busy fjord in an innovative and low carbon way. These novel approaches of small autonomous city barge vessels will compete with the trucks in cities such Amsterdam, Paris, Venice. Their comparative advantage is zero emissions. There are also pilots with small barges, such as the pilot with the Zulu in the AUTOSHIP project, to transport small volumes (pallets, big bags) with zero-emission autonomous barges in dense cities.
e. Political Trends

PT 1. AN INCREASING NUMBER OF EUROPEAN AND INTERNATIONAL POLICIES TO REACH SDGs AND ACHIEVE EMISSION TARGETS.

Short description: In order to be able to achieve emission targets, policies emanated by the European Institutions and International Organisations will stimulate the production of sustainable alternative fuels, as well as the deployment and use of sustainable alternative green and digital technologies designed to reach SDGs.

Drivers:

- **New Legislation:**
  - EC regulations and directives. The starting point is the European Green Deal, with the Climate Law as its center piece, which set the main targets in terms of climate (and circular economy). A more detailed description of the policy/legal measures envisaged in order to achieve these targets are mentioned in the next trend;
  - IMO Policy initiatives;
  - CCNR (Central Commission for Navigation on Rhine) initiatives;
  - National legislations.

- Especially for hydrogen, there was a New Joint declaration signed on February 2021 between the EC Partnerships: Zero Emission Waterborne Transport and Clean Hydrogen for Europe. With this declaration both the waterborne transport sector and the hydrogen sector confirm their willingness to create synergies through targeted collaboration efforts on the extended use of hydrogen for the waterborne transport sector.

**Impact on the waterborne transport sector:** In line with the trend, policies and investments are oriented towards the development and uptake of green technologies also in the waterborne transport sector. Backed by policies, the development and deployment of green technologies will be stimulated ensuring competitiveness of the European waterborne sector.
PT 2. An increasing number of measures and initiatives to increase the clarity on how to achieve GHG reduction targets.

Short description: Currently, there is no golden-bullet regarding the reduction of greenhouse gas emissions in the waterborne transport sector. However, a variety of sectors and a broader range of stakeholders will increasingly cooperate, stimulated by EU and national measures, to jointly develop roadmaps for the transition to zero-emission waterborne transport.

Drivers:

- New Regulations and studies:
  
  o EC policies, legislation and regulations. The broader framework is set by the European Green Deal and its connected initiatives. Arguably, the most important subsequent policy and legislative step is the ‘Fit for 55 package’, an interconnected set of proposals to enable the necessary acceleration of greenhouse gas emission reductions in the next decade. The most relevant elements of the “Fit for 55 Package” are: extension of EU ETS, including for shipping; a (new) Renewable Energy Directive; a revised Alternative Fuels Infrastructure Regulation; the FuelEU Maritime Initiative; a revision of the Energy Taxation Directive and a new Carbon Border Adjustment Mechanism\(^{11}\) that will put a carbon price on imports.
  
  o IMO policies and regulations
  
  o Inland navigation specific studies and initiatives
  
  o National and regional initiatives which first of define the way in which the European Green Deal targets are achieved in the case of EU countries. It is worth mentioning that these national and/or regional initiatives can also go beyond the European Green Deal ambitions, which are seen as the ‘minimum standard’.

Impact on the waterborne transport sector: There is currently a lack of sufficient information on how to achieve GHG reduction targets for the entire waterborne transport sector. There will not be one single solution, but several technologies are needed for the different segments of the waterborne transport sector. More targeted research is needed in this field of green technologies, where these technologies get tested and progressive insights are provided on them. The research needs to be correlated with the policy developments and the investments committed from both

\(^{11}\) [Carbon border adjustment mechanism | European Commission (europa.eu)](https://ec.europa.eu)
private and public sources. The ‘Fit for 55 package’ is expected to give more clarity on the steps to achieve the decarbonization targets and also the required efforts, in particular for the short-term (up to 2030).

Moreover, the EU needs to engage with other countries so that the necessary infrastructure and fuel supply ecosystem can be developed. For example: South Africa is pushing to be a leading manufacturer of fuel cells thanks to their rich platinum reserves; Chile is already moving fast into green hydrogen and ammonia, skipping the discussion of the blue/grey path; the USA has finally entered the decarbonisation game; etc. Consequently, Europe has a lot of potential partners in this field for collaboration and business opportunities development in strategic countries. If full decarbonization of the EU fleet is to be achieved, the EU will need to support others at the same time.

**PT 3. INCREASED ENVIRONMENTAL AMBITIONS (GHG, EMISSIONS TO AIR AND WATER) BACKED BY REGULATIONS, MARKET MEASURES, INCENTIVES AND INDUSTRY INITIATIVES.**

**Short description:** Many governments, while conflicting in other sectors, express their intentionsto cooperate to reach emission targets and support open global initiatives to build up common actions to fight climate change, as recently demonstrated by the Leaders’ Summit on Climate in 2021.

**Drivers:**

- Translation of EU ambitions into **policies and strategic plans**, providing for a regulatory framework that enables decision makers to take actions with a solid legal basis:
  - the amount of EU policy acts flourishing from the European Green Deal strategy in the course of 2020: the presentation of the *European Green Deal Investment Plan* and the *Just Transition Mechanism*; the proposal for a *European climate law* to ensure a climate neutral European Union by 2050; the proposal of a *Circular Economy Action Plan* focusing on sustainable resource use; the adoption of the *European Industrial Strategy*, a plan for a future-ready economy; the adoption of the *EU strategies for energy system integration and hydrogen* to pave the way towards a fully decarbonised, more efficient and interconnected energy sector; the presentation of the 2030 *Climate Target Plan* to reduce EU greenhouse gas emissions by at least 55% by 2030, compared to 1990 level; the launch of the
European Climate Pact bringing together regions, local communities, civil society, businesses and schools to participate in climate action and build a greener Europe.

- EU taxonomy for climate change mitigation as enabler to scale up sustainable investments
- The public and private actors setting targets in line with EU.

Impact on the waterborne transport sector: European maritime technology companies are the key drivers enabling the transition of the global waterborne transport sector towards environmental and climate friendly technologies.

In order to be able to achieve the European Green Deal objectives, both the EU and Member States will implement policies and regulations to achieve the environmental ambitions. These policies will stimulate an increasing number of market measures, by granting incentives, and will be followed by an increasing number of industry initiatives to be able to achieve the targets set.

PT 4. AN INCREASED POLITICAL FOCUS ON THE USE OF INLAND WATERWAY TRANSPORT (IWT), COASTAL SSS AND RAIL TO CARRY INLAND FREIGHT, BACKED BY EU POLICIES.

Short description: In order to mitigate climate change, and to decrease congestion on the European highways, inland waterway transport, coastal short sea shipping and rail will become the best alternative transport modalities to carry inland freight.

Drivers:

- Climate change mitigation measures
- EU policies setting clear modal shift objectives, a.o. Sustainable and Smart Mobility Strategy
- Investments in infrastructure for “preferred” transport modalities

Impact on the waterborne transport sector: The inland waterway transport (IWT) sector will have a bigger share in the continental transport flows, with the prerequisite of reaching the zero-emission target faster than the road transport sector. However, one uniform table with indicators for vessels certification is needed for the sector, not only for EU countries but also for neighboring countries that use inland waterways jointly with the EU countries. Namely, in the Danube river vessels certified in EU neighboring countries are not obliged to comply with EU measures, and can still navigate free of charge.
PT 5. CONTINUING TWO SPEED APPROACH WITH EUROPE TAKING THE LEAD IN CUTTING EMISSIONS.

Short description: The European Union has set the target to become the first climate-neutral continent by 2050, including the objective to cut emissions from transport by 90% in 2050. Other geographical regions have set different objectives, which will lead to a more diversified landscape of rules and regulations to fight climate change.

Drivers:

- The divide between developed and developing countries separates 'developed' countries that have historically emitted disproportionately high emissions from 'undeveloped' countries that have emitted considerably less emissions. This division is today largely influencing the two-speed approach, when South countries, such as China and India, say that developing economies should not have to share the same burden of curbing emissions as developed nations whose pollution went unchecked for decades (The New York Times, 23 Sep 2020)

Impact on the waterborne transport sector: A diversified landscape regarding emission targets for waterborne transport might create imbalance regarding competitiveness of the European waterborne transport sector. The EU is running the risk to lose competitiveness for EU shipping because of these targets, if others do not follow. Harmonizing the targets on the international level is important but will require more time to reach.
PT 6. CHINA’S RAISING LEADERSHIP IN THE WORLD-WIDE GEOPOLITICAL CONTEXT

Short description: China’s rapid rise in the global economy, including economic success and effective use of soft power, poses geopolitical challenges. China is a leading trading nation and the rest of the world is becoming more exposed to China.

Drivers:

- **Made in China 2025** - is a national strategic plan to further develop the manufacturing sector of China. China aims to move away from being the "world's factory"—a producer of cheap low-tech goods facilitated by lower labour costs and supply chain advantages. The plan aims to upgrade the manufacturing capabilities of Chinese industries, growing from labor-intensive workshops into a more technology-intensive powerhouse.

- **Belt and Road Initiative (BRI)** – new silk road and development strategy of China with investment plans in nearly 70 countries and international organizations. Economically unprecedented rise of China is highly institutionalized, fragmented, issue-specific. As demonstrated by BRI, greater global governance proactivity has more assertive agendas and a more realistic approach (Bora Ly 2020).

Impact on the waterborne transport sector: China is rapidly taking over in the waterborne transport sector, putting Europe at risk to lose this sector. Today, more than 90% of global shipbuilding takes place in just three countries: China, South Korea and Japan. China has a massive state aid, and Europe might soon become dependent in the supply chain and in navy equipment. European policy makers should be more strategic in this game.

China produces more high-tech products in the waterborne transport sector than before. Also, China is rapidly getting access to the main sources for battery production. Therefore, battery vessels will have Chinese technology inside.

At the same time, the European waterborne transport sector is implementing sustainability measures with high costs. These measures coupled with unfair competition could deprive the sector of any leeway on the European market, progressively forcing it out. (Europarl.europa.eu, 2020)
4. Results from the Open Consultation

The evaluation of the trends made through the online survey provides for interesting results which contributed to define a short list of potential drivers of change that would enable to move towards zero-emission waterborne transport by 2050.

Of course, some of the trends identified in cooperation with the GSEG - and their impacts on waterborne transport sector - can be quite predictable and policy interventions are already in place. That’s why the aim of the broader consultation was to rank the trends according to two criteria: importance and uncertainty, leading to the identification of the “critical uncertainties”, which will be the basis for the future work of STEERER – the second phase of the consultation process as explained in Chapter 1. The drivers of change that combine the highest importance with highest uncertainty will be selected, to create a scenario space.

The following tables present how respondents scored the individual trends from very strong, to strong, little or no impact and uncertainty for the future of the waterborne transport sector. (Please note that due to rounding the percentages in the replies, the total percentage for some trends is 99.9% or 100.1%).

Criteria “Impact”

<table>
<thead>
<tr>
<th>Social</th>
<th>ST1. Demographic change and migration: an increasingly developed world population demanding more trade towards different parts of the world</th>
<th>Very strong</th>
<th>Strong</th>
<th>Little</th>
<th>None</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>36.80%</td>
<td>60.50%</td>
<td>0.00%</td>
<td>2.60%</td>
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<table>
<thead>
<tr>
<th>Social</th>
<th>ST2. Increasing awareness of the environmental impact of transport influencing decisions of customers to buy locally / travel differently.</th>
<th>Very strong</th>
<th>Strong</th>
<th>Little</th>
<th>None</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>21.10%</td>
<td>50.00%</td>
<td>28.90%</td>
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</table>

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<tr>
<th>Social</th>
<th>ST3. Continuous evolution of consumption and shopping patterns influencing production and transport requirements (e.g. online shopping).</th>
<th>Very strong</th>
<th>Strong</th>
<th>Little</th>
<th>None</th>
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<tr>
<td></td>
<td></td>
<td>57.90%</td>
<td>36.80%</td>
<td>5.30%</td>
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<tr>
<td><strong>Technological</strong></td>
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<tr>
<td><strong>ST4.</strong> Increasing social pressure to address Climate Change, air pollution and biodiversity.</td>
<td><strong>ET1.</strong> An increasing importance of the green transformation as European industry is recovering from the COVID-19 pandemic</td>
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<tr>
<td><strong>TT1.</strong> Higher (energy) efficiency through increasing economies of scale in the entire waterborne transport sector (vessel size, ports, etc).</td>
<td><strong>ET2.</strong> Increasing investments to explore green opportunities within new markets</td>
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<tr>
<td><strong>TT2.</strong> An increase of the capacity of the inland waterways throughout Europe combined with clean power generation.</td>
<td><strong>ET3.</strong> Increasing green shipping business opportunities</td>
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<tr>
<td><strong>TT3.</strong> Increasing need for a coherent sustainable alternative fuel supply network.</td>
<td><strong>ET4.</strong> Insufficient public funding to support the transition to zero-emission ships in ports and operations combined with more costly sustainable alternative fuels</td>
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<td><strong>TT4.</strong> Increasing importance of standards and interoperability.</td>
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<tr>
<td><strong>TT5.</strong> Declining energy storage costs (e.g. batteries).</td>
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<td><strong>TT6.</strong> An increasing role of local governments being first movers in innovative/green ship operations.</td>
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<td><strong>TT7.</strong> European maritime technology is leading innovation.</td>
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<tr>
<th><strong>Very strong</strong></th>
<th><strong>Strong</strong></th>
<th><strong>Little</strong></th>
<th><strong>None</strong></th>
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<tbody>
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<td>42,10%</td>
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<td>18,40%</td>
<td>44,70%</td>
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<td>21,10%</td>
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<td>44,70%</td>
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<td>23,70%</td>
<td>65,80%</td>
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<td>36,80%</td>
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<td>34,20%</td>
<td>44,70%</td>
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<td>31,60%</td>
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<td>31,60%</td>
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<td>52,60%</td>
<td>39,50%</td>
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<td>34,20%</td>
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<td>36,80%</td>
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<td>Very strong</td>
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<tr>
<td><strong>Environmental</strong></td>
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<tr>
<td>EnvT1. Increasing temperatures and sea level rise</td>
<td>52,60%</td>
<td>36,80%</td>
<td>10,50%</td>
</tr>
<tr>
<td>EnvT2. An increase of fluctuating water levels of the inland waterways throughout Europe.</td>
<td>34,20%</td>
<td>57,90%</td>
<td>7,90%</td>
</tr>
<tr>
<td>EnvT3. More extreme weather events.</td>
<td>42,10%</td>
<td>42,10%</td>
<td>10,50%</td>
</tr>
<tr>
<td>EnvT4. Growing concerns on the environmental impacts of feedstocks for the production of biofuels which may challenge ecosystems.</td>
<td>28,90%</td>
<td>52,60%</td>
<td>15,80%</td>
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<tr>
<td>EnvT5. Increasing air pollution concerns within cities as well as sensitive nature areas (Natura2000)</td>
<td>39,50%</td>
<td>47,40%</td>
<td>13,20%</td>
</tr>
<tr>
<td><strong>Political</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PT1. An increasing number of European and international policies to reach SDGs and achieve emission targets.</td>
<td>43,20%</td>
<td>48,60%</td>
<td>8,10%</td>
</tr>
<tr>
<td>PT2. An increasing number of measures and initiatives to increase the clarity on how to achieve GHG reduction targets.</td>
<td>36,80%</td>
<td>57,90%</td>
<td>5,30%</td>
</tr>
<tr>
<td>PT3. Increased environmental ambitions (GHG, emissions to air and water) backed by regulations, market measures, incentives and industry initiatives.</td>
<td>52,60%</td>
<td>39,50%</td>
<td>7,90%</td>
</tr>
<tr>
<td>PT4. An increased political focus on the use of Inland Waterway Transport (IWT), coastal SSS and rail to carry inland freight, backed by EU policies.</td>
<td>24,30%</td>
<td>67,60%</td>
<td>8,10%</td>
</tr>
<tr>
<td>PT5. Continuing two speed approach with Europe taking the lead in cutting emissions.</td>
<td>34,20%</td>
<td>50,00%</td>
<td>10,50%</td>
</tr>
<tr>
<td>PT6. China’s raising leadership in the world-wide geopolitical context.</td>
<td>31,60%</td>
<td>57,90%</td>
<td>5,30%</td>
</tr>
<tr>
<td>Criteria</td>
<td>Social</td>
<td>Technological</td>
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<td></td>
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<tr>
<td>ST1. Demographic change and migration: an increasingly developed world population demanding more trade towards different parts of the world</td>
<td>Very strong</td>
<td>Strong</td>
<td>Little</td>
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<td></td>
<td>8,10%</td>
<td>35,10%</td>
<td>43,20%</td>
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<tr>
<td>ST2. Increasing awareness of the environmental impact of transport influencing decisions of customers to buy locally / travel differently.</td>
<td>13,50%</td>
<td>40,50%</td>
<td>40,50%</td>
</tr>
<tr>
<td>ST3. Continuous evolution of consumption and shopping patterns influencing production and transport requirements (e.g. online shopping).</td>
<td>8,10%</td>
<td>24,30%</td>
<td>51,40%</td>
</tr>
<tr>
<td>ST4. Increasing social pressure to address Climate Change, air pollution and biodiversity.</td>
<td>5,40%</td>
<td>48,60%</td>
<td>32,40%</td>
</tr>
<tr>
<td>TT1. Higher (energy) efficiency through increasing economies of scale in the entire waterborne transport sector (vessel size, ports, etc).</td>
<td>2,70%</td>
<td>45,90%</td>
<td>37,80%</td>
</tr>
<tr>
<td>TT2. An increase of the capacity of the inland waterways throughout Europe combined with clean power generation.</td>
<td>5,40%</td>
<td>48,60%</td>
<td>40,50%</td>
</tr>
<tr>
<td>TT3. Increasing need for a coherent sustainable alternative fuel supply network.</td>
<td>21,60%</td>
<td>45,90%</td>
<td>24,30%</td>
</tr>
<tr>
<td>TT4. Increasing importance of standards and interoperability.</td>
<td>2,70%</td>
<td>40,50%</td>
<td>43,20%</td>
</tr>
<tr>
<td>TT5. Declining energy storage costs (e.g. batteries).</td>
<td>5,40%</td>
<td>24,30%</td>
<td>59,50%</td>
</tr>
<tr>
<td>Category</td>
<td>Issue</td>
<td>Very strong</td>
<td>Strong</td>
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</tr>
<tr>
<td>Economic</td>
<td>TT6. An increasing role of local governments being first movers in</td>
<td>10,80%</td>
<td>35,10%</td>
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<td></td>
<td>innovative/green ship operations.</td>
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<td></td>
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<tr>
<td></td>
<td>TT7. European maritime technology is leading innovation.</td>
<td>8,30%</td>
<td>41,70%</td>
</tr>
<tr>
<td></td>
<td>ET1. An increasing importance of the green transformation as European</td>
<td>11,10%</td>
<td>50,00%</td>
</tr>
<tr>
<td></td>
<td>industry is recovering from the COVID-19 pandemic</td>
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<tr>
<td></td>
<td>ET2. Increasing investments to explore green opportunities within</td>
<td>11,10%</td>
<td>44,40%</td>
</tr>
<tr>
<td></td>
<td>new markets</td>
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</tr>
<tr>
<td></td>
<td>ET3. Increasing green shipping business opportunities</td>
<td>11,10%</td>
<td>38,90%</td>
</tr>
<tr>
<td></td>
<td>ET4. Insufficient public funding to support the transition to zero-</td>
<td>22,20%</td>
<td>33,30%</td>
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<tr>
<td></td>
<td>emission ships in ports and operations combined with more costly</td>
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<td></td>
<td>sustainable alternative fuels</td>
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<tr>
<td>Environmental</td>
<td>EnvT1. Increasing temperatures and sea level rise</td>
<td>14,30%</td>
<td>14,30%</td>
</tr>
<tr>
<td></td>
<td>EnvT2. An increase of fluctuating water levels of the inland waterways</td>
<td>8,60%</td>
<td>20,00%</td>
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<td></td>
<td>throughout Europe.</td>
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</tr>
<tr>
<td></td>
<td>EnvT3. More extreme weather events.</td>
<td>17,10%</td>
<td>25,70%</td>
</tr>
<tr>
<td></td>
<td>EnvT4. Growing concerns on the environmental impacts of feedstocks</td>
<td>16,20%</td>
<td>35,10%</td>
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<td></td>
<td>for the production of biofuels which may challenge ecosystems.</td>
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<tr>
<td></td>
<td>EnvT5. Increasing air pollution concerns within cities as well as</td>
<td>8,30%</td>
<td>30,60%</td>
</tr>
<tr>
<td></td>
<td>sensitive nature areas (Natura2000)</td>
<td></td>
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</tr>
<tr>
<td>Political</td>
<td>PT1. An increasing number of European and international policies</td>
<td>20,60%</td>
<td>23,50%</td>
</tr>
</tbody>
</table>


If we analyse the two criteria separately, the ranking of the trends is quite straightforward. The trend that will have the stronger impact on the waterborne transport sector according to the respondents is ST3 (Continuous evolution of consumption and shopping patterns influencing production and transport requirements (e.g. online shopping)) followed by ET2, EnvT1 and PT3 tied for second.
Figure 9. Results of the survey on evaluating the main trends relevant for the waterborne sector for criteria “IMPACT”.

On the other hand, the trend whose evolution in the future is the most uncertain to predict is PT5 (Continuing two speed approach with Europe taking the lead in cutting emissions) followed by ET4, TT3 and PT1.
Figure 10. Results of the survey on evaluating the main trends relevant for the waterborne sector for criteria “Uncertainty”.

However, as already stressed in several parts of this document, what really matters to build a scenario space and plan for interventions to influence the trajectory of the trends, is the combination of the two criteria together, a strong impact with a strong uncertainty. From the responses received, it came out that the trends that combine a very strong impact and a very strong uncertainty are again PT5, ET4, TT3 and PT1, as we can see in the following scattered diagram (figure 12). However, the percentages of responses assessing the uncertainty of these trends as ‘very strong’ are very low (between 20 and 25%), and the very strong impact ranks only between 30 and 50%.
Figure 12. The trends ranking on IMPACT and UNCERTAINTY, considering the responses on trends evaluation “very strong”.

The ideal ranking to build a scenario space would consider trends with a score above 66%. We therefore considered the responses ‘very strong’ and ‘strong’ together and ranked the trends accordingly. The representation on the scattered diagram changed significantly as represented in the following figure n° 12. In this case, the trends that combine the stronger impact with the stronger uncertainty are again PT5 and TT3, while ET4 and PT1 have a lower ranking.
Figure 13. The double ranking on IMPACT and UNCERTAINTY, considering the responses on trends evaluation “very strong” and “strong”.

The double ranking exercise reinforced the results obtained from the consultation and the responses received. The trends with the stronger impact and at the same time stronger uncertainty are the following two:

- **Technological Trend 3** - Increasing need for a coherent sustainable alternative fuel supply network.

- **Political Trend 5** - Continuing two speed approach with Europe taking the lead in cutting emissions.

These two trends are clearly recognized by the waterborne community as mostly representing the ‘critical uncertainties’ for the future of the waterborne transport sector and constitute a solid basis for the further investigation from STEERER, the GSEG and the wider waterborne community in the following steps of the foresight exercise.

**Additional observations:**

According to the respondents, more than 50% of the trends we presented in the questionnaire will have a “very strong” IMPACT. This fact suggests that most of the trends, identified by the consortium and the GSEG, are very relevant for the waterborne transport sector. On the contrary, the responses received for the UNCERTAINTY criteria show that there is not a clear position from
the waterborne community on how the trends will evolve in the future: for almost half of the trends the scores are equally split between a ‘strong’ and ‘little’ uncertainty.

More precisely, the following trends were evaluated for UNCERTAINTY with “middle” scores:

- ST2. Increasing awareness of the environmental impact of transport influencing decisions of customers to buy locally / travel differently.
- ST4. Increasing social pressure to address Climate Change, air pollution and biodiversity.
- TT1. Higher (energy) efficiency through increasing economies of scale in the entire waterborne transport sector (vessel size, ports, etc).
- TT2. An increase of the capacity of the inland waterways throughout Europe combined with clean power generation.
- TT7. European maritime technology is leading innovation.
- ET2. Increasing investments to explore green opportunities within new markets
- ET3. Increasing green shipping business opportunities
- EnvT4. Growing concerns on the environmental impacts of feedstocks for the production of biofuels which may challenge ecosystems.
- PT2. An increasing number of measures and initiatives to increase the clarity on how to achieve GHG reduction.
- PT4. An increased political focus on the use of Inland Waterway Transport (IWT), coastal SSS and rail to carry inland freight, backed by EU policies.

Some hypotheses can be made to explain the mixed view expressed by the respondents:

- The general opinion towards “middle” scores for the uncertainty criteria might be influenced by the current pandemic situation. Several studies have recognised that responses to surveys carried out in current times might be biased because of the COVID-19 pandemic (Rothbaum, Bee 2021). In terms of foresight and future studies, crises situation might have even stronger influence on the results: from tendency to underestimate long-term uncertainty in general to stronger “wishful” thinking with hope for less turbulent future.

- Having a more detailed look at the background of the respondents, it can be observed that most of them have an engineering background, which might lead to the “technology solves it all” logic. Probably, this also might influence the evaluation of trends with “low” rates for the UNCERTAINTY criteria.
For the sake of the STEERER project, the fact that the majority of the trends were evaluated as very impactful, but only few had high scores for uncertainty, is in line with the foresight approach as only few critical uncertainties are usually identified for building a scenario framework.
5. Conclusions and way forward

The first phase of the consultation was successfully concluded and the main outcomes the following process are:

- The first meeting of the GSEG was organised and the main trends relevant for the waterborne transport sector were discussed and validated.

- The off-line consultation with the GSEG on the identified trends was organised and provided for further information on the specifications of the trends, in particular the drivers of change behind them and the expected impact on the waterborne transport sector.

- As a result of these steps, 26 trends were identified by collaborative work of the STEERER Consortium and the GSEG. These trends were classified according to the STEEP method (social, technological, economic, environmental and political).

- An open consultation with a broader list of stakeholders was organised through an online survey to evaluate the trends and define the ‘critical uncertainties’ that will require further investigation from STEERER.

Two trends were identified as critical uncertainties – most impactful and at the same time most uncertain - as a result of the survey. These results of the first consultation process will be used by WP2 to define a preliminary ‘scenario space’. Task 2.2 “Scenarios with quantified targets for 2025, 2030 and 2050” of WP2 will use the critical uncertainties as selection criteria for screening the most viable scenarios from the existing ones.

The second part of the consultation process will be based on this work (WP2 – Task 2.2) concerning the development of scenarios, and quantification of targets at different time-horizons: 25-30-50, taking into account the social pathway. The GSEG will be asked to comment on selected scenarios during a second meeting, to enrich and refine them. A survey will be conducted to validate the consistency and intuitiveness of the main results of the Green Shipping Expert Group scenario analysis, and to validate the proposed targets.
References

Social Trends


Technological Trends


Economic Trends


Environmental Trends


Jonkeren, Olaf, et al. “Climate Change and Economic Consequences for Inland Waterway


Political Trends


## Annex 1. Agenda

### 1st meeting

of the Green Shipping Expert Group (GSEG)

**Wednesday, 16 December 2020, 09:30 – 12:30 o’clock**

**Online**

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>09:30 -09:50</td>
<td>Introduction to the STEERER project</td>
<td>(tbc), Waterborne Technology Platform</td>
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<tr>
<td>09:50-10:05</td>
<td>Opening words from the representative of the European Commission</td>
<td>Peter Crawley, Policy Officer Waterborne Transport, DG R&amp;I</td>
</tr>
<tr>
<td>10:05-10:35</td>
<td>Presentation of the stakeholders’ consultation process: the foresight methodology in STEERER</td>
<td>Andrea Ricci, Svetlana Ivanova, ISINNOVA</td>
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<tr>
<td>10:35-10:45</td>
<td>Presentation on the preliminary list of trends influencing the waterborne transport</td>
<td>Jaap Gebraad, Waterborne Technology Platform</td>
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<tr>
<td>10:45-11:00</td>
<td>Questions and Answers</td>
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<tr>
<td>11:00 – 11:20</td>
<td>Coffee Break</td>
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<tr>
<td>11:20-11:25</td>
<td>Introduction to the breakout sessions</td>
<td>Svetlana Ivanova, ISINNOVA</td>
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</table>
Participants: GSEG members, STEERER Consortium and representatives of the European Commission.
Annex 2. List of the participants of the 1st meeting of the Green Shipping Expert Group (GSEG) according to the discussion groups

<table>
<thead>
<tr>
<th>Name</th>
<th>Surname</th>
<th>Organisation</th>
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<td>1 Åsa</td>
<td>Burman</td>
<td>Lighthouse</td>
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<td>2 Manfred</td>
<td>Seitz</td>
<td>Manfred Seitz</td>
<td>General Director Secretariat</td>
<td>Hungary</td>
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<td>3 Jaap</td>
<td>Gebraad</td>
<td>Waterborne Technology Platform</td>
<td>Executive-Director</td>
<td>Belgium</td>
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<td>4 Martin</td>
<td>Dorsman</td>
<td>European Community Shipowners’ Associations</td>
<td>Secretary General</td>
<td>Belgium</td>
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<td>5 Hege</td>
<td>Økland</td>
<td>NCE Maritime CleanTech</td>
<td>CEO</td>
<td>Norway</td>
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<td>Company/Title</td>
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<td>6</td>
<td>Turi Fiorito</td>
<td>European Federation of Inland Ports Director</td>
<td>België</td>
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<td>7</td>
<td>Sander den Heijer</td>
<td>Netherlands Maritime Technology Sector manager</td>
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<td><strong>Economic trends. Moderator: Manuela Flachi, Magellan</strong></td>
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<td>1</td>
<td>Lennart Swoboda</td>
<td>Schulte Group Project Manager</td>
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<td>2</td>
<td>Juan-Manuel SUÁREZ</td>
<td>PortEco Managing Partner</td>
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<td>Bernard Dabezies</td>
<td>CNIM VP Innovation</td>
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<td>Dirk Degroote</td>
<td>European Tugowners Association Advisor</td>
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<td>5</td>
<td>Diane Gilpin</td>
<td>Smart Green Shipping Founder/CEO</td>
<td>United Kingdom</td>
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<td>6</td>
<td>Erik van der Blom</td>
<td>Royal IHC Head of Product Development</td>
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<td>7</td>
<td>Gunther Jaegers</td>
<td>Chemgas Shipping BV Managing Partner</td>
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<td>Henk Prins</td>
<td>Waterborne TP Chairman</td>
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<td>9</td>
<td>Grzegorz Pawelec</td>
<td>Hydrogen Europe Research, Innovation and Funding Manager</td>
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This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No.73283
### Social trends. Moderator: Svetlana Ivanova, ISINNOVA

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<td>Wassim Daoud</td>
<td>Head of sustainability</td>
<td>ISINNOVA</td>
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<td>Antidia Citores</td>
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<td>Surfrider</td>
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<td>Inland Navigation Europe</td>
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<td>Philipp Easthill</td>
<td>European Boating Industry</td>
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<td>Sandro Vidas</td>
<td>Croatia Shipowners’ Assosiation</td>
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<td>Gudrun JANSSENS</td>
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<td>Hélène SMIDT</td>
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<td>Khalid TACHI</td>
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<td>Markus EPPICH</td>
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<td>Martin QUISPEL</td>
<td>STEERER Consortium</td>
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<td>Robert RAFAEL</td>
<td>STEERER Consortium</td>
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<td>Salih Karaarslan</td>
<td>STEERER Consortium</td>
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### Technological trends. Moderator: Markus Lehne BALance Technology Consulting

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<td>1</td>
<td>Blandine VICARD</td>
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<td>ISINNOVA</td>
<td>FRANCE</td>
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<td>Alessandro Iafrati</td>
<td>Institute of Marine Engineering - National Research Council</td>
<td>Director</td>
<td>Italy</td>
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<td>Santiago Suarez de la Fuente</td>
<td>University College London Energy Institute</td>
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<td>Saimon Conti</td>
<td>CNT Technologies S.r.l. semplificata</td>
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<td>Jogchum Bruinsma</td>
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<td>Application Manager Maritime</td>
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<td>Hossein Ghaemi</td>
<td>Gdańsk University of Technology, Faculty of Ocean Engineering and Ship Technology</td>
<td>Academic staff - Assist. Prof.</td>
<td>Poland</td>
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<td>Selma Ergin</td>
<td>Istanbul Technical University</td>
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<td>Paolo Guglia</td>
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<td>Sebastiaan Bleuanus</td>
<td>Wärtsilä</td>
<td>General manager, research coordination &amp; Funding</td>
<td>Netherlands</td>
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<td>Gavin Allwright</td>
<td>International Windship Association (IWSA) Secretary general</td>
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<td>Ronald Vopel</td>
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<td>Victoria Petrova</td>
<td>European Commission Advisor - Directorate for Sustainable Industry and Mobility</td>
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<td>Poul Woodall</td>
<td>DFDS A/S Senior Advisor - Climate &amp; Environment</td>
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<td>IOANNIS ANDREPOULOS</td>
<td>UNION OF GREEK SHIPOWNERS TECHNICAL ADVISOR</td>
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<td>Wolfram Guntermann</td>
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<td>Peter Crawley</td>
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<td>8</td>
<td>Hans Anton Tvete</td>
<td>Hans Anton Tvete Program Director</td>
<td>Norway</td>
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Annex 3. The Survey on evaluating the main trends relevant for the waterborne sector

How to reach zero-emission waterborne transport in 2050? Your opinion matters!

What are the global trends that might influence the waterborne transport sector and how much do we already know about them? Over the last months STEERER, in consultation with the Green Shipping Expert Group, have identified Social, Technological, Economic, Environmental, and Political trends.

STEERER is eager to know how much these trends might affect the waterborne transport sector in the future.

We will use the results to rank the trends and to detect what alternative futures might be envisaged for the sector and where there is more need for action! 🔄

By clicking ‘Enter’ you register your reply. In order to go back, please click on the arrow on the right corner of your screen.

Let’s begin! press Enter 🎥
1 In the following pages we present you the trends one by one according to the STEEP approach (using categories Social, Technological, Economic, Environmental, Political). For each of the trend we ask your assessment according to two criteria **IMPACT** and **UNCERTAINTY** for the development of the European waterborne transport sector.

- **Impact** – The concept of impact encompasses that of importance and of expected effect. In practice, a trend will have a strong impact if its future development is likely to generate or considerably accelerate significant change.
- **Uncertainty** – the concept of uncertainty relates to the difficulty to predict the trend, whether it will become robust, its direction, its speed of development. The concept of uncertainty is directly instrumental in assessing the role that future strategic choices, investments, or R&D activities can play in orienting and steering change in the most desirable direction. If the future development of a given trend is predictable (“on the cards”), then the room for policy action will be reduced.

Ready? Before we begin, could you please kindly indicate* your NAME, COUNTRY, ORGANISATION and SECTOR for statistical purposes? (*not compulsory)

Type your answer here...
For each trend this type of question was presented (below):

Social Trend 1

Demographic change and migration: an increasingly developed world population demanding more trade towards different parts of the world.

Short description: With significant changes ahead in the structure of the world’s population, such as demographic change and migration, demography is set to remain one of the main factors shaping global trade flows. For long, Europe had a position at the centre of the global trading system. The rise of Asia’s population prefigured its role at the heart of the global economy in the future, changing the trade patterns.

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<th>Impact</th>
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<th>Little</th>
<th>Strong</th>
<th>Very strong</th>
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<tbody>
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<td>Uncertainty</td>
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