# ITHR0200413

# TRANSITION TO HYDROGEN FUELLED CROSSBORDER SEA-MOBILITY - TransH2

# Deliverable 1.2.2.

# Joint report on questionnaire results

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# Introduction

The increasing need for sustainable and environmentally friendly transportation solutions has never been more important, particularly in the maritime sector, which has long been a significant contributor to global greenhouse gas emissions. In alignment with the European Green Deal and the EU mission "Restore our Ocean and Waters," there is a concerted effort to achieve zero pollution and drastically reduce emissions from maritime activities. One of the forefront solutions to this challenge is the adoption of zero-emission fuels, specifically green hydrogen, which promises a significant reduction in the carbon footprint of maritime transport.

Within this framework, the objective of the TransH2 project is to enhance sustainable cross-border sea mobility by demonstrating the feasibility and practical application of green hydrogen in maritime transport. By focusing on cross-border and regional maritime routes, the project aims to transition maritime transport systems towards zero-emission operations.

Part of this effort is the establishment of a collaborative hydrogen (H2) maritime transport network. This network seeks to involve a diverse range of stakeholders, including port authorities, transport operators, research institutions, ministries, agencies, and technology providers from both Italy and Croatia, as well as international organizations and EU institutions. The primary goals of this network are to prioritize green maritime routes using hydrogen-fueled vessels, raise awareness about the applications of hydrogen in maritime transport, facilitate transregional knowledge exchange, and promote co-investment in hydrogen infrastructure and technologies.

The collaborative network will serve as a platform for stakeholders to share knowledge, experiences, and innovations related to hydrogen maritime transport. By fostering this collaborative environment, the project aims to accelerate the adoption of hydrogen-fueled vessels and the accompanying fueling infrastructure in ports, thus contributing to the European Sustainable and Smart Mobility Strategy's target of having zero-emission vessels market-ready by 2030.

The purpose of this questionnaire is to assess the level of interest and commitment of various institutions towards adopting hydrogen as a maritime fuel. Understanding the current landscape of interest and readiness is crucial for tailoring subsequent project activities and ensuring that the network addresses the real needs and challenges faced by stakeholders. Secondly, the survey will gather information on the prior experience of institutions with hydrogen technologies and maritime transport. This data will help identify existing expertise within the network and areas where additional support or capacity building may be needed. Additionally, the survey will evaluate the willingness and capacity of institutions to collaborate within the network. This includes exploring potential areas for joint research, development projects, and investment opportunities.

The survey is designed to gauge interest, assess capabilities, and foster collaboration among stakeholders. The insights gained from the survey will guide the development of targeted initiatives, ensuring that the network effectively promotes and supports the adoption of hydrogen technologies in maritime transport. The findings of this survey have provided valuable insights into the current state and future potential of hydrogen in the maritime sector in Croatian and Italian territories.

## Structure of the questionnaire

The questionnaire turnout saw a total of 28 responses, with Italy contributing 5 and Croatia contributing 23. Lower overall turnout could be attibuted to respondents in the marina operators' sector, generally having limited knowledge about hydrogen while maritime agencies, which act as intermediaries between shipowners, lack direct influence on decisions and technologies related to hydrogen use and do not have relevant experience to share.

The questionnaire was published on Microsoft Forms platform and the responses were collected from 3rd to 31st June. It was structured into 14 thematic subcategories, each designed to gather specific information from the respondents. These subcategories provide a broad framework to assess the current state, interests, capabilities, and challenges of organizations in relation to hydrogen as a fuel for maritime applications.

1. **General info**

   This section aims to collect basic demographic information about the respondent and their organization. It includes questions about the respondent's position, country, type and size of the organization and its maturity. This section also seeks to understand the organization's core business activities and any involvement in hydrogen-related projects. The expected outcome is to profile the respondents and their organizations accurately, providing a foundation for analyzing responses in the context of organizational characteristics.

2. **Interest and awareness**

   This section surveys the respondents' familiarity with hydrogen as a potential fuel for maritime applications and their level of interest in exploring hydrogen-based solutions. It also asks about key trends in hydrogen fuel use and production that might impact their research and innovation activities. The expectation is to assess the general awareness and interest levels within the maritime sector regarding hydrogen technologies, helping to identify areas where more information or support may be needed.

3. **Experience**

In this section respondents are asked about their previous experiences with implementing or experimenting with hydrogen technologies in maritime contexts. Questions focus on the main challenges encountered and satisfaction with the outcomes. The goal is to gather insights into practical experiences, common obstacles, and the success rates of past hydrogen projects within the sector.

4. **Infrastructure**

This section queries respondents about their existing infrastructure or facilities suitable for handling hydroge to help understand the current state of hydrogen infrastructure.

5. **Safety and regulation**

Respondents are asked about their perceptions of the safety aspects of using hydrogen in maritime operations. This section aims to uncover concerns and requirements related to safety and regulation, which are critical for the broader acceptance and implementation of hydrogen technologies.

6. **Collaboration and networking**

This section explores the respondents' interest in joining an informal network of stakeholders for hydrogen maritime projects. The goal is to identify potential collaborators and understand their preferences and needs, facilitating the formation of a substantial network.

7. **Economic viability**

Questions in this section assess the respondents' views on the economic feasibility of transitioning to hydrogen in maritime operations. The aim is to understand the economic considerations and motivations that drive or hinder investments in hydrogen technologies.

8. **Supply chain integration**

This section asks about the geographical location of the organization's activities and the parts of the value chain related to hydrogen that they occupy. The expectation is to map the supply chain and identify logistical and operational challenges that need to be addressed.

9. **Vessel conversion and retrofitting**

Respondents are asked if they would consider retrofitting existing vessels to run on hydrogen and the criteria guiding such decisions. This section aims to assess the potential for retrofitting existing fleets and the factors that influence these decisions.

10. **Environmental impact**

This section evaluates the importance of reducing emissions and achieving environmental sustainability for the respondents' organizations. It also explores the perceived role of hydrogen in achieving these goals. The goal is to understand the environmental priorities of the organizations and how hydrogen fits into their sustainability strategies.

11. **Research and development**

This section focuses on specific research areas related to hydrogen in maritime applications that interest the respondents. The section seeks to understand the R&D capabilities and focus areas of the organizations.

12. **Training and skills development**

This section asks if the organization provides training or education related to hydrogen technologies and their interest in participating in such training. The aim is to identify training needs and opportunities for skill development within the network.

13. **Hydrogen supply sources**

Respondents are asked about the most feasible sources of hydrogen for maritime use in their region. This section aims to identify preferred hydrogen sources, which can inform supply chain development and investment strategies.

14. **Long-term commitment**

The final section inquires about plans or strategies committed to long-term sustainability and decarbonization and how hydrogen fits into the long-term vision for the organization's operations. The goal is to assess the long-term commitment of organizations to sustainable practices and the role of hydrogen in their future plans.

# 1. General information

### Country distribution

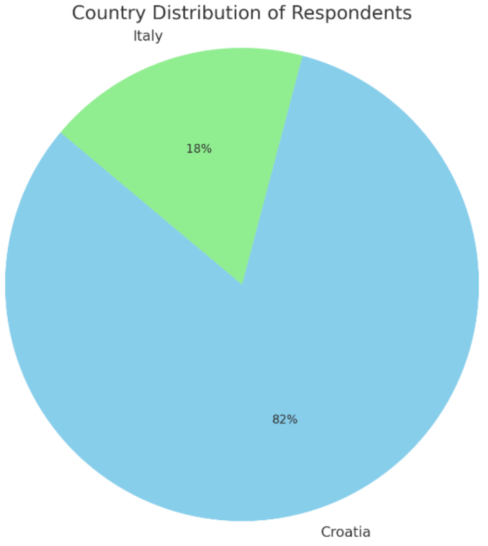


Figure 1. Country distribution of respondents.

This distribution indicates that the majority of responses come from Croatia (82%) highlighting a significant interest or participation from this country in the context of the survey or project. Italy (18%) contributes a smaller portion of the responses. The limited representation from Italy suggests an opportunity to engage more participants in future project activities to ensure a more comprehensive understanding of the challenges and opportunities related to hydrogen technologies.

### Distribution of respondents's roles within the organizations

The list of roles provided illustrates a diverse range of positions held by respondents within their respective organizations..

- **Executive roles** include high-level roles such as CEO, president, CTO, director, and owner. Executive roles are well-represented among the respondents, indicating a strong leadership presence.
- **Managerial roles** cover positions like project manager, business development manager, technical manager, innovation & policy manager. Managerial roles form a significant part of responses. These positions are important for overseeing project implementation, driving business development, managing technical aspects, and ensuring that innovation policies align with organizational goals.
- **Research and academic roles**, wich include researchers and professors. These roles are important in advancing research, developing new technologies, and fostering collaborations between academia and industry.
- **Technical and support roles,** such as technical director, and ITF inspector, important for ensuring the technical feasibility and operational efficiency of hydrogen projects.
- **Strategic and development roles** are the most represented and include positions like member of the board, head of the project development service, strategic business and public affairs and consultants, reflecting a strong focus on long-term planning, policy development, and strategic initiatives.
- **Administrative and sales roles** like project and investment assistant and sales & marketing who play a supportive role in project coordination and market engagement. These positions ensure smooth operational processes and a market-oriented approach to hydrogen technology adoption.

## Type of organization

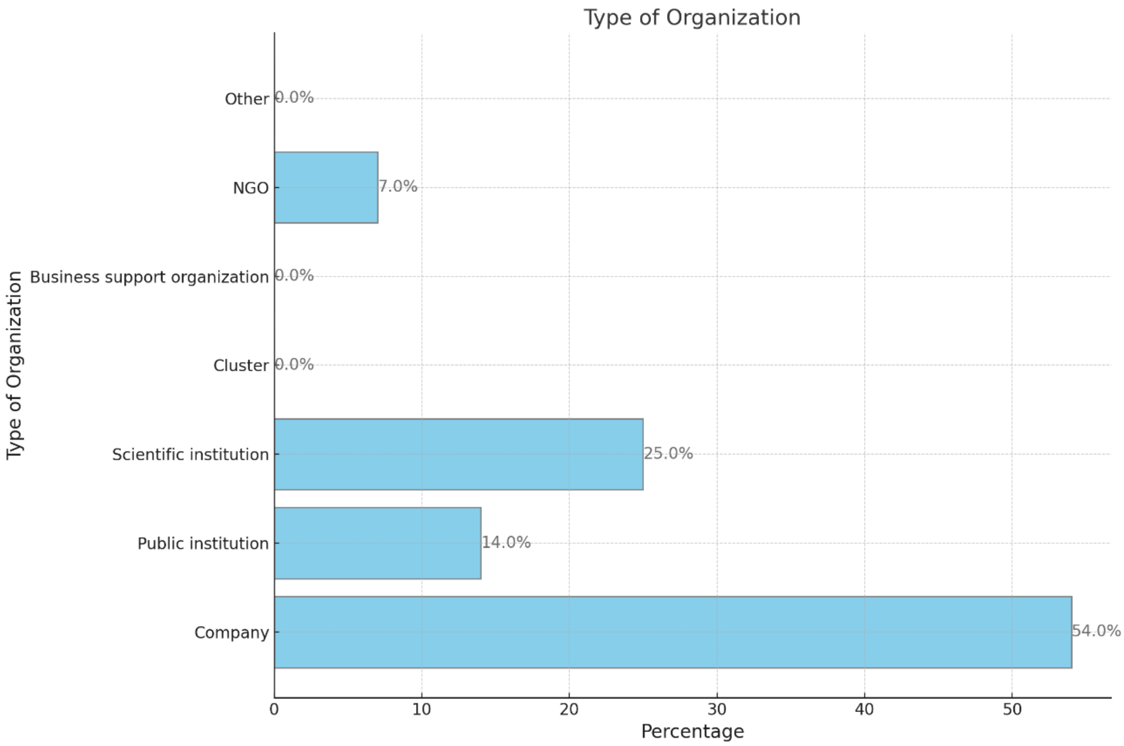


Figure 2. Type of organization.

This distribution indicates that companies form the largest group of respondents (54%). Scientific institutions also have a notable presence (25%), reflecting substantial interest or involvement from research and higher education sectors. Public institutions contribute a moderate number of responses (14% ), while NGOs make up 7%. Clusters, business support organizations, and other categories have no representation in the responses, indicating lower engagement or relevance within these groups for the subject of H2 transition.

## Size of the organizations

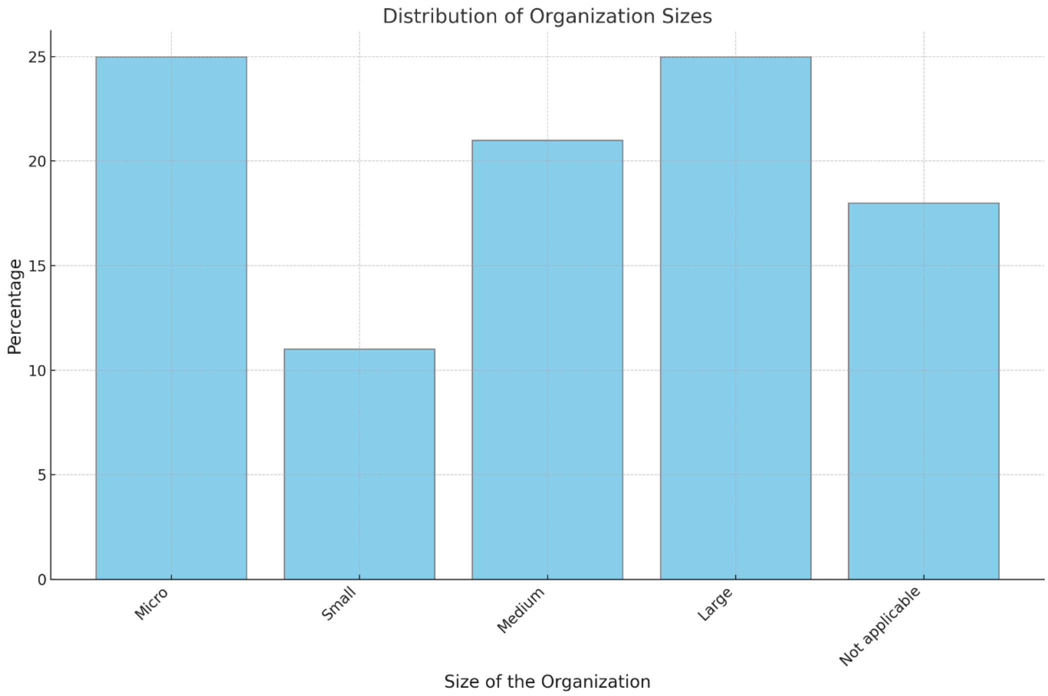


Figure 3. Distribution of organization sizes.

The distribution of organization sizes among the respondents reflects a balanced mix of micro, medium, and large organizations, each contributing uniquely to the hydrogen technology ecosystem. The presence of a significant number of micro and small organizations underscores the role of innovative start-ups and SMEs in driving technological advancements and providing specialized solutions:

- **Micro** (25%): Micro-sized organizations represent a quarter of the respondents, highlighting the involvement of small-scale enterprises in the hydrogen sector. These organizations often bring agility and innovation to the table, crucial for early-stage technology development.
- **Small** (11%): Small-sized organizations constitute 11% of the respondents. These firms typically have more resources than micro organizations and can contribute to niche areas of hydrogen technology.
- **Medium** (21%): Medium-sized organizations make up 21% of the respondents. These organizations are likely to have a balanced mix of resources and capabilities,

allowing them to engage in substantial research and development activities while also scaling their innovations.

- **Large** (25%): Large organizations also represent a quarter of the respondents. These entities typically have extensive resources, established infrastructure, and a significant market presence, making them key players in the adoption and commercialization of hydrogen technologies.
- **Not applicable** (18%): 18% of respondents indicated that the size categorization was not applicable to them. This category may include diverse types of entities such as consortiums, alliances, or other non-traditional organizational structures.

### Organizations' main activity and core business

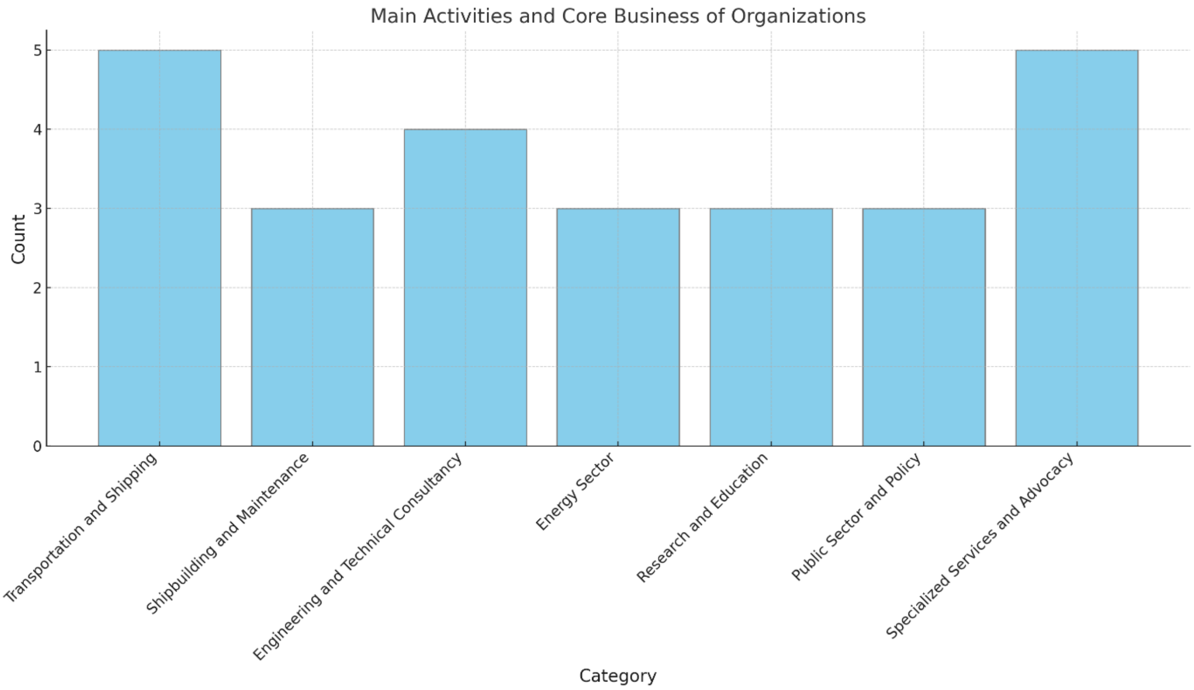


Figure 4. Organizations' main activity and core business.

Overall, the distribution of main activities and core businesses reflects a comprehensive engagement from various sectors. The diverse range of activities highlights the multifaceted nature of the maritime and hydrogen sectors and could benefit collaboration and participation in future TransH2 project activities.

The general categories include:

- **Transportation and shipping**: This category has the highest representation, emphasizing the sector's central role in adopting hydrogen technologies to reduce emissions and enhance sustainability in maritime logistics.
- **Shipbuilding and maintenance**: The significant presence of shipbuilding and maintenance organizations indicates a strong focus on the infrastructure needed to support hydrogen-powered vessels and retrofit existing ones.
- **Engineering and technical consultancy**: Engineering and consultancy services are critical for providing the technical expertise necessary for designing and optimizing hydrogen systems for maritime use.
- **Energy sector**: The involvement of energy sector organizations suggests an interest in transitioning from traditional fossil fuels to cleaner alternatives like hydrogen, integrating hydrogen into existing energy supply chains.
- **Research and education**: Research and educational institutions play a pivotal role in advancing hydrogen technology through innovation and workforce development, contributing to the knowledge base and providing necessary training.
- **Public sector and policy**: Public institutions and policy-makers are essential for establishing regulatory frameworks and providing government support, facilitating the adoption of hydrogen technologies.
- **Specialized services and advocacy**: Specialized services and advocacy groups support the promotion of hydrogen technologies and ensure stakeholder engagement, playing a crucial role in the broader adoption of these solutions.

## Type of work/projects organizations deal with in the field of hydrogen


Figure 5. Type of work/projects organizations deal with in the field of hydrogen.

The visualization reveals the diversity in hydrogen-related projects undertaken by organizations. The most prominent area is international cooperation, engaging 16% of organizations. Networking is also significant, involving 13% of entities. Industrial research follows with 11% engagement. Experimental development and support to organizations are each pursued by 9% of organizations. Both technology transfer and hydrogen technology scaling are projects for 7% of entities. Education-related projects are handled by 5%, while infrastructure projects see 4% involvement. A small percentage, 2%, of organizations focus on production and distribution of green hydrogen, public-private partnerships, and services. Additionally, 13% of organizations are currently not engaged in any hydrogen-related projects. This distribution indicates a strong emphasis on collaboration, research, and networking within the hydrogen sector, reflecting its multifaceted nature and the various strategies employed by organizations to advance hydrogen technologies and infrastructure.

## Key capacities of organizations

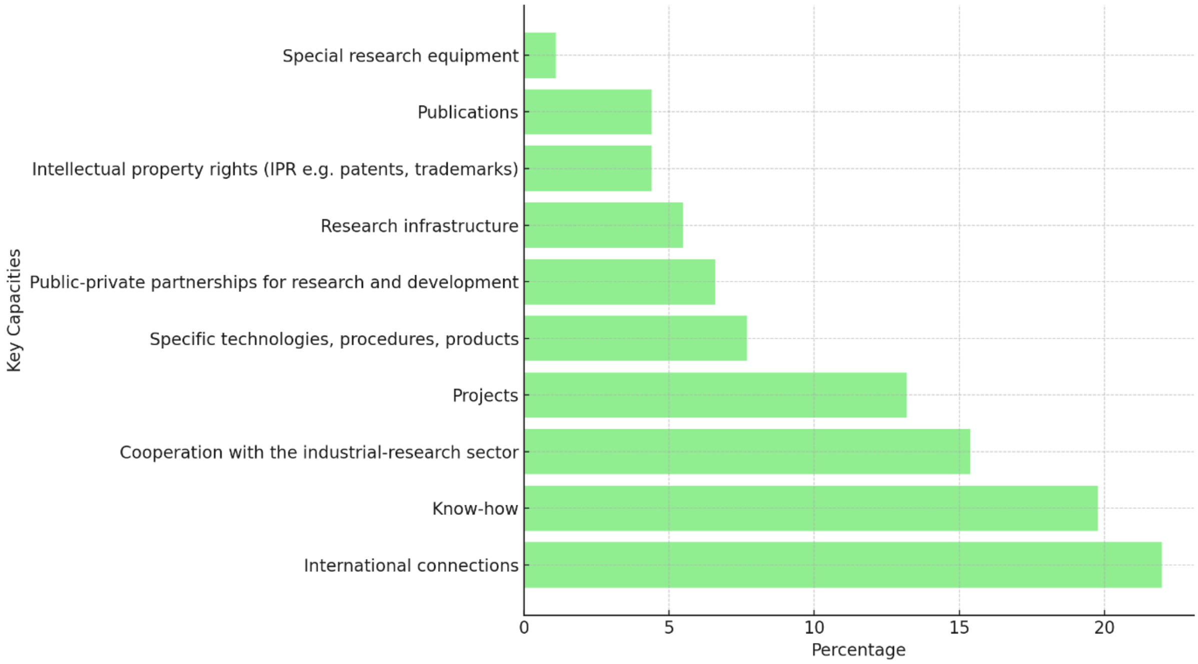


Figure 6. Key capacities of organizations.

The visualization highlights the key capacities of organizations within the hydrogen sector. International connections stand out as the most significant capacity, accounting for 22%. Know-how follows closely at 20%, underscoring the importance of expertise and specialized knowledge. Cooperation with the industrial-research sector is also crucial, involving 15% of organizations, indicating strong collaborative efforts. Projects represent 13% of the capacities, reflecting the active engagement in various initiatives. Specific technologies, procedures, and products make up 8%, showing a focus on tangible innovations. Public-private partnerships for research and development constitute 7%, highlighting collaborative funding and resource sharing. Research infrastructure accounts for 6% and intellectual property rights for 4% emphasizing the need for robust facilities and legal protections. Publications stand at 4%, indicating dissemination of research findings. Lastly, special research equipment, at 1%, suggests a smaller yet vital focus on specialized tools and instruments. Overall, these capacities illustrate a well-rounded approach in advancing hydrogen technologies.

**Most important key capacity of surveyed organization**


Figure 7. Wordcloud of most important key capacities.

The word cloud visualization highlights the most important key capacities of organizations within the hydrogen sector. Prominent capacities include extensive experience in research and development. Organizations emphasize their expertise in shipbuilding, maritime operations, and project management. International connections and collaborations play a significant role, along with the ability to navigate technical, economic, and legislative landscapes. Involvement in EU projects, such as the North Adriatic Hydrogen Valley, underscores their active participation in significant initiatives. Specialized knowledge in building various types of ships, coupled with operational capabilities, underscores their practical skills. Additionally, organizations boast about their ability to handle large-scale projects, integrate innovative technologies, and possess infrastructure suitable for developing hydrogen-driven boats. These capacities collectively illustrate a comprehensive and robust approach towards advancing hydrogen technologies and maritime mobility.

Mentioned key capaciteies can be roughly grouped in 5 categories:

1. **Research and development** , such as research and industrial experience in hydrogen technologies, development and experimental research
2. **Shipbuilding and maritime operations** – includes entities with expertise in ship operations, maritime rules, HR, know-how in building ships from 15 to 30m in

service, patrol, fishing and passenger function, passenger and vehicle transport, experience in operating and managing ships and business, mechanical design, fabrication, materials, development of offshore platforms for wave energy conversion, which can be used in combination with hydrogen production and storage in the context of maritime mobility abd sbility to integrate innovative technologies on board the ship.

3. **Project management and technical expertise** - project development, construction of marina, technical, economic, legislative and regulatory analyses, management of projects of large financial value; management and resource capacities, existing commercial electricity production from RES, human knowledge and infrastructural capacities for the application of hydrogen in business.
4. **International collaboration and networking** - EU projects ("North Adriatic Hydrogen Valley" (NAHV)), good cooperations with worldwide cruise companies, former naval staff and lawyers' expertise, participation in various international institutions that make decisions related to shipping, including the transition to hydrogen.
5. **Infrastructure and technical resources** - Suitable infrastructure including workforce for research, testing and development of hydrogen-driven boats, knowledge and experience in the field of EU funds and hydrogen technologies, IP (Intellectual Property), specific technologies, procedures, products, publications and special research equipment.

# 2. Interest and awareness

**Familiarity with hydrogen as a potential fuel for maritime applications**

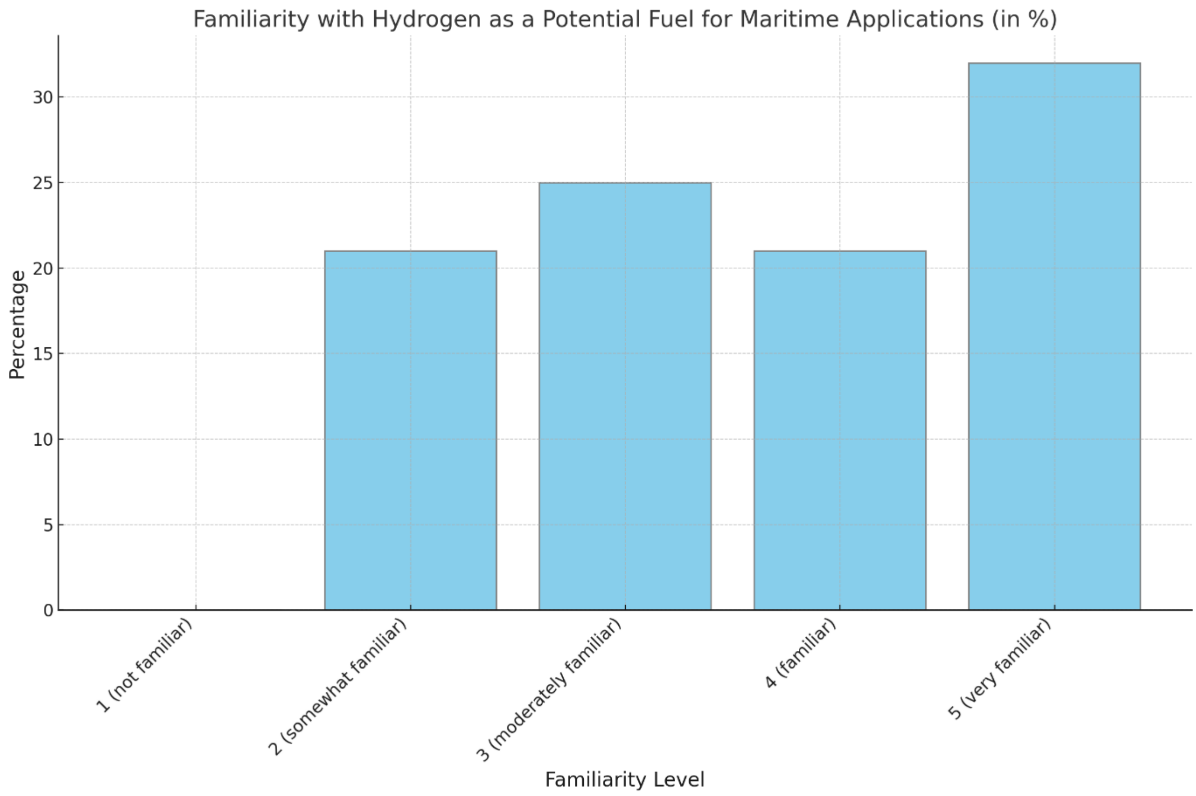


Figure 8. Familiarity with hydrogen as a potential fuel for maritime applications.

On a scale of 1 (not familiar) to 5 (very familiar), none of the respondents were completely unfamiliar with potential maritime uses of hydrogen fuel. About 33 % of organizations are very familiar with hydrogen fuel, indicating a strong awareness. Moderately familiar respondents make up 25%, while both somewhat familiar and familiar categories each account for 21 % of the organizations. This indicates that a significant majority (approximately 79%) have at least moderate familiarity, suggesting a solid foundation for further engagement and development in this area.

**Level of interest in exploring hydrogen-based solutions for maritime transport**

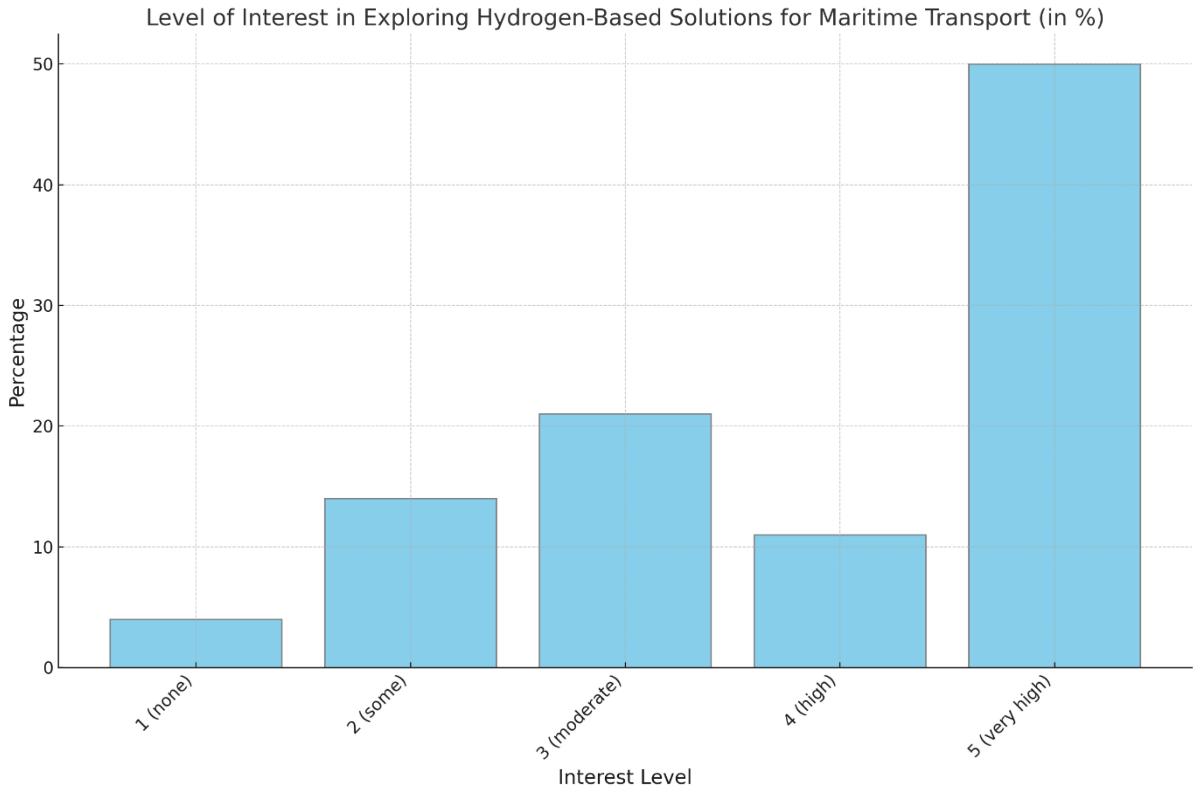


Figure 9. Level of interest in exploring hydrogen-based solutions for maritime transport.

On the other hand, a significant majority (50%) of institutions show a very high interest in hydrogen-based solutions. Moderate interest is exhibited by 21% of the institutions. Some interest is present in 14 %, while high interest accounts for 11%. Only 4% reported no interest. These findings indicate a strong inclination towards hydrogen-based solutions within the maritime transport sector, with a combined 82 % of institutions displaying moderate to very high interest, suggesting a high potential for development, or at least adoption of hydrogen technologies in the future.

Efforts to provide more detailed information, case studies, practical examples, and potential collaborations could help convert the moderate interest into higher commitment levels. Engaging with institutions that show some interest could further broaden the base of support and accelerate the adoption of hydrogen solutions in maritime transport. This high level of interest reflects the potential for significant advancements and investments in hydrogen technology, driving the maritime industry towards more sustainable and environmentally friendly practices.

**Key trends in the area of hydrogen fuel use and/or production that will have the greatest impact on organizations' research or innovation activities in the next few years?**

The respondents' results highlight several key trends in hydrogen fuel use and production. There is a strong emphasis on the development of infrastructure and technology, with significant attention to the legislative and regulatory frameworks required to support hydrogen deployment. Cost and efficiency are critical concerns, with respondents noting the need for mass production to drive down prices and improve demand. In the maritime sector, hydrogen is viewed as a viable alternative fuel, with applications extending to short sea shipping and broader transport sectors. Education and knowledge transfer are crucial for integrating hydrogen technologies, particularly in training seafarers. Innovation is driven by research into fuel cells, storage solutions, and advanced management systems. Additionally, the integration of renewable energy sources is seen as vital for a sustainable hydrogen economy. Projects like the NAHV demonstrate ongoing investment and commitment to hydrogen solutions. Overall, the results reflect a comprehensive approach to advancing hydrogen technologies, emphasizing infrastructure, cost reduction, education, and innovation.


Figure 10. Wordcloud of key trend sin the area of hydrogen fuel use and/or production.

The collected inputs could be summarized in 7 broader categories:

1. **Infrastructure and technology development** – such as development of infrastructure for distribution and storage and industrial use of hydrogen, development of the legislative and regulatory framework and production, storage, and use offshore.
2. **Cost and efficiency** – current price, efficiency and availability of hydrogen technology, cost reduction curve for systems and components.
3. **Application in maritime transport** – including electrolysis, green hydrogen application in transport sector, alternative for short sea shipping, application on board.
4. **Education and knowledge transfer** - new education for seafarers to use hydrogen as fuel
5. **Reasearch and innovation** - development of fuel cells and bunkering and storage solutions, development of advanced management systems for the purpose of stabilizing the energy network and integrating renewables into energy systems, multi-disciplinary research and use as a basis for synthesizing other types of marine fuels
6. **Renewable energy integration** - increasing the share of Renewable Energy Solutions (RES) fuel (Renewable fuels of non-biological origin - RFNBO) in all modes of transport and greening of industry in general.
7. **Projects and investments** - North Adriatic Clean Hydrogen Investment Platform (NACHIP) and North Adriatic Hydrogen Valley (NAHV) project, production, storage and use offshore.

**Familiarity with key actions of the EU Hydrogen Strategy (COM/2020/301)**

The EU Hydrogen Strategy (COM/2020/301), adopted in July 2020, outlines a comprehensive plan to promote the use of hydrogen as a key component in achieving climate neutrality by 2050 in 20 key actions.[1]

It's aim is to create a comprehensive and integrated hydrogen ecosystem in the EU by promoting the development and deployment of hydrogen technologies across the EU by creating a hydrogen market, investing in hydrogen production and infrastructure, increasing funding for research and innovation, supporting the integration of hydrogen into industrial applications, developing and harmonizing standards and regulations for hydrogen technologies, fostering global partnerships and cooperation on hydrogen

[1] https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen/key-actions-eu-hydrogen-strategy_en, 22.7.2024.

development, raising public awareness about the benefits of hydrogen and, among other things, investing in education and training programs to develop the necessary skills for the hydrogen economy.

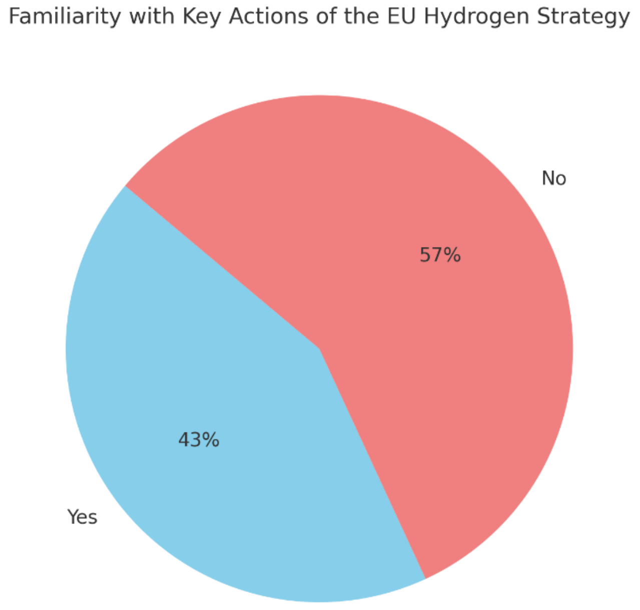


Figure 11. Familiarity with key actions of the EU Hydrogen Strategy.

The pie chart shows that 57% of survey respondents are not familiar with the key actions of the EU Hydrogen Strategy (COM/2020/301), while 43% are familiar, indicating that a majority of the surveyed group lacks awareness of the EU's hydrogen initiatives and the importance and emphasis the EU is placing on the development of hydrogen technologies, especially when it comes to possible funding opportunities if they align their projects with EU priorities, making them eligible for funding under various EU programs.

# 3. Experience

**Implementation or experimentation with hydrogen technologies**

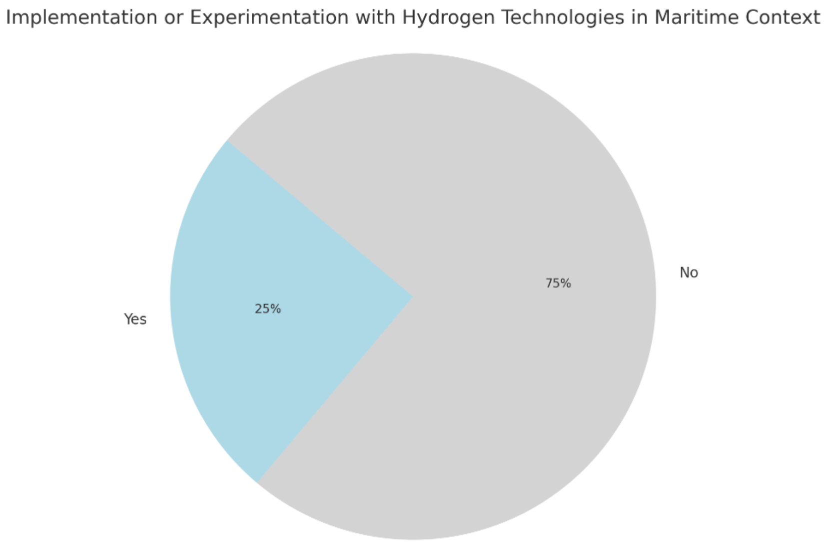


Figure 12. Implementation or experimentation with hydrogen technologies.

The pie chart illustrates that only 25% (7)of respondents have previously implemented or experimented with hydrogen technologies in a maritime context, while 75% (21) have not. Despite the strong interest and awareness of hydrogen technologies indicated in earlier responses, actual hands-on experience remains limited. This gap suggests significant potential for growth in practical applications. Emphasizing key trends such as infrastructure development, cost efficiency, and technology adoption could bridge this gap, fostering broader implementation and experimentation with hydrogen technologies in maritime contexts. Increased investment and pilot projects could drive this transition towards a more sustainable maritime industry.

## Main challenges encountered

Despite the strong interest in hydrogen technologies, actual implementation and experimentation in the maritime sector have been limited, as highlighted by the chart above. The few respondents who have engaged in such activities pointed out several challenges they encountered. Namely, the **infrastructure for refueling** hydrogen ships is still underdeveloped, posing significant logistical hurdles and **hydrogen storage** is still a challenge.

A lack of standards and rules for building and operating hydrogen-powered ships is an obstacle. This includes unclear **regulatory frameworks** and a need for **standardized guidelines**, which complicates compliance and operational procedures.

The **technology readiness level (TRL)** for many hydrogen solutions is still low, indicating that these technologies are not yet mature for widespread commercial use. Additionally, **power scalability** remains an issue, limiting the efficiency and effectiveness of hydrogen applications.

**High costs** associated with equipment and the funding required for such technologies present significant barriers. The **economic viability** of hydrogen technologies is still in question, making investments risky.

Issues related to **volume occupation, poor autonomy** of hydrogen-powered vessels, and the inherent dangers of handling hydrogen were also noted. These **practical and safety concerns** need to be addressed to ensure reliable and secure operations.

Overall, the results emphasize that while interest in hydrogen technologies is high, **practical implementation is still in its nascent stages, fraught with regulatory, technological, economic, and logistical challenges**. These issues must be addressed through coordinated efforts in policy-making, technological innovation, and infrastructure development for advancing hydrogen as a viable maritime fuel.

## Satisfaction with the outcomes

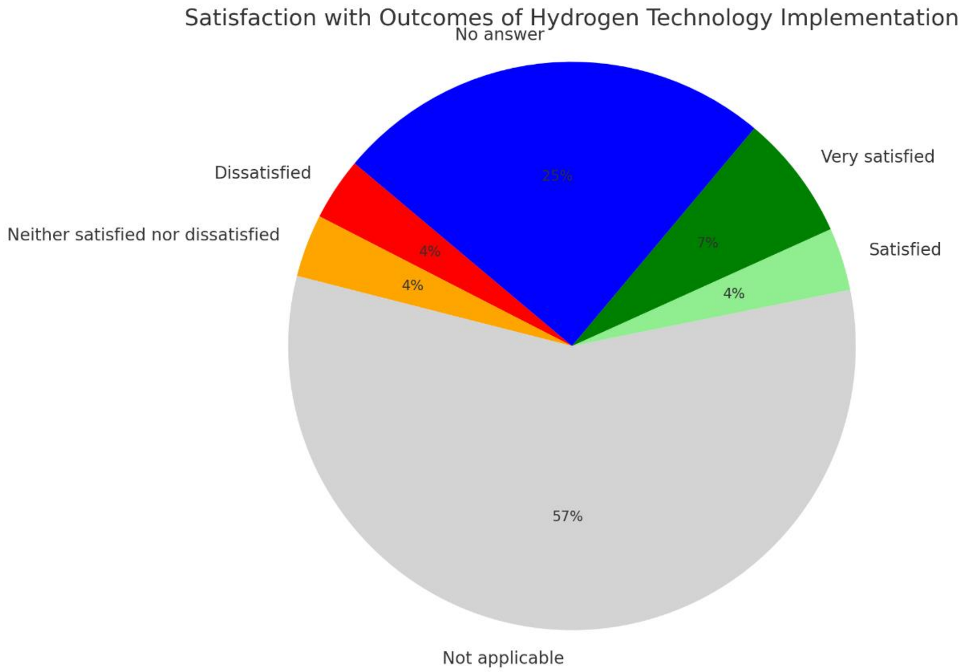


Figure 13. Satisfaction with the outcomes of hydrogen technology implementation.

The pie chart indicates that 57% of respondents found the question not applicable, reflecting a lack of implementation or experimentation with hydrogen technologies. Among those who did respond, 7% were very satisfied, 4% were satisfied, 4% were neither satisfied nor dissatisfied, and 4% were dissatisfied. Additionally, 25% provided no answer. The low satisfaction rates and high non-applicability emphasize the early stage of hydrogen technology adoption in the maritime sector. This aligns with previous findings, underscoring the need for more extensive implementation, standardization, and supportive infrastructure to achieve meaningful and satisfactory outcomes.

# 4. Infrastructure

**Existing infrastructure or facilities for handling hydrogen**

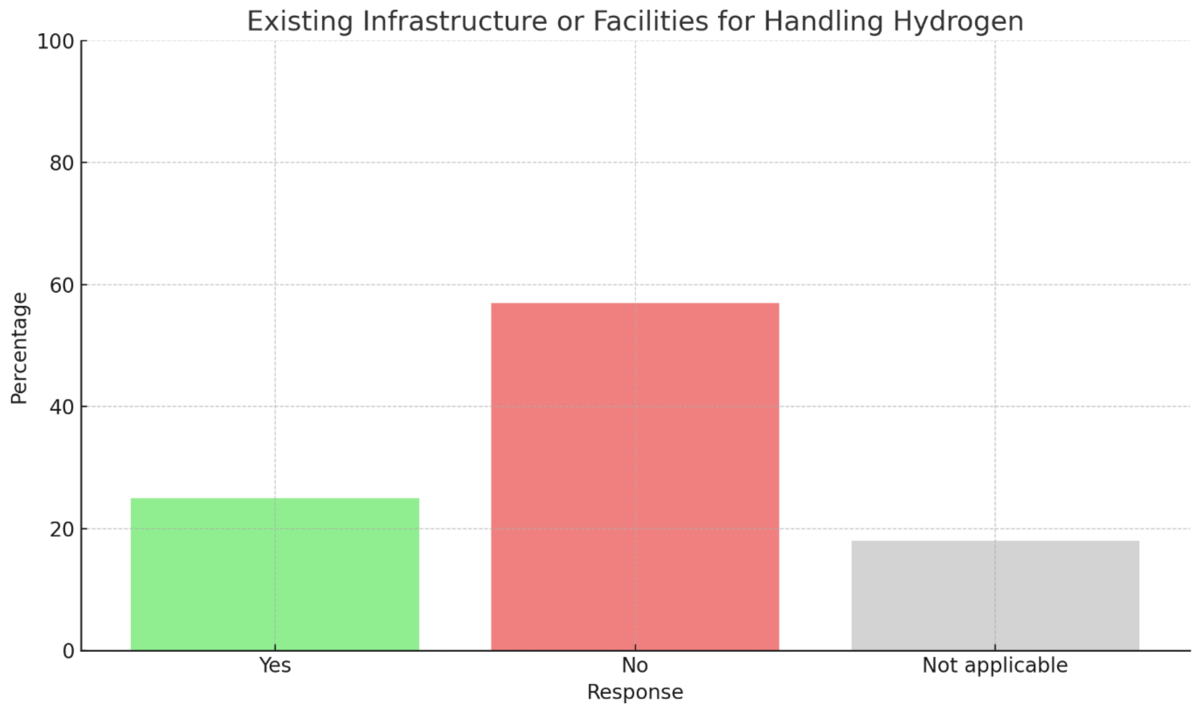


Figure 14. Existing infrastructure or facilities for handling hydrogen.

Only 25% of respondents' organizations have existing infrastructure or facilities suitable for handling hydrogen, opposed to 57% that do not. This highlights a significant gap in the readiness and availability of infrastructure to support hydrogen technologies within these organizations. This lack of infrastructure aligns with earlier findings that underscore the nascent stage of hydrogen technology adoption in the maritimne sector. Addressing this gap will be important for advancing hydrogen implementation, requiring significant investments and development efforts in infrastructure.

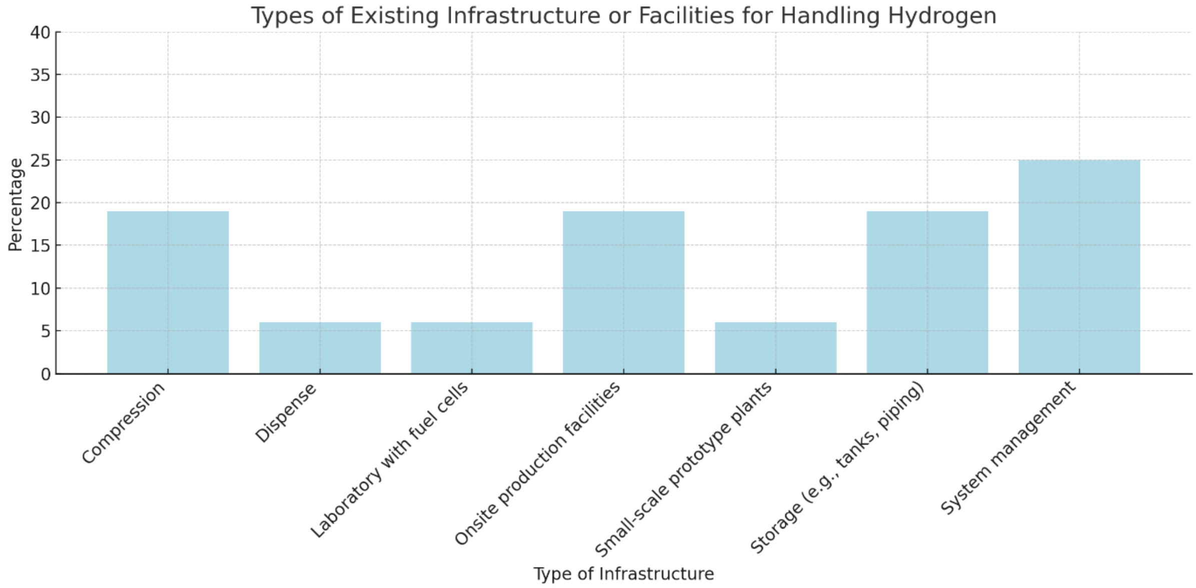


Figure 15. Types of existing infrastructure or facilities for handling hydrogen.

Of the 26% of the respondents whose organizations have infrastructure or/and facilities for handling hydrogen, system management infrastructure leads with 25%, followed by compression, onsite production facilities, and storage (each at 19%). Dispensing and small-scale prototype plants each account for 6%, while laboratories with fuel cells represent 6% as well. The overall low percentages reflect a limited readiness for hydrogen technology implementation, aligning with previous findings that underscore the need for enhanced infrastructure development in the maritime sector.

Of the entities surveyed, **36% plan to develop hydrogen infrastructure, while 46% do not**. These results indicate a significant interest in developing hydrogen infrastructure, but also highlight that nearly half of the organizations are not currently planning such developments.

# 5. Safety and regulation

**Perception of the safety aspects of hydrogen use in maritime operations**

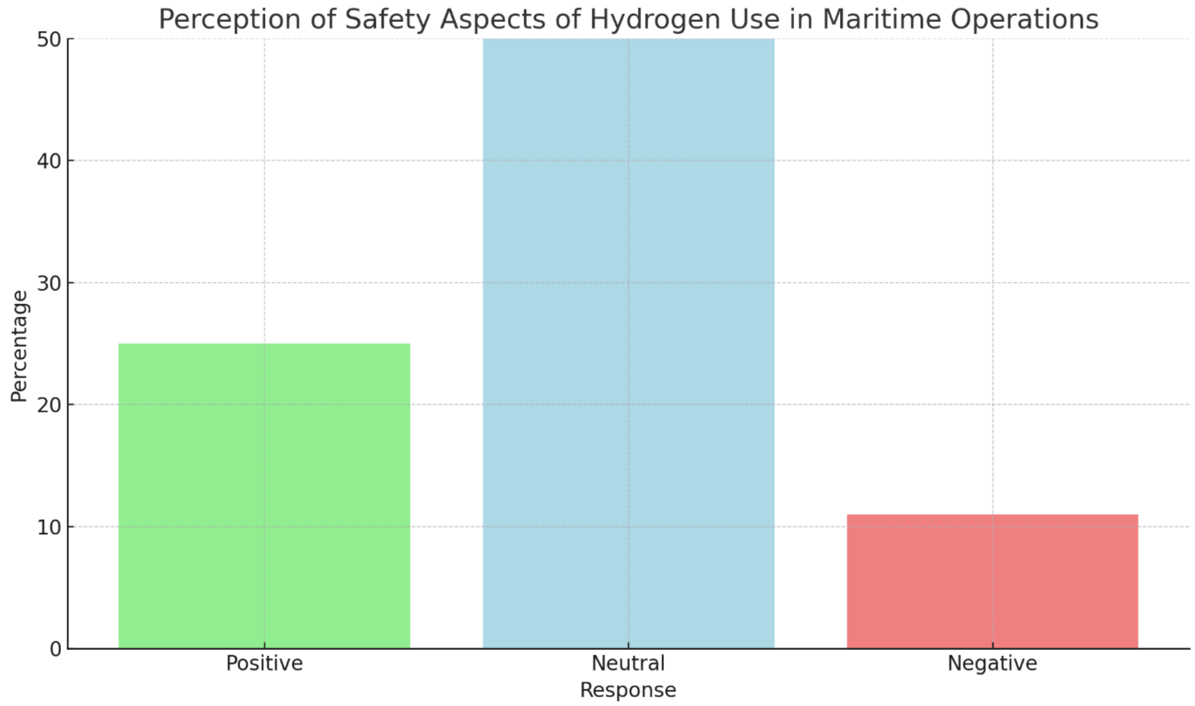


Figure 14. Perception of the safety aspects of hydrogen use in maritime operations.

25% of respondents have a positive perception of the safety aspects of hydrogen use in maritime operations, while 64% have a neutral perception, and 11% view it negatively. The majority of respondents are neutral, indicating uncertainty or a wait-and-see attitude towards hydrogen safety. A significant portion is positive, reflecting confidence in the safety measures and technologies currently in place. However, the presence of negative perceptions underscores the need for further advancements in safety standards, education, and regulatory frameworks to address concerns and build broader confidence in hydrogen's safety for maritime use.

As for the necessary regulatory framework for adopting hydrogen as a fuel, the respondents' answers could be grouped in several larger categories:

1. **State and institutional incentives:** Respondents highlight the importance of state incentives to promote the adoption of hydrogen as a maritime fuel. This

could include financial incentives, tax breaks, and other government-backed support mechanisms that can reduce the economic barriers to implementing hydrogen technologies. In addition to that, classification entities can provide standardized frameworks that ensure the safety and reliability of hydrogen systems in maritime application. Maritime classification societies also play a big role in certifying and regulating the safety standards of maritime vessels. Their involvement is important for ensuring that hydrogen technologies meet the required safety and operational standards.

Another issue that was pointed out is alignement of national regulations with international standards to create a cohesive regulatory environment that facilitates the safe and efficient use of hydrogen.

Finally, encouraging investment through financial incentives and tax breaks can stimulate research, development, and deployment of hydrogen technologies. This support can accelerate the transition to cleaner energy sources in the maritime sector.

2. **Technical and safety guidelines:** Technical guidelines are crucial for setting clear standards for the design, fabrication, and operation of hydrogen systems, ensuring that they meet high safety and performance criteria. The implementation of guidelines related to safety aspects, material selection, and the design and fabrication of storage tanks is particularly important to prevent accidents and ensure the integrity of hydrogen storage and handling systems.

   The SOLAS (International Convention for Safety of Life at Sea) and MARPOL (The International Convention for the Prevention of Pollution from Ships) frameworks are highlighted as essential regulatory frameworks that need to be adapted to include specific provisions for hydrogen technologies. Ensuring the safe use of hydrogen at filling stations is also identified as a critical area that requires clear and stringent safety protocols.

   The respondents also emphasized the importance of a clear definition of mechanisms for encouraging the production of green hydrogen. This includes the need for regulatory changes that create conducive conditions for the use of hydrogen in maritime traffic and transport. The overall sentiment underscores the necessity of establishing a complete and coherent regulatory framework that covers all aspects of hydrogen production, storage, bunkering, and refueling. This comprehensive approach is seen as vital to support the safe and widespread adoption of hydrogen as a maritime fuel.

3. **Research, development and education:** The responses point out the need for substantial investment in these areas to advance hydrogen as a maritime fuel. Increasing investment in research and development of new technologies for the production, storage, and use of hydrogen should be complemented by financial incentives and tax breaks to encourage innovation and the commercialization of hydrogen technologies. Education and awareness campaigns are also highlighted as necessary to foster wider social acceptance and understanding of hydrogen technologies.

   There is also a strong emphasis on integrating education, research, and product development efforts with national energy and climate plans. This integration would ensure that hydrogen development is aligned with broader sustainability goals and policies. By promoting these aspects, stakeholders can build a knowledgeable workforce and a supportive public, both of which are crucial for the successful implementation of hydrogen technologies in the maritime sector.

4. **Infrastructure**: Respondents note the absence of a complete regulatory framework in some regions, emphasizing the urgency of establishing such frameworks to facilitate hydrogen adoption. The creation of a set of regulatory frameworks is seen as a necessary step for the further development of hydrogen infrastructure. This includes establishing protocols for the safe storage and handling of hydrogen, as well as the refueling of hydrogen-powered vessels.

   Investment in infrastructure lays the groundwork for the widespread use of hydrogen. This involves constructing bunkering stations, developing storage solutions, and ensuring that refueling processes are standardized and safe. The emphasis is on creating a supportive environment where hydrogen can be seamlessly integrated into existing maritime operations, thereby promoting its use as a sustainable and viable fuel option.

5. **International and regional strategies:** The EU Hydrogen Strategy is highlighted as an important initiative, providing a comprehensive framework for integrating hydrogen into the energy mix and reduce EU's dependence on imported fossil fuels.. Respondents also stress the need for IMO international regulations and standardization to ensure global consistency and safety. Updating the IGF (International Code of Safety for Ships using Gases or other Low-flashpoint Fuels)

code is seen as essential to address current gaps and make it relevant for hydrogen technologies. These strategies and regulatory updates are crucial for fostering international cooperation and ensuring that hydrogen adoption is globally standardized and efficient.

# 6. Collaboration and networking

**Interest in being a part of the project's informal network of stakeholders**

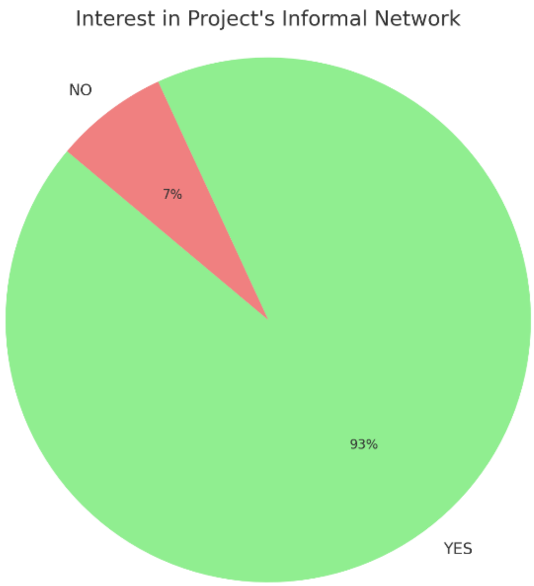


Figure 15. Interest in being a part of the project's informal network of stakeholders.

Most of the respondents (93%) are interested in joining the project's informal network of stakeholders interested in collaborating on H2 maritime projects. This high high level of willingness to collaborate should be utilized in future TransH2 project activities to which interested stakeholders have a lot to contribute.

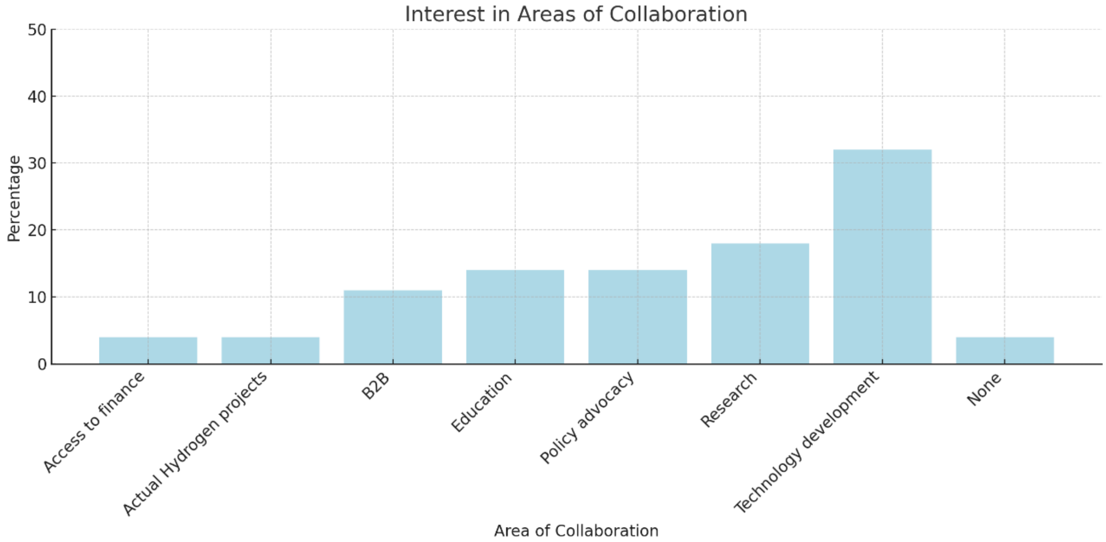


Figure 16. Interest in areas of collaboration.

Their preference when it comes to specific areas of collaboration they are interested in reveals that the highest interest is in technology development (32%), followed by research (18%), and both education and policy advocacy (14% each). B2B collaborations account for 11%, while access to finance, actual hydrogen projects, and none each account for 4%. These findings indicate a strong focus on advancing technology and research to support hydrogen adoption in the maritime sector. There is also significant interest in education and policy advocacy, highlighting the need for knowledge dissemination and supportive regulatory frameworks to facilitate the growth of hydrogen projects.

# 7. Economic viability

### Perception of economic feasibility of transitioning to hydrogen

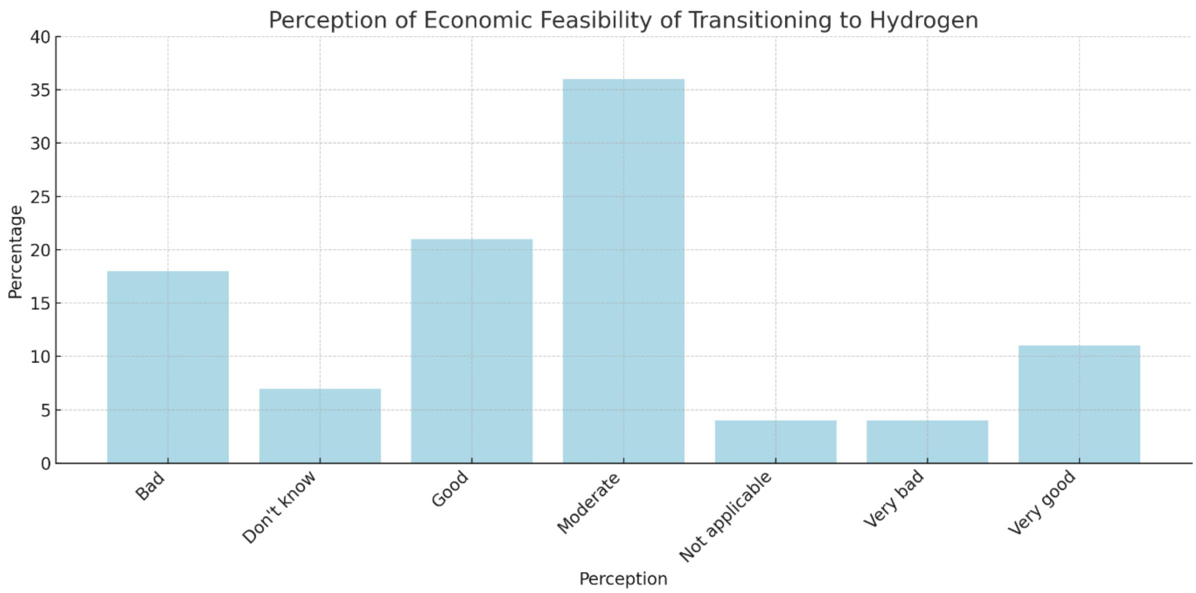


Figure 17. Perception of economic feasibility of transitioning to hydrogen.

The majority of the respondents (36%) perceive the economic feasibility as moderate. Positive perceptions (good and very good) account for 32%, while negative perceptions (bad and very bad) total 21%. A small percentage (7%) are unsure, and 4% find the question not applicable. This distribution indicates cautiously optimistic outlook on the economic viability of hydrogen transition, with a significant portion recognizing potential benefits but also probably aware of the challenges that need to be addressed for broader acceptance and implementation.

**Factors that would influence organizations' decision to invest in hydrogen-related projects**

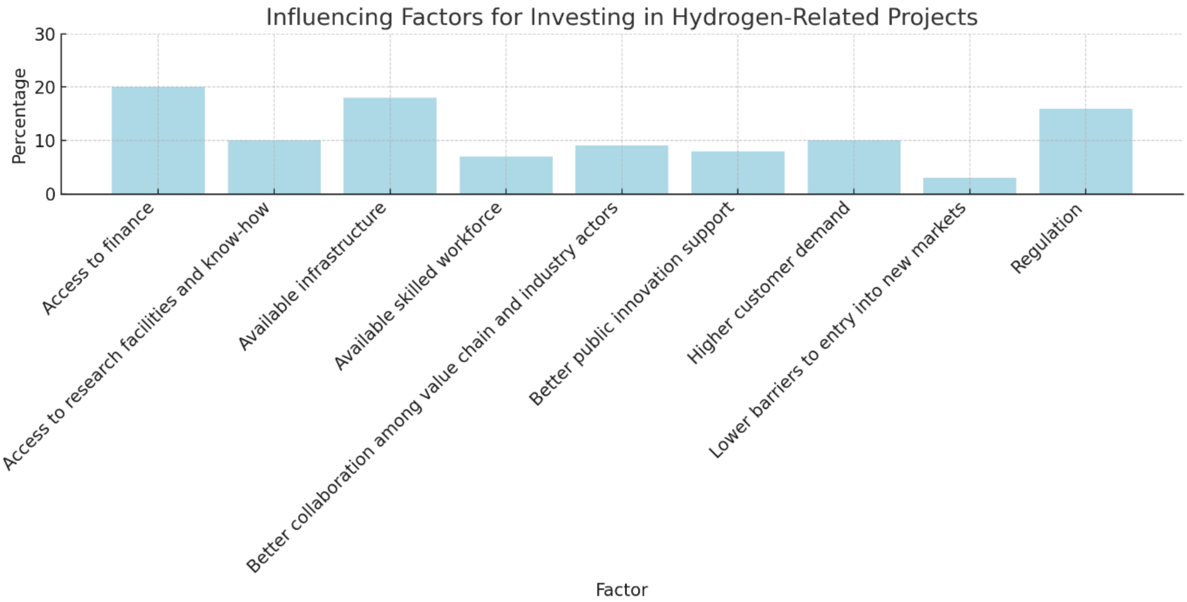


Figure 18. Factors that would influence organizations' decision to invest in hydrogen-related projects.

When asked what factors would influence their decision to invest in hydrogen-related projects, respondents most commonly pointed out **access to finance** (20%) and **available infrastructure** (18%) as top factors that would influence their investment decisions. The high percentage indicates that stakeholders view financial support as essential for mitigating the high initial costs associated with hydrogen technology development and infrastructure, while the importance of existing infrastructure underscores the necessity of having a solid foundation to build upon. Earlier findings revealed a lack of sufficient hydrogen infrastructure, which is seen as a barrier to adoption.

**Regulation** (16%) also plays a significant role, emphasizing the need for clear and supportive policies.

**Access to research facilities and know-how** (10% of responses) is vital for innovation in hydrogen technologies. This aligns with the earlier emphasis on research and development, education, and the need for technical guidelines to advance the sector.

**Higher customer demand** (10%) also plays a significant role, since the stakeholders are more likely to invest if there is a clear and growing demand for hydrogen solutions.

**Better collaboration among value chain and industry actors** (9%), **better public innovation support** (8%) and **available skilled workforce** (7%) would also play a significant part in organizations' decision to invest, while **lower barriers to entry into new markets** (3%) are the least important factor for investing in hydrogen-related projects.

These findings suggest that financial support, infrastructure, and regulatory frameworks play the most signifcant role in fostering investment in hydrogen-related projects.

# 8. Supply chain integration

**Location of the organizations' activity**

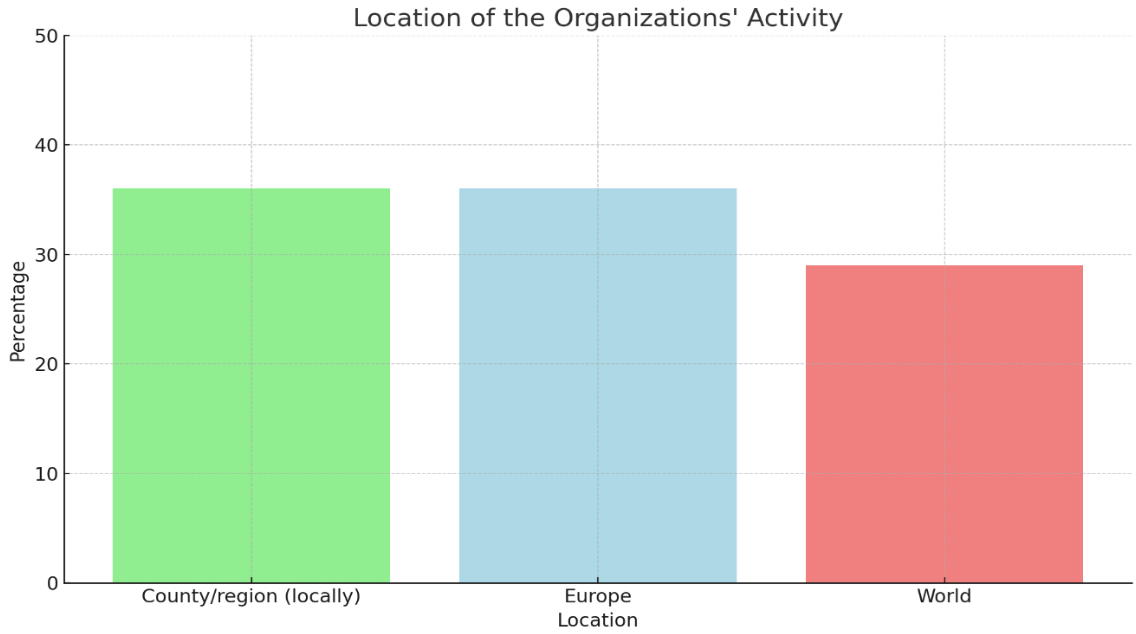


Figure 19. Location of the organizations' activity.

The chart shows the distribution of entities' activities across different geographic regions. The results indicate that 36% of organizations operate locally within their county or region. Another 36% have activities across Europe, while 28% engage in activities worldwide. This distribution suggests that while a significant number of organizations are focused on local and regional operations, there is also considerable involvement at the European and global levels.

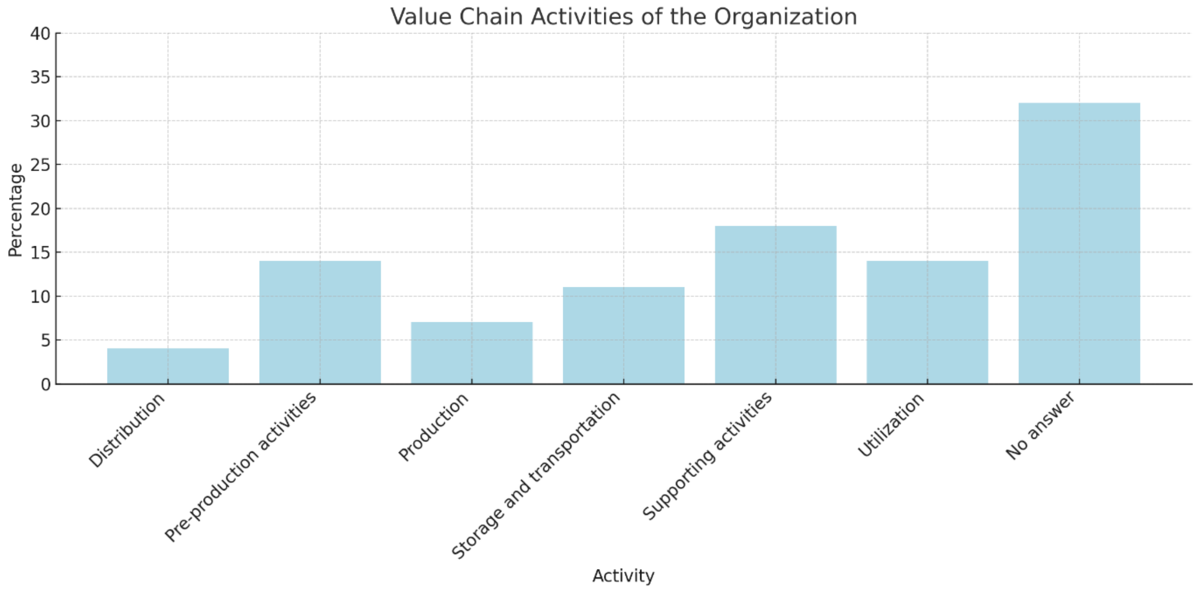


Figure 20. Value chain activities of the organization.

When it comes to distribution of respondents' activities across various stages of the hydrogen value chain, supporting activities, such as certification, training, and business support are the most common, accounting for 18% of responses. Pre-production activities, including research and development, and utilization activities each represent 14%. Storage and transportation activities account for 11%, while production activities make up 7%. Distribution is the least represented activity, with only 4%. Notably, 32% of respondents did not provide an answer. These results indicate a stronger focus on preparatory and supporting roles within the hydrogen value chain.

**Location of the suppliers**


Figure 21. Location of the suppliers.

A significant percentage (61%) of the respondents found this question as not applicable, suggesting either a lack of suppliers or their irrelevance to their operations. Among those who responded, 21% sourced suppliers internationally, 11% nationally, and 7% locally. These findings highlight a notable reliance on international suppliers, which may reflect the global nature of hydrogen technology supply chains. However, the high percentage of non-applicable responses suggests that many organizations might not currently be engaging with suppliers or are in early stages of their hydrogen projects.

## Primary customers

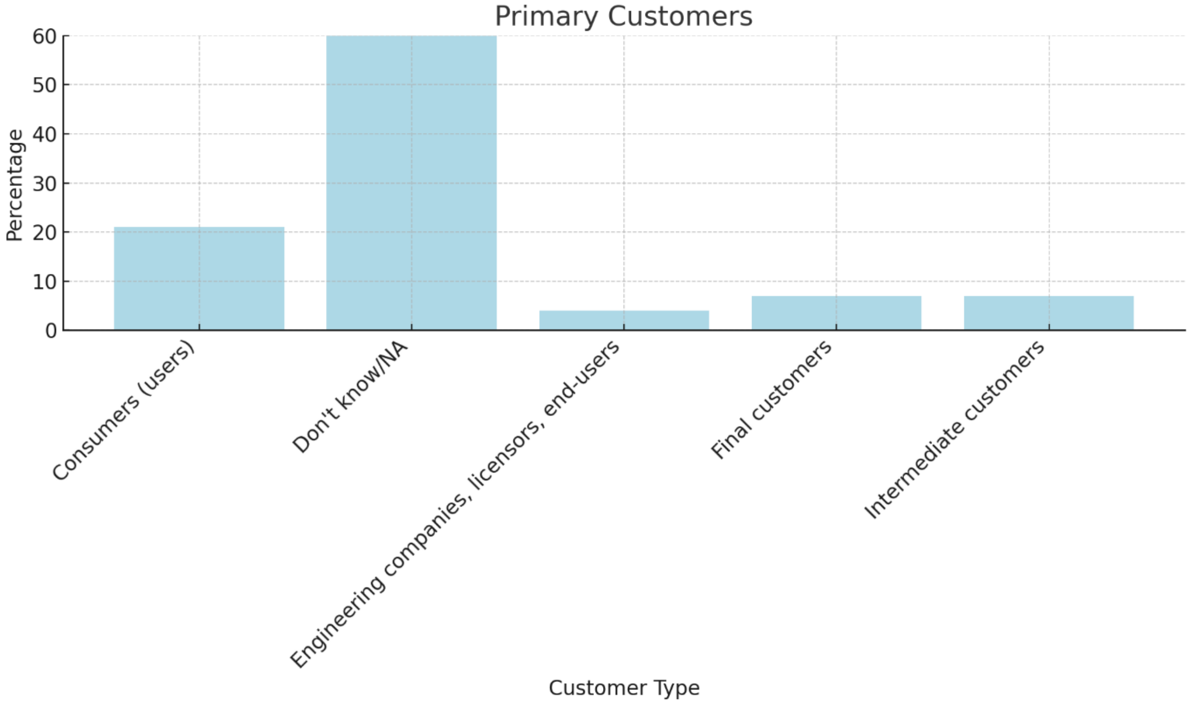


Figure 22. Primary customers of the organizations.

The chart indicates that a significant portion of respondents, 61%, don't know how their primary customers are or that the question isn't applicable to their operations. Among those who provided definitive answers, 21% identified consumers (users) as their primary customers. Engineering companies, licensors, and end-users, final customers, and intermediate customers each accounted for a smaller share, with 4%, 7%, and 7%, respectively. These results suggest that while some organizations have a clear understanding of their primary customer base, a considerable number are uncertain or not directly engaged with specific customer categories in their hydrogen-related projects.

## Challenges in terms of sourcing, transportation and distribution

The responses on challenges in the value chain in terms of soourcing, transportation and distribution reflect broader themes from previous survey findings. A recurrent issue is the lack of existing infrastructure, which is critical for the production, storage, and transportation of hydrogen. This is worsened by the high costs associated with building and maintaining the infrastructure, indicating a substantial financial barrier that needs addressing.

Safety concerns are also prominent, with respondents citing the high flammability of hydrogen and the strict safety protocols required to handle it. These concerns underscore the need for better standardization and regulatory frameworks to ensure safe handling and transportation.

The responses also indicate skepticism about the commitment of current industry players and the readiness of the market to adopt hydrogen technologies. This highlights the need for stronger industry engagement and clearer regulatory guidance to drive adoption.

Another key challenge is the integration and coordination of supply chain actors, which is crucial for creating a seamless hydrogen economy. The geographical constraints, such as the distance of specific regions and their transport connectivity, further complicate the logistics.

The high cost of technology and production, coupled with an unclear regulatory framework, presents additional barriers. These issues emphasize the need for comprehensive policies and financial incentives to make hydrogen economically feasible.

# 9. Vessel conversion and retrofitting

**Retrofitting existing vessels**

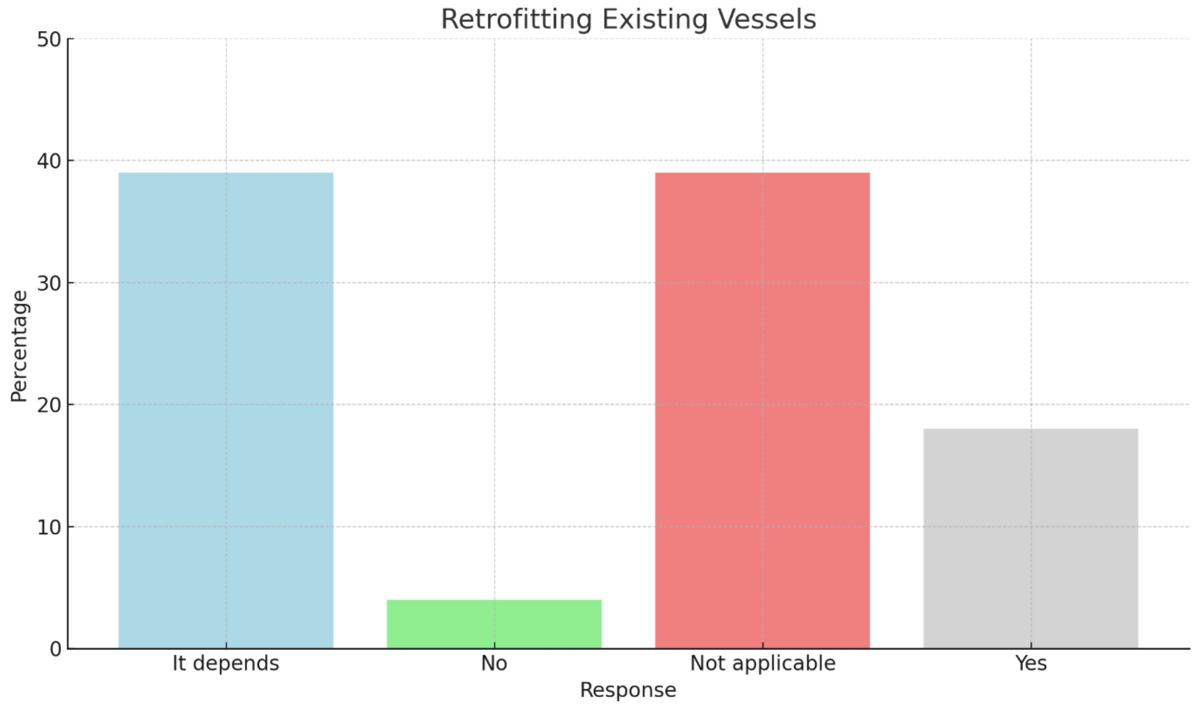


Figure 23. Willingness to retrofit existing vessels.

A significant portion, 39%, stated that it depends, suggesting that the decision is contingent on specific conditions or factors. Another 39% found the question not applicable, indicating that retrofitting might not be relevant to their operations. Only 18% responded positively, showing a willingness or ability to retrofit, while 4% responded negatively. These results highlight the complexity and conditional nature of retrofitting vessels for hydrogen use, reflecting the need for detailed assessment and context-specific considerations before proceeding with retrofitting projects.

**What criteria would guide organization's decision to convert vessels to hydrogen propulsion**

The respondents pointed out several criteria important for their decision to convert vessels to hydrogen propulsion. Financial considerations, including economic feasibility, profitability, and cost reduction, are the most important, reflecting concerns about high infrastructure and technology costs previously identified in the survey. Safety and regulatory factors, such as security, regulatory certainty, and adherence to safety protocols are also important, emphasizing the need for comprehensive frameworks and standards.

The availability and reliability of hydrogen supply are essential, aligning with earlier concerns about the current lack of infrastructure. Technological maturity and feasibility, including the readiness and modularity of refit solutions, are significant factors, underscoring the importance of continued research and development.

Environmental sustainability and the potential for reducing carbon footprints are also important criteria, consistent with the overarching goal of transitioning to greener energy solutions.

# 10. Environmental impact

**Importance of reducing emissions and achieving environmental sustainability**

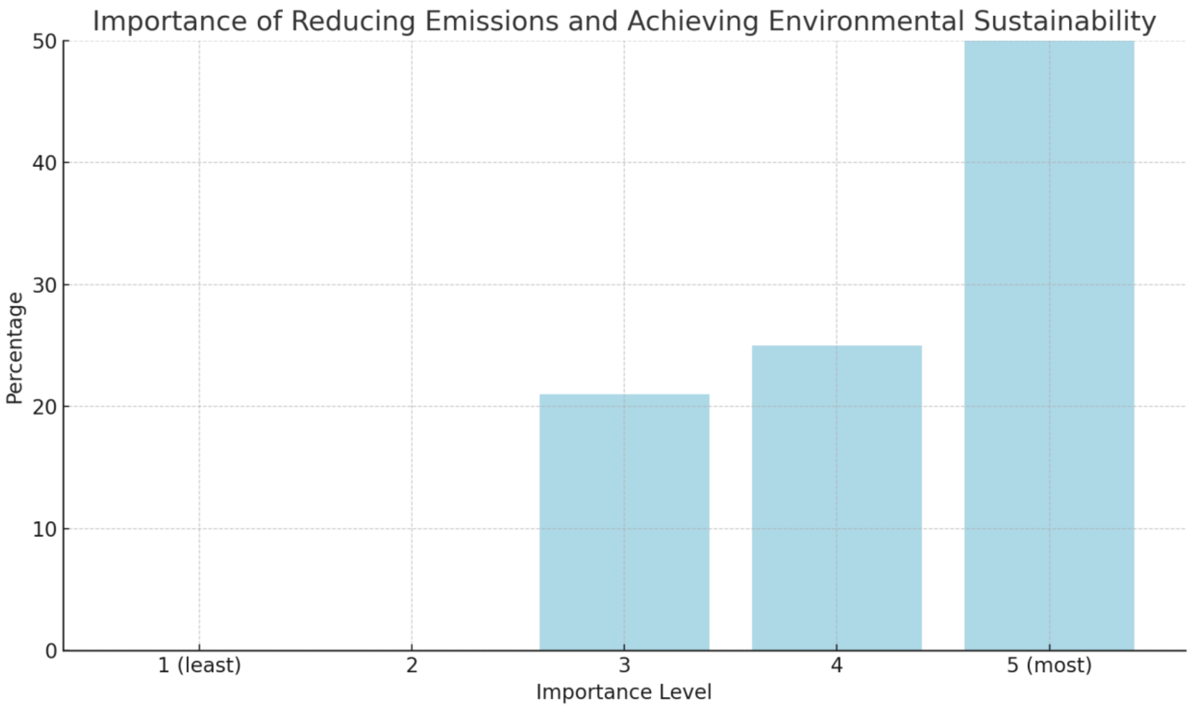

Figure 24. Importance of reducing emissions and achieving environmental sustainability.

The findings demonstrate a strong consensus among respondents regarding the importance of reducing the environmental impact. A substantial 54% rated it as most important (5), and 25% rated it as very important (4). No respondents rated it as unimportant (1 or 2). This reflects a clear recognition of the significance of environmental sustainability, aligning with earlier survey findings emphasizing the necessity for greener energy solutions and the role of hydrogen in reducing emissions. This widespread agreement underscores the priority of integrating sustainable practices in future maritime projects.

**Role of hydrogen in acheiving environmental goals**

The respondents have offered diverse opinions on the role of hydrogen in achieving decarbonization and sustainability goals. Many respondents see hydrogen as a crucial element in reducing greenhouse gas emissions and achieving the National Energy and Climate Plans (NECP) goals. Hydrogen is viewed as a priority and a significant contributor to emission reduction, especially in the transport sector, where it can serve as a clean alternative to traditional fuels.

However, some respondents express skepticism about hydrogen's current role, citing existing technological and infrastructure limitations. They note that while hydrogen has strategic and long-term importance, its immediate impact may be limited.

A few respondents also highlight the uncertainty and complexity of integrating hydrogen into the current energy system, suggesting that its role will depend on broader energy transition efforts and regulatory frameworks.

Overall, the responses reflect a cautious optimism about hydrogen's future role in decarbonization, relied on overcoming current technological, economic, and infrastructural challenges. This aligns with previous findings that emphasize the need for supportive policies, financial incentives, and continued research and development to realize hydrogen's full potential.

# 11. Research and development

### Specific research areas of interest

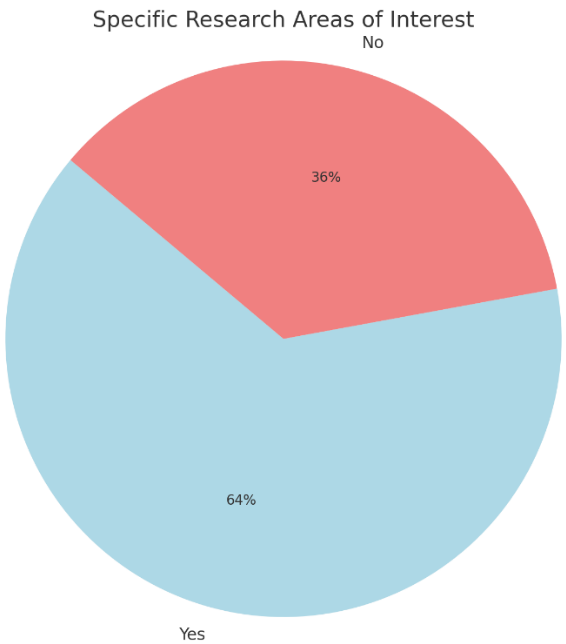


Figure 25. Specific research areas of interest.

The majority (64%)of respondents indicated that their organizations are interested in specific research areas related to hydrogen use in maritime applications. In contrast, 36% of respondents indicated no interest.

The areas they pointed out include marinization of key technologies such as fuel cell systems, hydrogen storage and safety, and the refit of smaller boats up to 20 meters. There is a significant focus on the applicability, availability, and economic viability of hydrogen technologies, which aligns with earlier survey findings emphasizing the importance of financial feasibility and technological readiness.

Hydrogen ferries and the integration of hydrogen solutions into commercial vessels are also prominent, indicating a clear interest in practical, scalable applications for hydrogen in maritime transport. The development of engines and storage tanks for smaller boats, on-shore supply and fueling logistics, and on-board integration highlight the importance of addressing infrastructure and logistics challenges.

The responses also point out the significance of educational efforts and ground infrastructure to support hydrogen as an energy carrier. The interest in offshore conversion, storage, and the use of wave energy, as well as scaling power technologies for large passenger ships, reflects a forward-looking approach to integrating hydrogen into various maritime contexts.

### Percentage of dedicated employees performing R&D work

43% of the respondents didn't provide the percentage of employees dedicated to R&D work in their organizations or found it doesn't apply to their operations.

Amog the other 57%, the answers provide a varied engagement in R&D activities. some organizations have a very small percentage (less than 5%, 1-2%, or less than 1%) of the employees dedicated to R&D, while others report substantial engagement (60% and 70%). A few outliers report extremely high dedication, with one stating 100%. This disparity suggests that while some organizations heavily invest in R&D, others may have limited resources or focus in this area. The overall trend indicates a mix of high and low commitment to R&D across different organizations.

### Elements of innovation processes undertaken by organizations

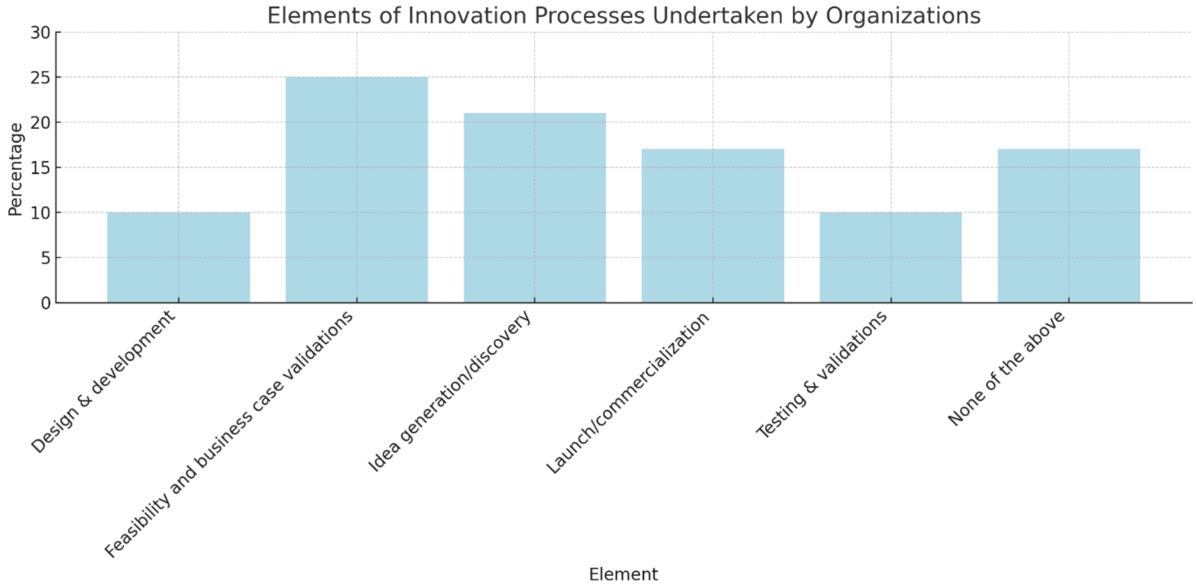


Figure 26. Elements of innovation processes undertaken by organizations.

Feasibility and business case validations are the most common elements, undertaken by 25% of respondents. Idea generation and discovery follow at 21%, while launch and commercialization are undertaken by 17%. Design and development, as well as testing and validations, each account for 10%. Notably, 17% of respondents indicated none of the above, suggesting no active involvement in these innovation processes. These findings indicate a strong focus on the initial stages of innovation, such as feasibility studies and idea generation, with comparatively fewer organizations engaged in later stages like commercialization and validation.

**Innovations introduced by the organizations**

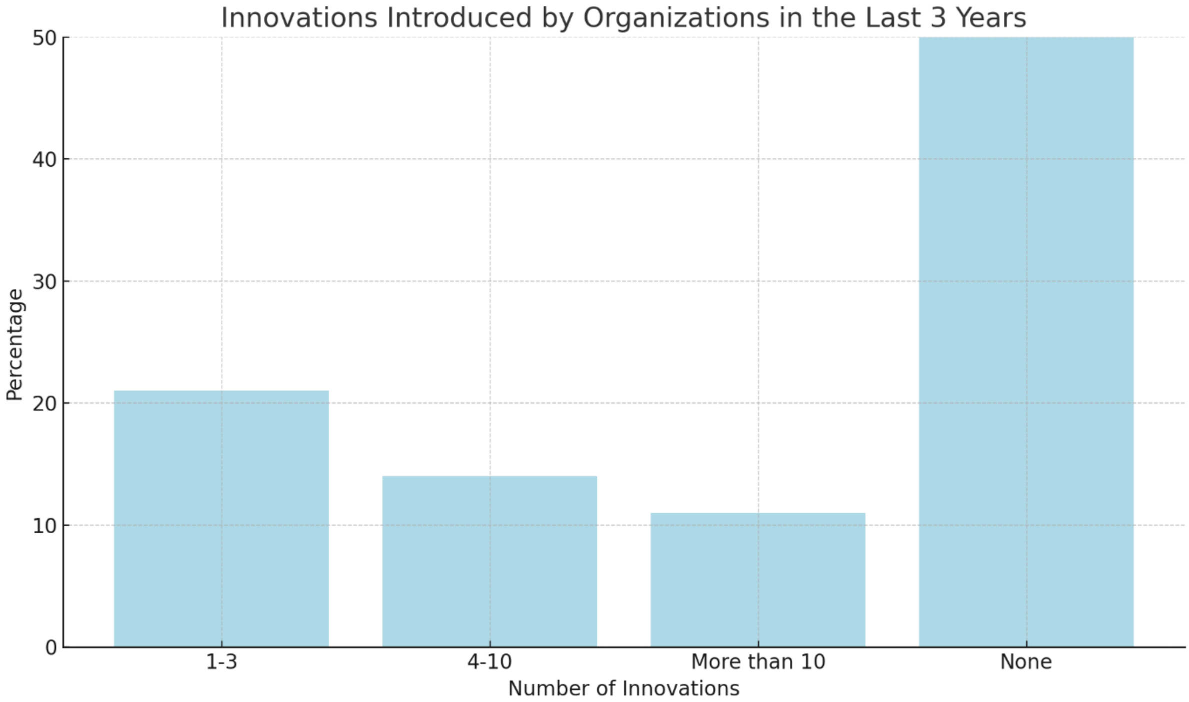


Figure 27. Innovations introduced by the organizations.

The results indicate that 54% of respondents reported no innovations in the past three years, indicating that a significant portion of organizations either do not prioritize innovation or face barriers such as limited resources, regulatory challenges or market conditions that hinder their ability to innovate.

Among the active innovators, 21% introduced 1-3 innovations and 14% introduced 4-10 innovations,. These are the entities moderately engaged in innovation likelylikely in the early stages of innovation or having established processes and teams dedicated to developing and commercializing new ideas.

11% of respondents introduced more than 10 innovations in the last 3 years, indicating an innovative operational ecosystem, likely possessing significant R&D capabilities with a strong focus on continuous improvement and technological advancement.

Enhancing the overall innovation ecosystem (support through e.g. financial incentives, policy frameworks, or collaborative opportunities) could help more organizations move from the 'none' category into active innovation, contributing to industry-wide advancements and sustainability goals.

### Level at which innovations are new

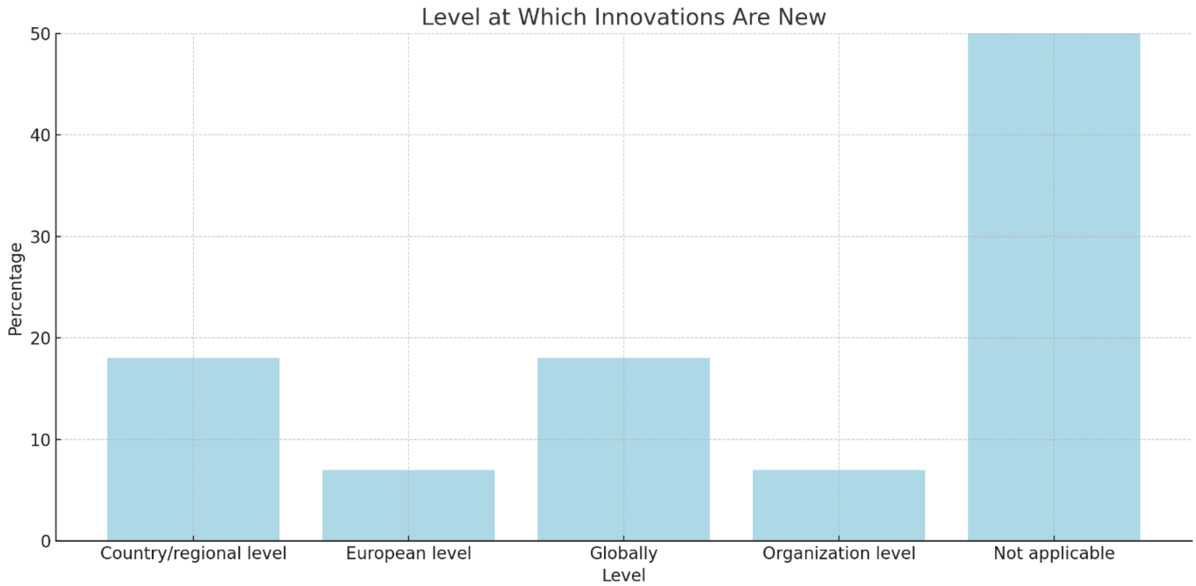


Figure 28. Level at which innovations are new.

50% of respondents indicated that the question wasn't applicable for their organization, suggesting either a lack of innovations or irrelevance to their operations. Among applicable responses, innovations are most commonly new at both the country/regional level and globally, each accounting for 18%. Innovations at the European level and within the organization are less common, each representing 7%. These findings suggest that organizations are pursuing innovations that have both local and global significance, though a significant portion still does not engage in innovation activities.

# 12. Training and skills development

**Organizations providing training or education related to hydrogen technologies**

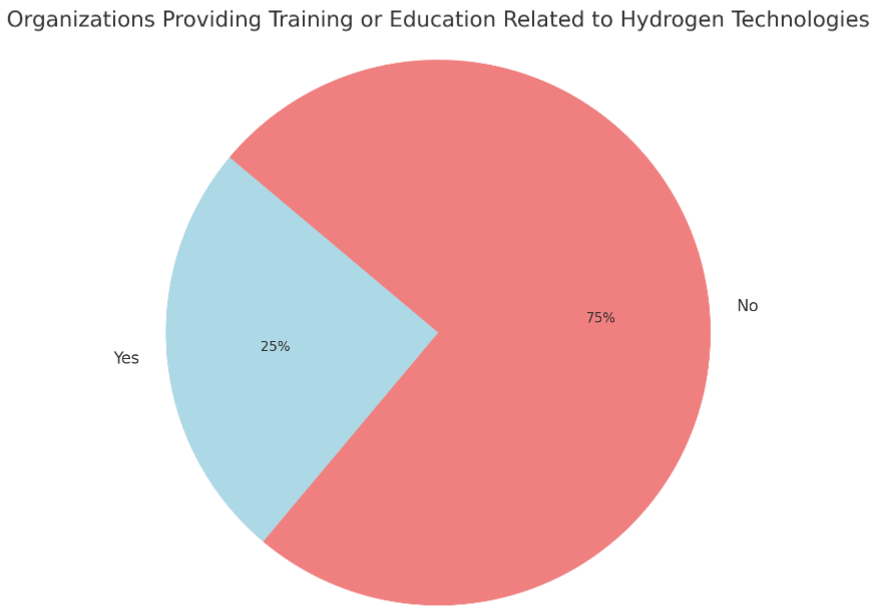


Figure 29. Organizations providing training or education related to hydrogen technologies.

Only 25% of respondents' organizations offer training or education in hydrogen technologies. The remaining 75% do not provide such programs. This suggests several underlying challenges, primarily related to resource constraints and the availability of adequate training programs. The limited availability of specialized hydrogen technology training programs is a possible significant barrier. This shortage can stem from the relatively nascent stage of hydrogen technology adoption, leading to fewer educational institutions and training providers offering such specialized courses. A lack of internal expertise and awareness about the benefits and implementation of hydrogen technologies can also hinder organizations from prioritizing training in this area. Additionally, the complexity and cost of maintaining the infrastructure needed for practical training, such as hydrogen production and storage equipment, could further worsen these challenges.

However, when asked if they would be interested in participation in training regarding H2 usage in maritime transport 82% of the respondents answered positively. This gap between current training provision and interest could open up opportunities for TransH2 project activities by seeking partnerships for pilot actions and promoting awareness about the benefits of hydrogen technologies.

# 13. Hydrogen supply sources

**Most feasible hydrogen sources for maritime use**

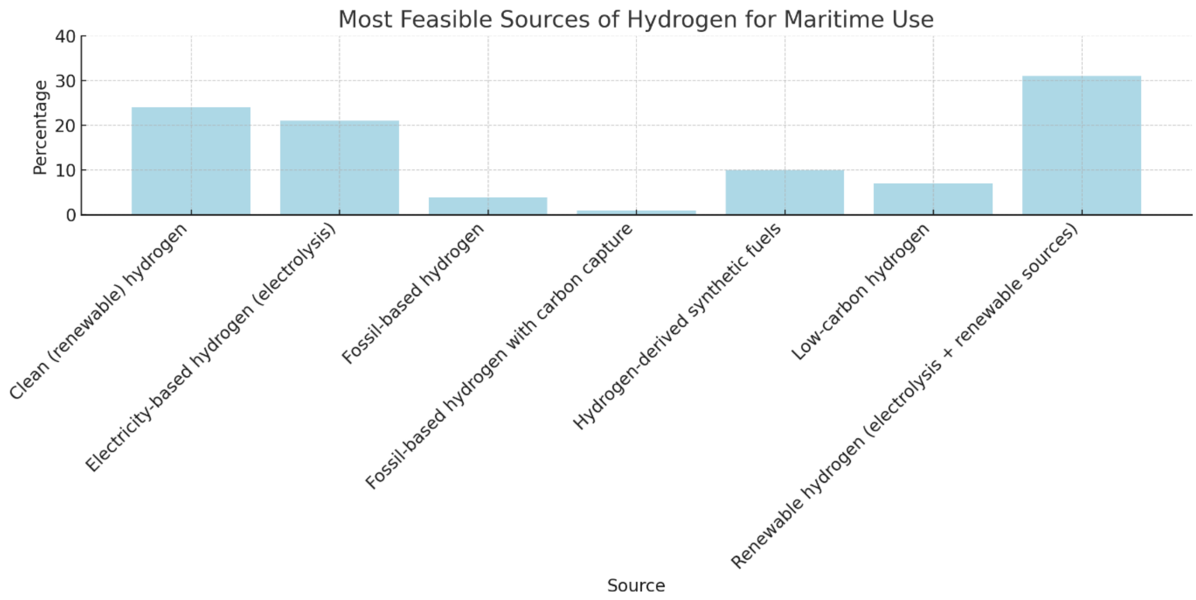


Figure 30. Most feasible hydrogen sources for maritime use.

Regarding the most feasible sources of hydrogen for maritime use, renewable hydrogen (electrolysis + renewable sources) is considered the most feasible by 31% of respondents, followed by clean (renewable) hydrogen at 24%. Electricity-based hydrogen from electrolysis is also favored by 21%. In contrast, fossil-based hydrogen (4%) and fossil-based hydrogen with carbon capture (2%) are viewed as the least feasible options. Hydrogen-derived synthetic fuels (11%) and low-carbon hydrogen (7%) are seen as moderately feasible.

The strong preference for renewable hydrogen sources underscores the sector's commitment to sustainability and reducing carbon emissions. The significant interest in clean and electricity-based hydrogen aligns with previous findings that emphasize environmental sustainability as a key priority. The low feasibility of fossil-based hydrogen indicates a shift away from traditional energy sources towards greener alternatives. This could reflects a broader industry awareness of the need to shift their operations towards sustainable practices, with a focus on leveraging renewable energy for hydrogen production to meet decarbonization goals.

**Partnership preferences**

Asked if they have any preffered partnerships thy would want to explore, most of the respondents (71%) indicated no preference for specific suppliers or partnerships, while 29% did not provide an answer. This suggests that most organizations are open to exploring various suppliers and partnerships for their hydrogen-related projects. The lack of specific preferences could indicate flexibility and a willingness to collaborate with a wide range of partners, potentially driven by the emerging nature of hydrogen technologies and the need for diverse expertise and resources. This openness can be leveraged to build a broad network of collaborations to advance hydrogen initiatives.

# 14. Long-term commitment

**Long-term sustainability and decarbonization plans**

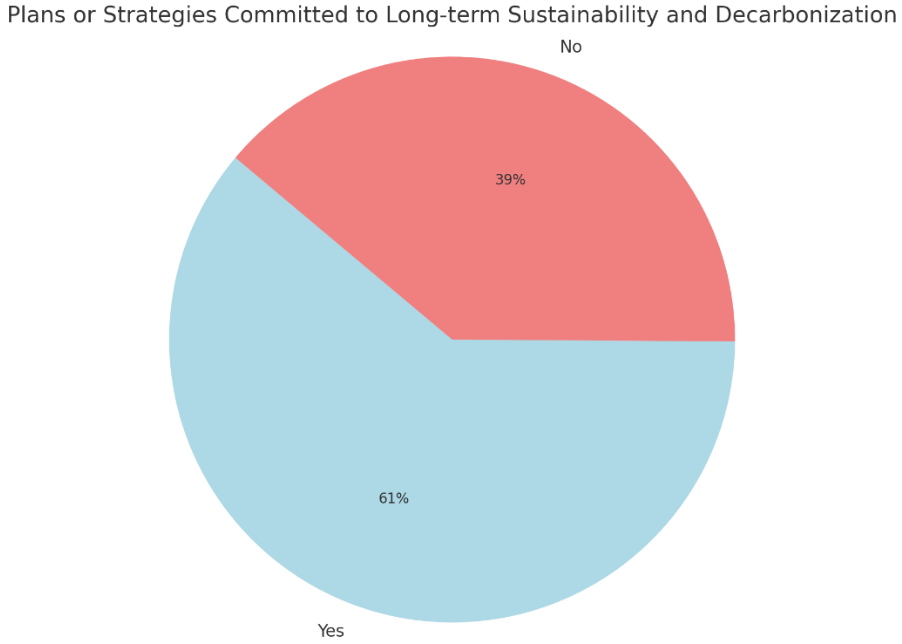


Figure 31. Plans or strategies in place committed to long-term sustainability and decarbonization plans.

61% of respondents have plans or strategies in place for long-term sustainability and decarbonization, while 39% do not. This indicates a substantial commitment and awareness among a majority of organizations towards achieving sustainability goals, reflecting the growing importance of decarbonization in the maritime sector. However, the fact that 39% of organizations lack such plans suggests there is still room for increased adoption and implementation of sustainability initiatives.

When asked how does hydrogen fit into their long-term vision for the organization's operations, the respondents provided a diverse range of perspectives. Some organizations, such as the **Croatian Hydrogen Association**, are inherently aligned with hydrogen adoption, viewing it as a major role or key factor in their future operations. Others see hydrogen as a hypothetical possibility, contingent on mass production, legislative requirements, or the development of necessary infrastructure.

Several respondents indicated that hydrogen fits within a broader context of green technologies and renewable energy sources. They recognize its potential but highlight the need for broader use and reduced costs for more substantial investments. For research institutions like the University of Rijeka, hydrogen is a significant part of their research activities and collaborative projects, such as the North Adriatic Hydrogen Valley.

A portion of the responses reflect uncertainty or current irrelevance, with some stating that hydrogen is not applicable to their operations at this time. This indicates that while there is significant interest and potential for hydrogen integration, practical and infrastructural challenges remain significant barriers to widespread adoption.

# Recommendations for further development and improvement of the network

Encouraging organizations to participate in the forthcoming TransH2 project activites and increasing collaboration within the project network requires strategies that could foster a collaborative culture, facilitate communication, and create shared goals by highlighting the tangible benefits and opportunities associated with their involvement.

One strategy is to **share clear shared goals and objectives** by creating a unified vision and mission for the network. Clearly defined goals that align with the interests of all participants can provide a sense of purpose and direction. These goals and accomplished milestones should be regularly communicated to keep everyone motivated and engaged.

Another compelling incentive is the promise of **collaborative innovation**. By joining the network, organizations gain access to a diverse pool of expertise, fostering an environment where knowledge sharing and joint research initiatives can lead to technological advancements and innovative solutions. This collaborative approach can accelerate the development of hydrogen projects and enhance the competitive edge of participating organizations.

Showcasing **success stories and case studies** of similar networks and ongoing (and former) projects can also be persuasive. Demonstrating how other organizations have benefited from such collaborations in terms of technological breakthroughs, market expansion and cost savings can build confidence and interest.

Regular **newsletters and updates** are essential for keeping all members informed about the latest developments, upcoming events, and important milestones. These communications can be disseminated via email or through the centralized online platform. Newsletters can highlight key achievements and provide updates on ongoing activities. Keeping everyone informed fosters a sense of community and ensures that all members are aware of the network's progress and any upcoming opportunities for involvement.

**Social media and other digital communication channels** can also enhance the visibility and reach of the TransH2 network. Platforms like LinkedIn, Twitter, and Facebook can be used to share updates, promote events, and engage with a broader audience. These channels can also facilitate networking and collaboration with additional stakeholders, industry experts, and potential partners. A strong online presence can help attract new members, increase public awareness, and build a supportive community around the project.

Gathering **feedback from stakeholders** on what is working well and what needs improvement can help in fine-tuning the network's activities and approaches. Surveys, polls, and suggestion boxes can be used to collect this feedback. Acting on the feedback demonstrates that the network values its members' input and is committed to continuous improvement.

Organizing **physical events**, such as workshops that are already planned in the project application, can also strengthen the network. In-person interactions can foster deeper connections and facilitate more effective collaboration. These events will provide opportunities for hands-on learning, networking, and building relationships that can enhance the overall cohesion and effectiveness of the network.

# Conclusion

The survey results reveal a complex landscape of opinions and readiness regarding the adoption and integration of hydrogen technologies in the maritime sector. The majority of respondents recognize the critical role of hydrogen in achieving decarbonization and environmental sustainability goals. However, significant barriers such as limited infrastructure, high costs, technological readiness, and a lack of specialized training hinder the widespread adoption of hydrogen solutions. Despite these challenges, there is a strong interest in hydrogen technologies, with many organizations indicating a willingness to engage in research, training, and collaborative projects to advance hydrogen usage.

The survey results reveal a high level of familiarity and interest in hydrogen among respondents. This widespread awareness is important for driving the adoption of hydrogen technologies, as it indicates a non-negligible knowledge within the industry. Furthermore, there is a strong interest in exploring hydrogen-based solutions, with over 50% of respondents expressing very high and moderate to high interest. This high level of interest underscores the industry's readiness to transition to hydrogen, provided that the necessary support and infrastructure are in place.

Infrastructure readiness emerged as a critical challenge, with many organizations lacking the necessary facilities to handle hydrogen. Majority of respondents indicated no existing infrastructure suitable for hydrogen handling, highlighting a significant barrier to the widespread adoption of hydrogen technologies. The main challenges identified include high costs of technology, lack of infrastructure, regulatory uncertainties, and safety concerns related to hydrogen storage and transportation. Addressing these challenges will require substantial investment in developing hydrogen infrastructure, including production facilities, storage systems, and refueling stations. Public-private partnerships can play a pivotal role in this development, ensuring that the necessary infrastructure is in place to support the transition to hydrogen.

Funding and investment opportunities are critical enablers for advancing hydrogen projects. Many respondents highlighted the importance of EU and governmental financial incentives to support hydrogen initiatives. Awareness of funding opportunities linked to the EU Hydrogen Strategy could significantly boost project development and implementation. Simplifying and streamlining the application processes for EU and governmental funding programs, alongside introducing financial incentives such as grants, subsidies, and tax breaks, can encourage investment in hydrogen technologies by offsetting initial high costs and making hydrogen projects more economically viable.

Research and innovation are essential for driving the hydrogen agenda forward. Collaborative research initiatives between academia, industry, and research institutions can lead to breakthroughs in hydrogen production, storage, and utilization technologies. Establishing innovation hubs dedicated to hydrogen research can serve as focal points for knowledge exchange, skill development, and technological advancements. Increased funding for hydrogen-related research and development projects will stimulate innovation, leading to the development of more efficient, cost-effective, and safer hydrogen technologies.

Developing and harmonizing standards and regulations, including safety protocols, environmental standards, and technical specifications also play a crucial role in the successful integration of hydrogen technologies. Creating regulatory roadmaps that outline the steps and timelines for integrating hydrogen into the maritime sector can provide clarity and certainty for organizations planning to invest in hydrogen technologies. By ensuring compliance with EU standards, organizations could secure permits, access markets, and avoid legal issues, facilitating a smoother market entry.

Industry collaboration and networking are vital for enhancing the development and adoption of hydrogen technologies. Establishing informal networks of stakeholders interested in hydrogen maritime projects can facilitate collaboration, knowledge sharing, and joint ventures. Organizing industry conferences and forums can bring together stakeholders from various sectors to discuss challenges, share best practices, and explore collaboration opportunities. These platforms can provide valuable insights and foster partnerships that drive the hydrogen agenda forward.

Safety and risk management are necessary considerations in the adoption of hydrogen technologies. Comprehensive safety training programs for handling hydrogen should be developed, covering best practices, emergency response procedures, and risk management strategies. Investing in safety research can improve the safety of hydrogen storage, transportation, and utilization, helping to mitigate risks and build confidence in hydrogen systems. Ensuring that safety standards are met across the hydrogen value chain will be necessary for gaining public and stakeholder trust. Organizations should be encouraged to integrate hydrogen into their long-term strategic planning, ensuring that hydrogen is considered a critical element in their sustainability and decarbonization efforts.

Collaborating with countries leading in hydrogen technology can provide valuable insights and resources, helping to overcome common challenges and accelerate the transition to hydrogen and adoption of hydrogen technologies.

The high level of interest and familiarity among stakeholders, coupled with the strategic importance of hydrogen, creates a strong foundation for advancing hydrogen technologies in the maritime sector. Achieving this transition requires concerted efforts to address knowledge gaps, develop infrastructure, secure funding, promote research, establish regulatory frameworks, and foster collaboration.