GETTING TO ZERO COALITION
GLOBAL MARITIME FORUM

Mapping of Zero-Emission Pilots and Demonstration Projects

Fifth Edition | July 2024

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About the Getting to Zero Coalition

The Getting to Zero Coalition is an industry-led platform for collaboration that brings together leading stakeholders from across the maritime- and fuels value chains with the financial sector and others committed to making commercially viable zero-emission vessels a scalable reality by 2030, towards full decarbonisation by 2050. It is managed by the Global Maritime Forum, who initially founded the Coalition together with the World Economic Forum and Friends of Ocean Action.

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Summary

The Mapping of Zero-Emission Pilots and Demonstration Projects has, since 2020, presented snapshots of the evolving landscape of innovation in zero-emission shipping across ship technologies, fuel production technologies, bunkering, and infrastructure. This fifth edition documents a major milestone in shipping's decarbonisation journey, as many of the activities, technologies, and projects formerly covered by this report have matured beyond piloting and demonstration and begun to focus on commercial deployment and are thus excluded from this year's report. Many new projects have also been added, with a majority of those announced in 2023 and early 2024. Projects previously included in earlier reports continue to evolve, with an increase in projects receiving approvals in principle (AiP), indicating continued positive progress towards commercialisation. For those projects, new and old, that have disclosed their timelines, most expect completion in or after 2025.

The progression of these projects underscores continued momentum in maritime decarbonisation, as the industry moves from testing and demonstration to implementing viable, commercial zero-emission solutions, marking a crucial step toward sustainable shipping.

Key takeaways

- The Mapping of Zero-Emission Pilots and Demonstration Projects now includes 340 registered projects, up from 236 registered projects in the fourth edition.[1]
- Ammonia and hydrogen combustion engines and fuel cells dominate ship technology projects. With methanol-powered vessels entering operations in multiple segments, these projects are now mostly considered mature and have been excluded from the report.
- In bunkering and infrastructure projects, onshore bunkering is prioritised over offshore, with a focus on hydrogen and ammonia infrastructure. This reflects the complexity and necessity for robust onshore systems before advancing to offshore. Additionally, there is a clear trend towards integrating fuel production with bunkering infrastructure, particularly for hydrogen.
- Innovative fuel production projects are mostly in the concept stage, facing lengthy timelines and obstacles such as environmental approvals, large investment needs, and market demand issues. These projects need strong market signals, financial and political support to ensure the needed progression.
- Collaboration levels across these projects remain high, with many companies and countries involved in individual projects, particularly in Europe.
- Government bodies play a crucial role in supporting projects, but information about the extent of their support, funding, and overall project costs remains unclear.
- Despite high levels of collaboration between companies from different countries, there is a significant lack of involvement from some developing countries, especially small island developing states and least developed countries. This extends to government participation in projects as well.
- There has been a decrease in publicly funded projects and geographical differences in funding availability remain, with European funds predominating.
- Improved availability and exchange of information related to projects' progress and results could help accelerate learning and consolidation around key technologies.

1 Due to a methodology update, 137 projects out of the 373 projects included in the fourth edition of this study were excluded from further analysis. More details can be found later in this report.

What is the Mapping of Zero-Emission Pilots and Demonstration Projects?

This study includes zero-emission pilots and demonstration projects from the global maritime ecosystem focusing on ship technology, bunkering and infrastructure, and fuel production solutions that can help the maritime industry decarbonise by 2050. The terms 'pilots' and 'demonstration projects' refer to projects or services in their early stages of development and exclude those that are commercially available. This study is based on updated information from previous editions as well as new projects that have been discovered or announced since May 2023, when the **fourth edition** was published, and February 2024.

Projects have been gathered via desk research and outreach to the wider global shipping community of the Getting to Zero Coalition and Global Maritime Forum. While the authors are hopeful that a majority of announced zero-emission pilots and demonstration projects have been captured, the findings of this study do not claim to be exhaustive. Lastly, the fuel scope of this study is based on the Getting to Zero Coalition's definition of zero-carbon energy sources, which focuses on fuel production pathways from feedstocks and technologies that emit net-zero carbon on a well-to-wake basis.[2] With this definition in mind, this study aims to objectively present some of the key trends and developments in zero-carbon fuels and technologies.

Development into commercial phases

The previous edition of this report identified several technologies that had developed into a commercial phase, such as vessels employing methanol-fuelled internal combustion engines. To ensure a rigorous analysis of the status of pilot and demonstration projects, the methodology used was therefore updated for this edition.[3] With this update, 137 of the 373 projects included in the last edition were excluded from further analysis. Some 95% of the excluded projects focused on ship technology, and more specifically, battery-powered propulsion (30%), methanol internal combustion engine/methanol dual fuel engine (20%), and hydrogen fuel cells on small vessels (18%).[4]

2 *Please consult the Getting to Zero Coalition's* ***technical guidance*** *for further information on the types of technologies covered under zero-emission pathways.*

3 *Please consult the* ***methodology*** *for detailed information on scope and project inclusion.*

4 *See Appendix 1 for more details on the projects excluded.*

Tracking of projects along timeline

Another change implemented for this edition is the presentation of project tracking along timelines. Previous editions focused on showcasing the cumulative number of projects collected between editions. While this illustrated the number of announcements that were added between years, it lacked granularity on the project start years. With the changes to the methodology mentioned above, it was also decided to present the total number of pilots and demonstration projects along their start years.

Consideration of project type and focus

Additionally, while one project may have more than one focus area – for example, both ship technology and bunkering and infrastructure – it is no longer considered possible for one project to have more than one type. For this analysis, only the current status of a project was considered – either concept study, laboratory testing, or demonstration in normal operations. When no update was made publicly available or shared with the authors, the last known type was applicable, even when it was predicted that the project had likely moved from, e.g., a concept study to a demonstration phase. This means that in some cases it is possible that the percentages shown add up to over 100%, as some projects have more than one focus.

Where are we today?

The global maritime sector continues to make significant efforts to undertake zero-emission pilots and demonstration projects. The total number of projects considered in scope for this study amounts to 340, 104 of which are new projects added in this edition. Most of these new projects are recent, with 64% announced in 2023 and 2024, while the remaining 36% started before 2023.

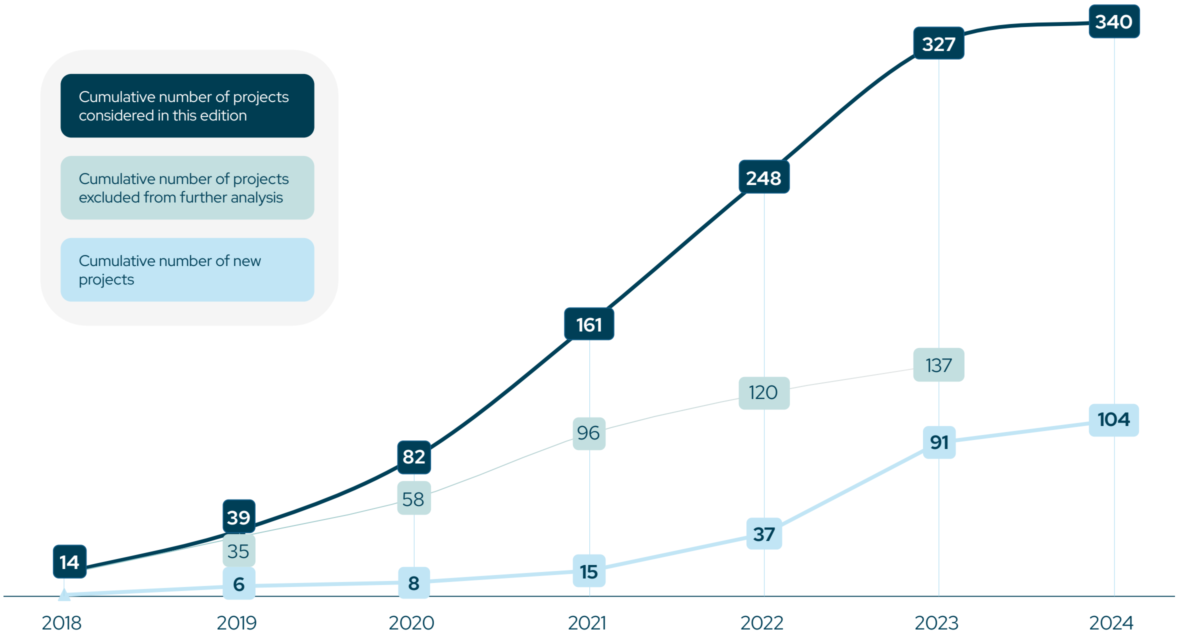


Figure 1: Cumulative number of projects, per start year

Similar to the last edition, there is still a predominance of ship technology projects; however, there is a wider balance on project representation this year, with an increase in fuel production projects (39% in this edition versus 24% in the previous). This development perhaps reflects the increased interest in securing zero-emission fuel production for maritime use, especially given many initiatives in both Europe and Southeast Asia promoting such projects.

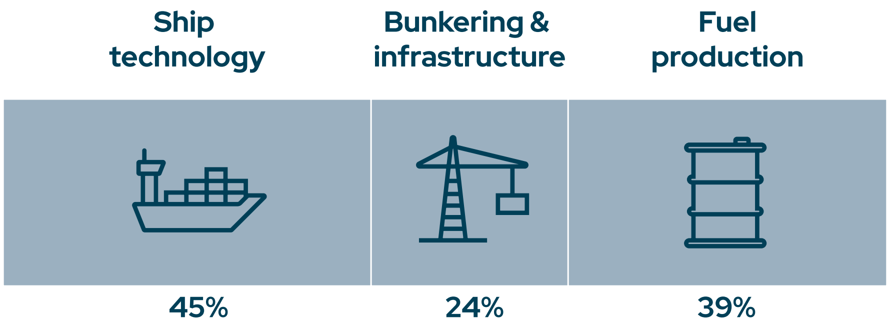


Figure 2: Share of projects per focus

Following the positive advancements into the commercialisation stage, the projects still in scope for this report have shown other types of progression. This includes updates such as signing new partnership agreements, receiving funding, getting a concept approved by classification societies, or moving from a feasibility stage to demonstrating technology in normal operations. Given the change in project analysis, it is difficult to determine with certainty the progression of projects previously included in earlier editions as this aspect has not been fully tracked. Nevertheless, the majority of projects remain at a concept study stage with less than a quarter of all projects classified as being demonstrations.

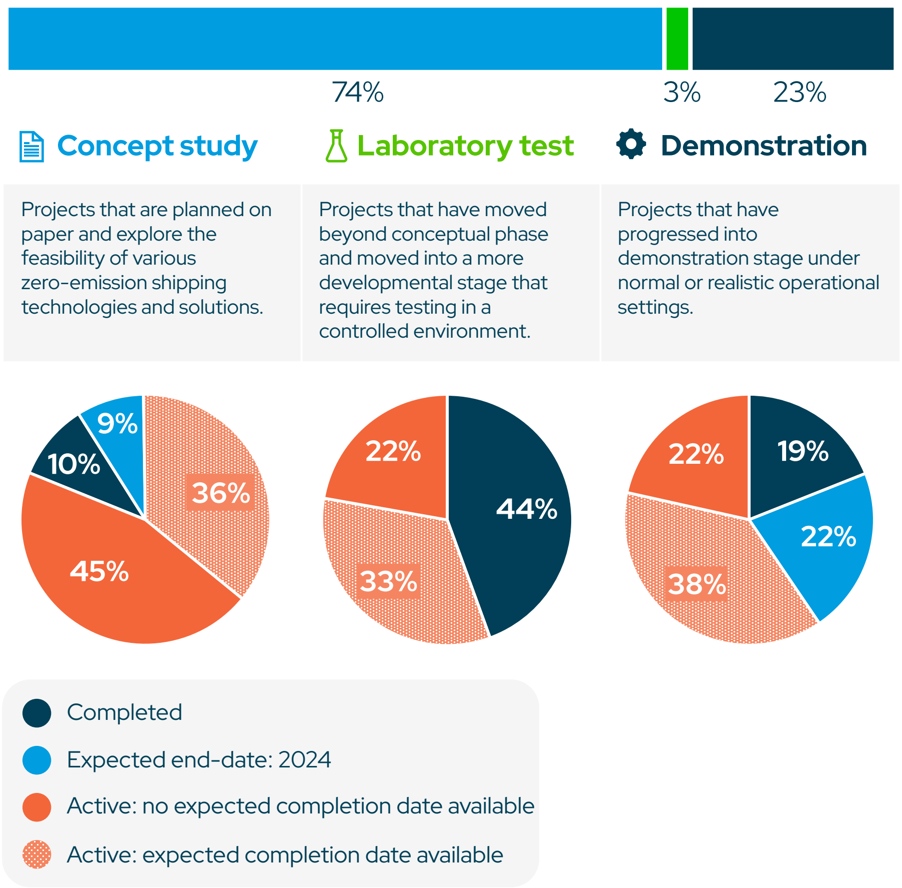


Figure 3: Share of projects by type and status

Given the nascency of most projects, it is unsurprising that 76% of all projects are estimated to be completed in or after 2025 while only 11% have already been completed or are expected to be completed in 2024. While ship technology and bunkering and infrastructure projects mostly do not disclose their expected completion date (43% and 48% respectively), over half of the included fuel production projects are expected to be completed before 2030 (51%).[5] The lack of transparency on the completion dates for key projects could signal uncertainty or challenges in execution. However, the more transparent timeline for fuel production projects suggests a potential readiness of new fuels to enter the market within the decade.

5 The remaining 1% of fuel production projects that have shared their expected completion date mention 2040.

Project developments

Development of ship technology projects

Ship technology projects represent 45% of all projects included in this edition, with more stable growth in the number of projects than in previous years. This growth was mainly in the number of concept studies, with only two new laboratory tests since the last edition[6] and 13 new demonstration projects.

One way to track promising developments is the number of approvals in principle (AiPs)[7] registered, which has grown from 30 to 52 since the last edition. Ship technology projects represent 40 of these AiPs, translating to 26% of this project type having now reached this important step, with six of these 40 projects having moved to a demonstration stage since their inception. The significant increase in such approvals underscores the accelerated pace at which ship technologies are gaining regulatory acceptance. This trend points to a robust pipeline of innovations ready for real-world testing and eventual commercialisation.

Fuel choice varies by project type

Two-thirds of all ship technology projects are concept studies. Of these, more than half focused on ammonia. However, the situation looks different within demonstration projects, where hydrogen is the energy source of choice for nearly half of all demonstrations. Of the ship technology projects at the laboratory testing stage, four focus on ammonia (three on ammonia internal combustion engines and one on ammonia fuel cells), with the others focusing on methanol carbon capture and storage/carbon capture and utilisation (CCS/CCU), vessel design and retrofits, and hydrogen fuel cells.[8]

This distribution can be attributed to a larger need for concept studies focused on ammonia-related technologies, which are at an earlier stage of development. In contrast, hydrogen fuel cells have been successfully tested on smaller vessels and are now being demonstrated on larger vessels, while methanol technologies have, overall, reached a more mature stage than both ammonia and hydrogen.[9]

Few projects focusing on onboard CCS/CCU

Another finding is the very low number of ship technology projects focusing on onboard CCS/CCU, represented by just seven projects out of 153. Though it is difficult to ascertain specific reasons behind these low figures, it could relate to the uncertainty of international regulation being discussed at the International Maritime Organization (IMO) which will influence such technologies being used onboard deep-sea going vessels. Despite this uncertainty, two of these seven projects were added in this edition, highlighting the maritime industry's continued interest in the application of these solutions.

6 *While neither were included in the last edition of this report, one laboratory test included in this edition started in 2020 and the other started in 2024.*

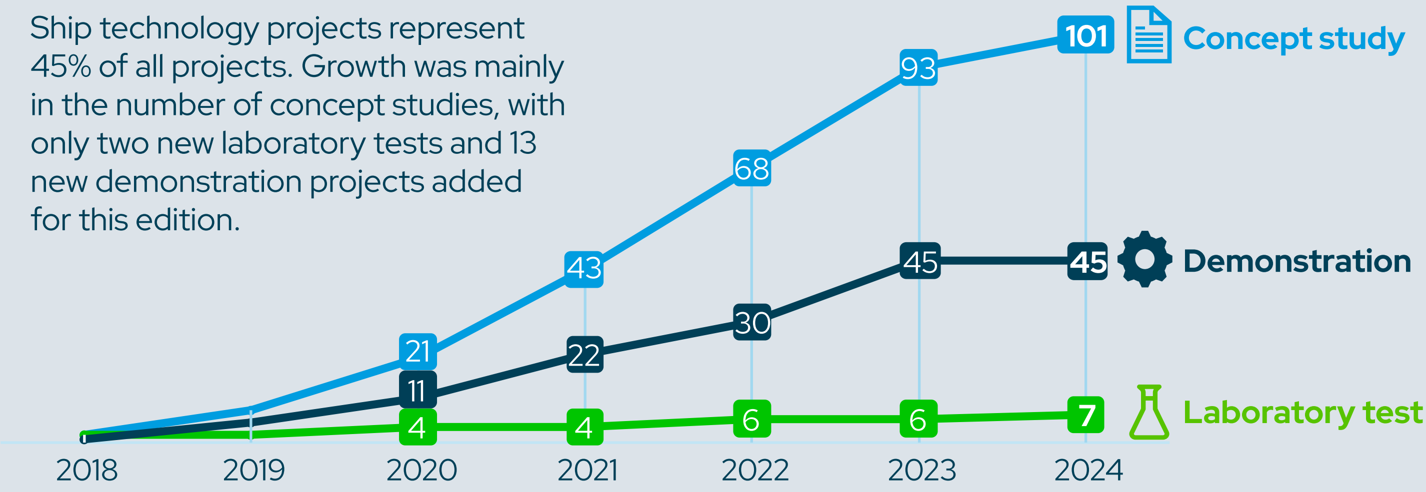
7 *Approval in Principle refers to the evaluation and approval of a concept in its initial design stages, confirming its technical feasibility and moving it into further development stages.*

8 *A more detailed overview of the percentual representation of each technology per project focus can be seen in Appendix 2.*

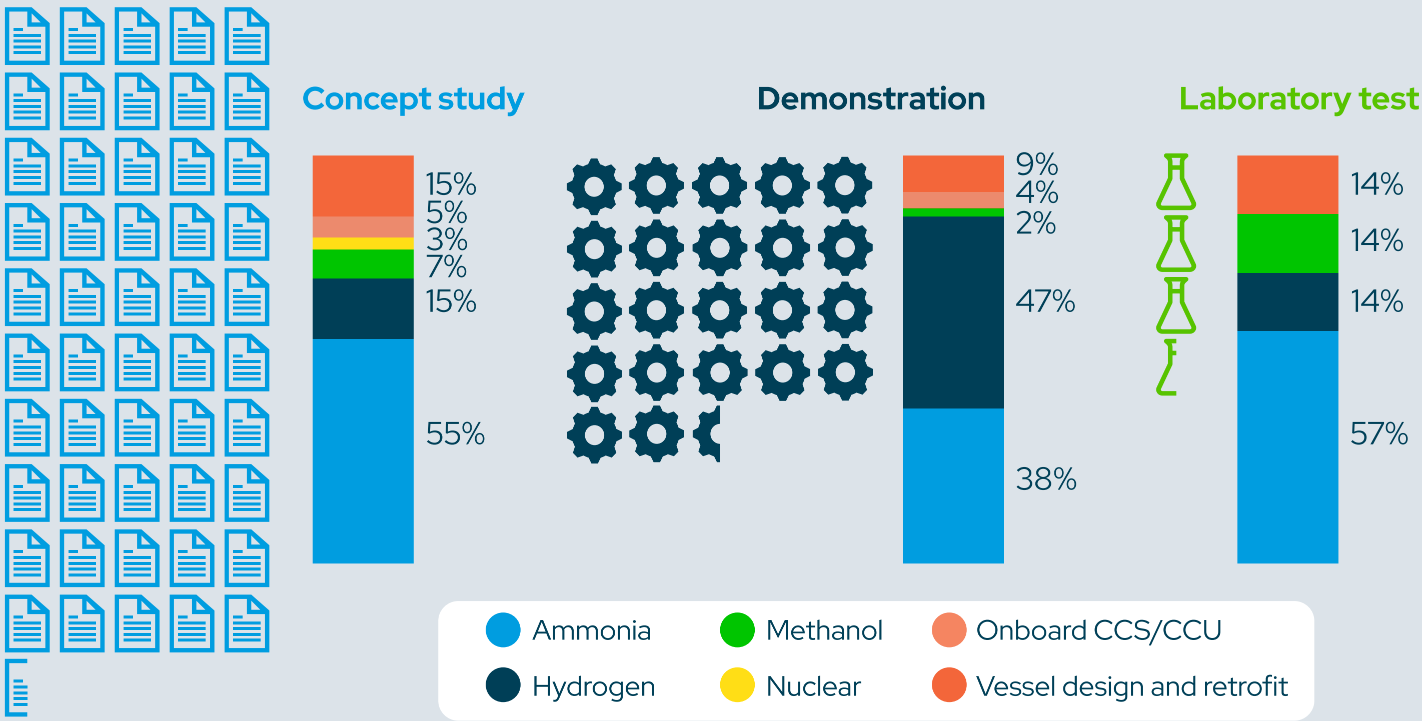
9 *Refer to the* **methodology** *for a clarification on which technologies and vessel sizes are still in scope.*

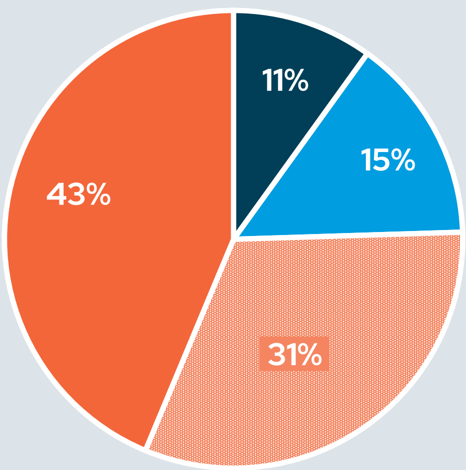
Ship technology project developments

Ship technology projects represent 45% of all projects. Growth was mainly in the number of concept studies, with only two new laboratory tests and 13 new demonstration projects added for this edition.



Cumulative number of ship technology projects considered in this edition





Ammonia and hydrogen combustion engines and fuel cells dominate ship technology projects. This can be attributed to a larger need for concept studies focused on ammonia-related technologies, which are at an earlier stage of development. In contrast, hydrogen fuel cells have been successfully tested on smaller vessels and are now being demonstrated on larger vessels, while methanol technologies have, overall, reached a more mature stage compared to both ammonia and hydrogen.

- Completed
- Expected end-date: 2024
- Active: no expected completion date available
- Active: expected completion date available

Development of bunkering & infrastructure projects

Bunkering and infrastructure projects represent roughly a quarter of all projects in this edition. The bulk of these are concept studies, and considering lengthy timelines for safety and other approval processes, only one project progressed into a demonstration stage since the last edition. This slow progression highlights the complexities and regulatory hurdles that must be overcome to implement these new fuels and technologies, suggesting that significant advancements in infrastructure will be essential for the broader adoption of zero-emission fuels.

Prevalence of onshore bunkering

Of these projects, the majority focus on onshore bunkering (46%), followed by port spatial and safety modifications (25%), bunkering vessels (22%), and offshore bunkering (7%). There is a similar distribution of these types of bunkering between concept studies and demonstrations in normal operations, with the only laboratory test being a port spatial and safety modifications project.[10] The relatively lower emphasis on offshore or ship-to-ship bunkering could be due to the need to take a phased approach in which onshore infrastructure is developed first. Bunkering equipment needs to be redesigned to handle spills and toxic gases, with adjustments to port protections to detect and prevent leaks and ensure crew safety. This highlights the need for strong onshore infrastructure and port spatial and safety modifications before moving to bunkering vessels and offshore operations. Furthermore, the higher complexity and cost associated with offshore bunkering suggests that these projects may not advance as swiftly as other projects in this category.

When looking at these projects through an energy lens, the largest individual category is onshore hydrogen bunkering infrastructure (23%), followed by ammonia bunkering infrastructure (19%), and ammonia bunkering vessels (14%). The port spatial and safety modifications category includes a variety of energy sources since it aggregates projects focused on modifications, such as infrastructure for storage, distribution, and charging, as well as testing of the necessary modifications for the safe bunkering and handling of different fuels.[11]

Synergies between bunkering and fuel production

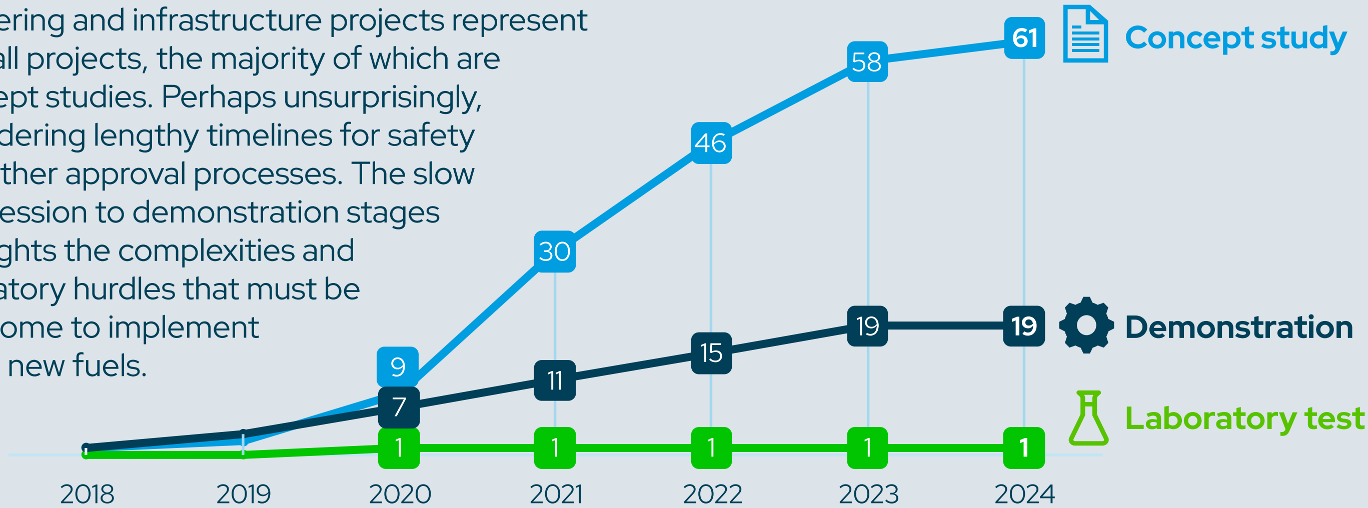
Of the 81 bunkering and infrastructure projects included in this report, 21% are connected to a fuel production project, showcasing a synergy between production and the necessary supporting infrastructure. This is particularly the case for onshore hydrogen bunkering projects, where 37% are connected to a hydrogen fuel production project. While most are related to hydrogen production via electrolysis, one project is connected to blue hydrogen, and another expects to produce ammonia in the long term, with only one being related to blue hydrogen from natural gas with CCS. Additionally, 30% of the port spatial and safety modification projects are also related to green hydrogen production (except one blue hydrogen project). The same is seen in ammonia projects, although at a smaller scale.

10 Appendix 3 provides a more detailed overview of the bunkering types.

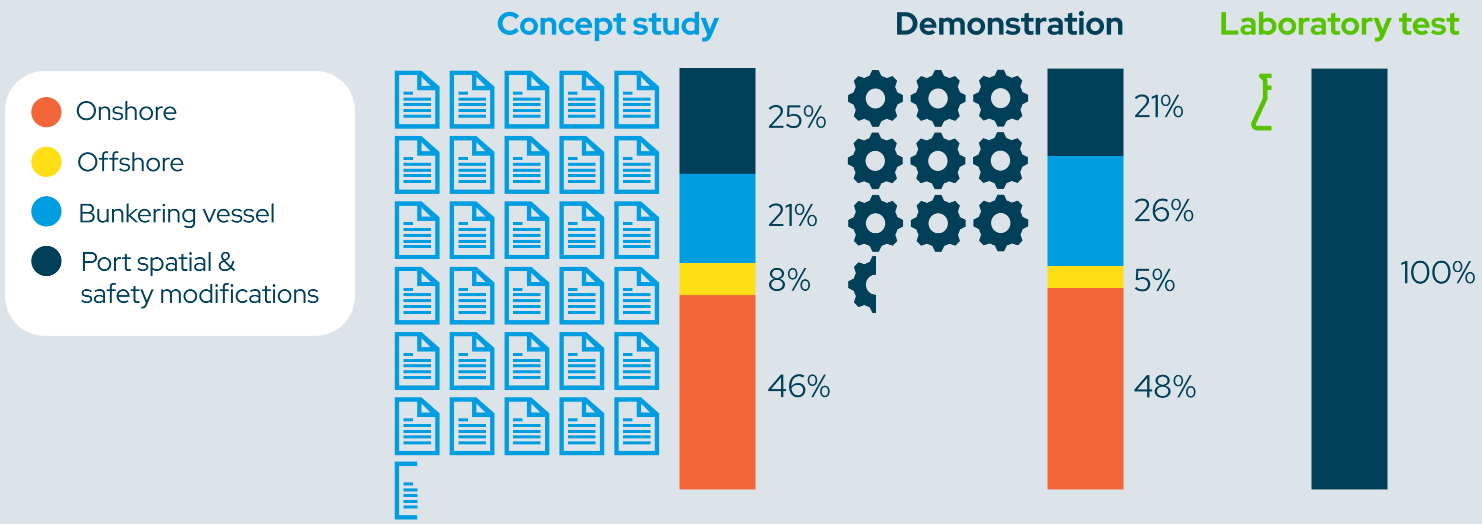
11 For example, one of the projects included in this category focuses on the development of an automated system able to handle the different zero-emission fuels, from the port operations itself to the bunkering process.

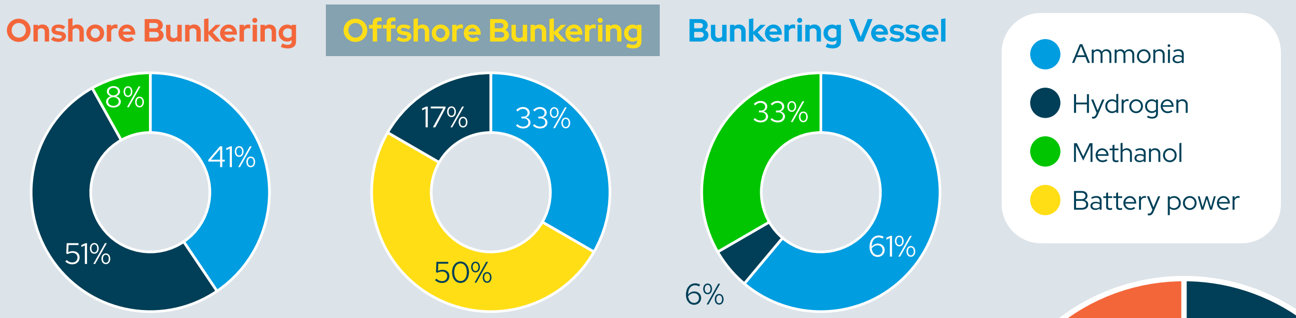
Bunkering and infrastructure project developments

Bunkering and infrastructure projects represent 24% all projects, the majority of which are concept studies. Perhaps unsurprisingly, considering lengthy timelines for safety and other approval processes. The slow progression to demonstration stages highlights the complexities and regulatory hurdles that must be overcome to implement these new fuels.

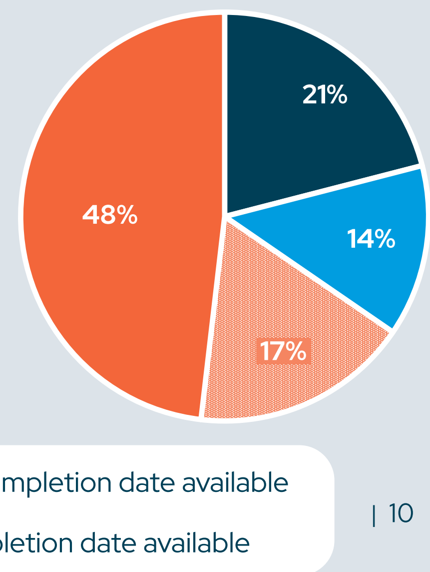


Cumulative number of projects considered in this edition





Ammonia and hydrogen combustion engines and fuel cells dominate ship technology projects. This can be attributed to a larger need for concept studies focused on ammonia-related technologies, which are at an earlier stage of development. In contrast, hydrogen fuel cells have been successfully tested on smaller vessels and are now being demonstrated on larger vessels, while methanol technologies have, overall, reached a more mature stage compared to both ammonia and hydrogen.



Development of fuel production projects

Fuel production projects saw the most significant growth and now represent 39% of all projects included in this report (versus 24% in the previous edition). This growth was primarily within concept studies, which grew from 87 projects in the fourth edition to 110 in 2024. No changes in the number of demonstration or laboratory projects were identified; however, four new demonstration projects were included in this edition, with one starting in 2022 and the remaining in 2023.

As the building block for the production of green and blue ammonia and methanol, green hydrogen is expected to continue to represent a bigger proportion of fuel production projects. Additionally, as presented in the methodology, both hydrogen and methanol fuels are in mature stages; however, all energy sources still require additional efforts for production at scale.[12]

Prominence of hydrogen and methanol

While concept studies represent the largest fraction of fuel production projects, these projects have a balance in fuel sources. The largest shares focus on green hydrogen via electrolysis (29%), green methanol via electrolysis from renewable energy (25%), green ammonia produced via Haber-Bosch synthesis with an alkaline electrolyser or proton-exchange membrane (18%), and green methanol via gasification/reforming from biomass (11%). The remaining 17% cover different production pathways for green and blue fuels.

In addition to the currently active concept study on the use of solid oxide electrolyser cells for producing green ammonia, a laboratory test was also conducted between 2018 and 2021. Most demonstration projects focus on green hydrogen via electrolysis (52%) followed by green methanol via electrolysis from renewable energy (24%). Green and blue ammonia are only represented by one project each, with no publicly available information on production or electrolyser capacity.

More momentum needed to meet future fuel demand

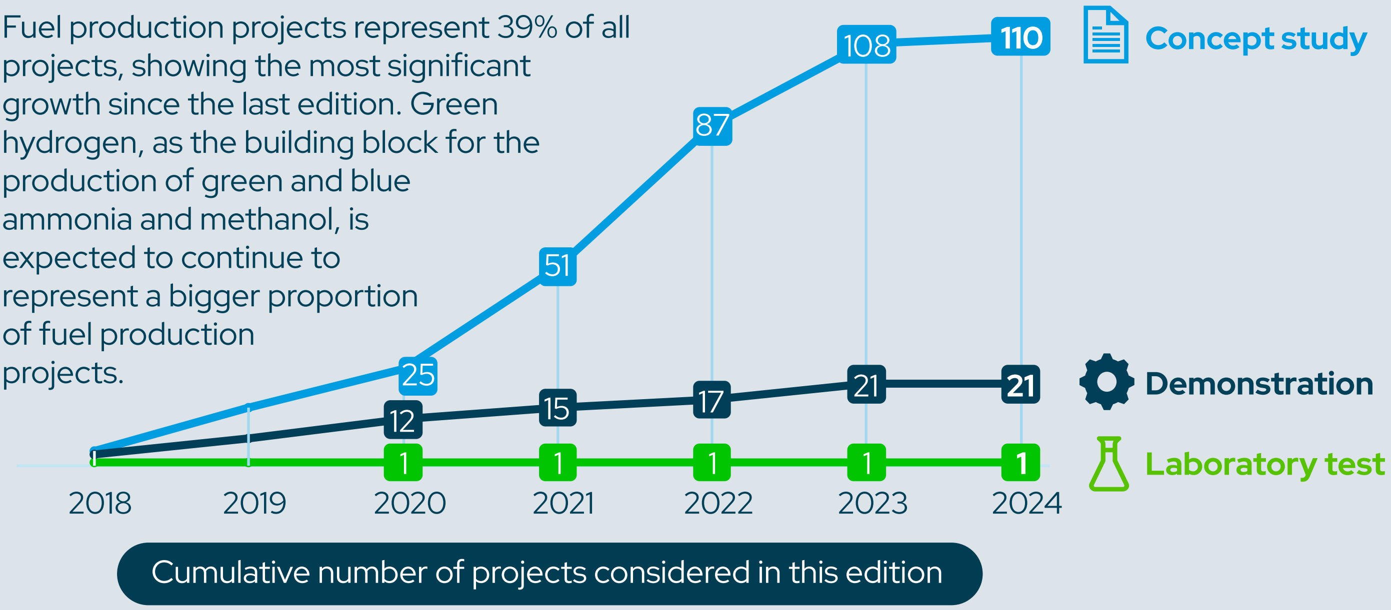
Fuel production projects are essential for shipping's decarbonisation, as the industry is expected to rely heavily on alternative zero-emission fuels to achieve its climate targets. However, only nine fuel production projects have moved to demonstration between 2020 and 2024.[13] These projects need strong market signals, financial and political support, without which progress may be limited and may have implications for the industry's ability to access zero-emission fuels in the coming years. Upcoming industry regulations may help address this stall in progress, hence developments in this space are expected to change significantly in the coming years.

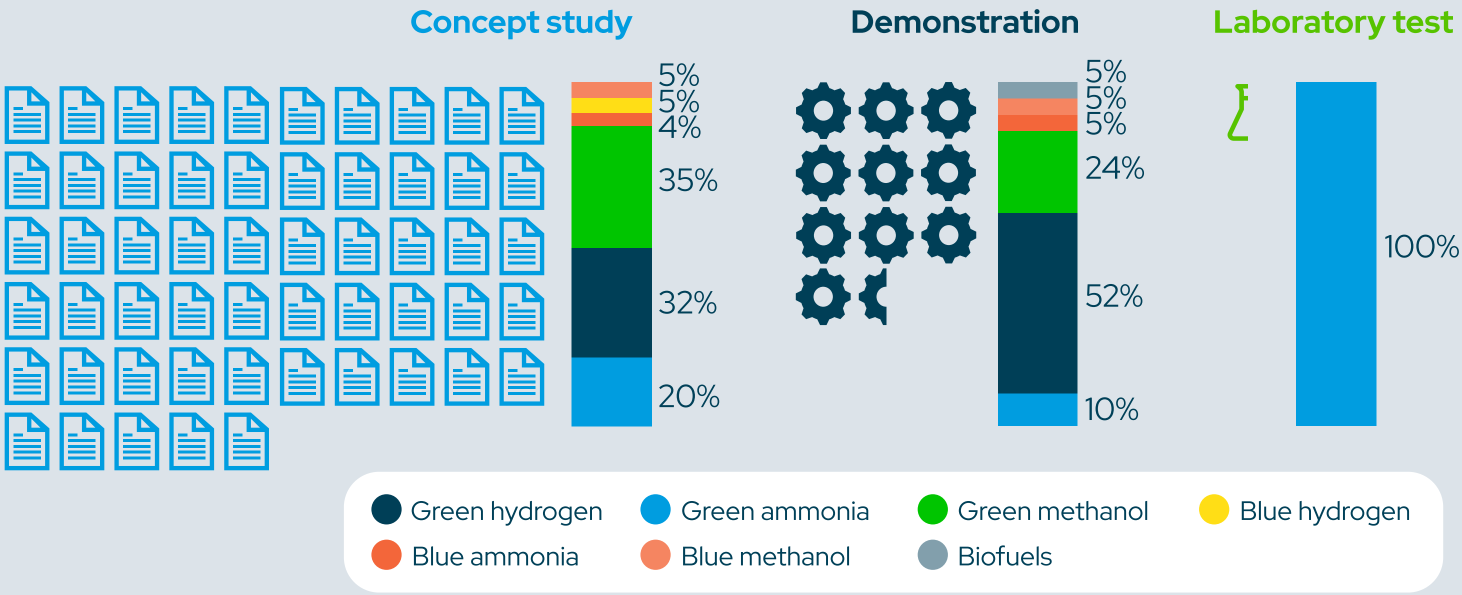
12 As clarified in the methodology, some fuel production technologies have been used in other industries. However, with a need for scalability, the line between pilot and demonstration and commercial projects can be blurred. This section focuses on projects that can scale pathways that are already commercial but also on pathways that are still at an early innovative stage. Lastly, it is important to note that, despite the degree of innovation, the demonstration stage on production projects is usually reached at a later stage, due to lengthy approval processes regardless of the fuel chosen.

13 As mentioned, 95% of the excluded projects focused on ship technology meaning that fuel production projects still see a slow trend in development progress.

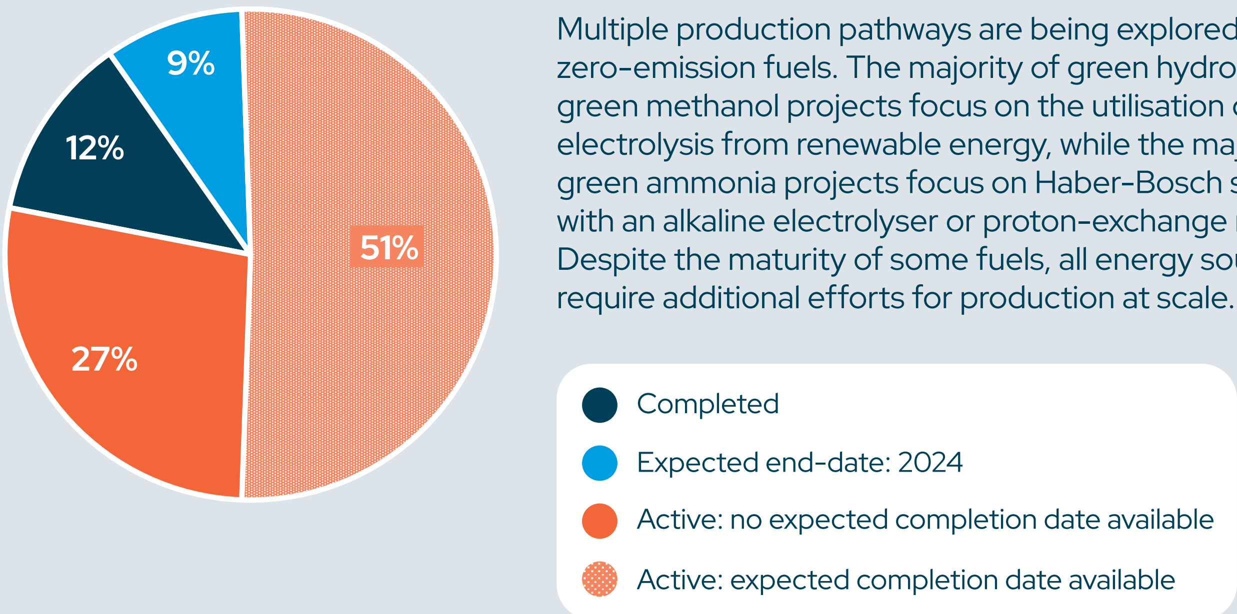
Fuel production project developments

Fuel production projects represent 39% of all projects, showing the most significant growth since the last edition. Green hydrogen, as the building block for the production of green and blue ammonia and methanol, is expected to continue to represent a bigger proportion of fuel production projects.





Multiple production pathways are being explored for zero-emission fuels. The majority of green hydrogen and green methanol projects focus on the utilisation of electrolysis from renewable energy, while the majority of green ammonia projects focus on Haber-Bosch synthesis with an alkaline electrolyser or proton-exchange membrane. Despite the maturity of some fuels, all energy sources still require additional efforts for production at scale.



Collaboration

Industry collaboration

Collaboration continues to trend upward from last year's edition, with projects with fewer than one lead stakeholder diminishing from 30% to only 14% of the total. On average, five companies are involved in each project. Fuel production projects show the least collaboration while bunkering and infrastructure projects involve, on average, the most companies per project (see Figure 4).

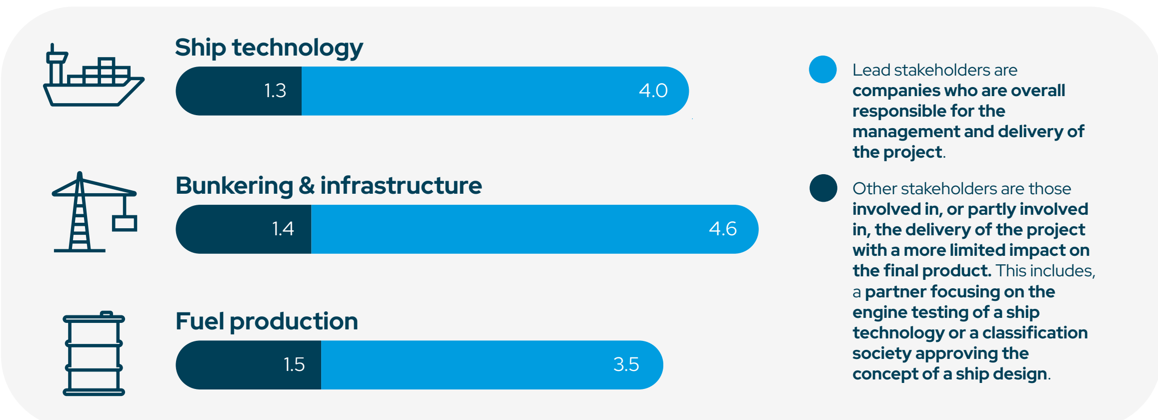


Figure 4: Average number of lead and other stakeholders per project

Geographical collaboration

This edition counts over 900 unique companies headquartered in 56 countries.[14] Norway has the most companies involved in projects with 132, followed by the United Kingdom (100), Germany (75), Japan (70), and the United States (60). While 18 countries were already represented in the last edition of this study and do not have any new projects included in this edition, 20 countries increased their number of industry projects, and companies from eight new countries[15] are now included in at least one project. On average, each company is only involved in 1.7 projects, with values varying from one project up to 20. Nevertheless, it is important to note that 13 countries, i.e., 23% of all included countries, have at least one company involved in over five projects (see Figure 5 for a geographical representation of the number of companies per country).

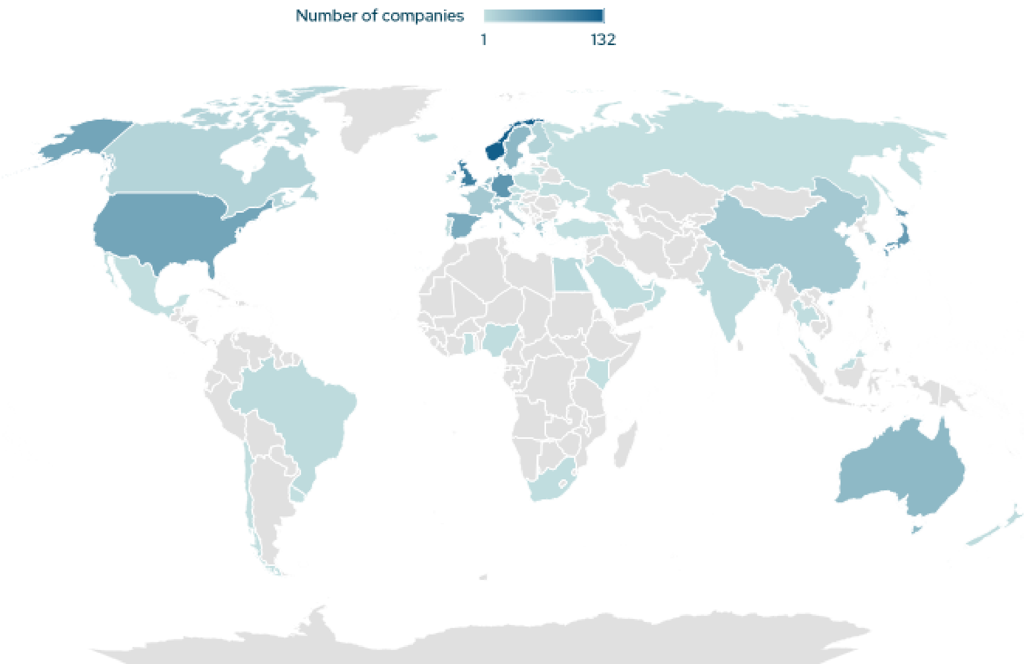


Figure 5: Country representation according to the headquarters location (including lead and other stakeholders)

Focusing on lead stakeholders, a significant majority of projects involve companies from at least two different countries. Here, there's a dominance of companies from developed countries, particularly Denmark, France, Germany, Japan, Norway, the United Kingdom, and the United States.

Industry collaboration in these projects can facilitate knowledge dissemination and technology transfer, which can enable a just and equitable transition if collaboration is done between companies in developed and developing countries. It

14 Like the previous edition, in this fifth edition the authors have focused on the companies' location over the project location. By focusing on the location of the headquarters or local offices, when such was clearly stated, the authors aim to provide a broader picture of the collaboration between the stakeholders involved.

15 These countries are Croatia, Czech Republic, Ghana, Israel, Kenya, Saudi Arabia, Slovenia, and Taiwan.

is therefore important to see where companies are engaging with each other. When viewed through this lens, there is a significant lack of collaboration between lead stakeholders from developed countries and companies from the Global South.[16] The seven countries listed above have very few engagements with companies from developing countries, and those that do are mainly countries with high-income and middle-income economies. Narrowing the lens further to view not just the number of projects with lead stakeholders from developing countries, but the number of individual countries from these project collaborations further highlights the limited geographical inclusion of developing countries (see Figure 6).

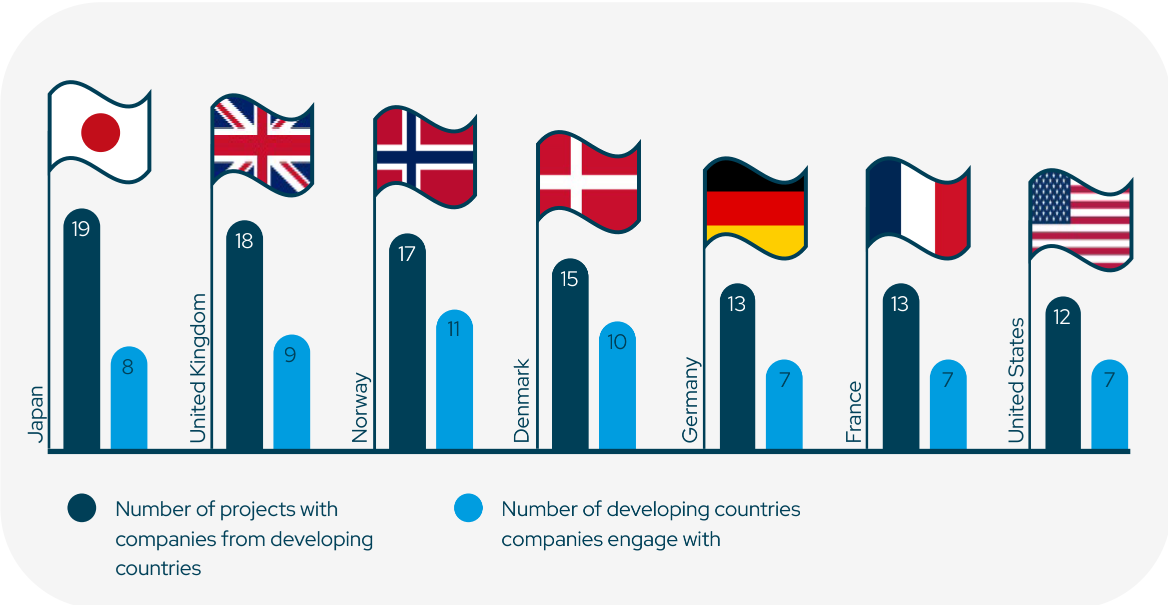


Figure 6: Collaboration between the top seven countries and companies from developing countries

Solely looking at the representation of developing countries, there are 104 companies headquartered in 21 developing countries. The countries included here are either high-income developing economies (83 companies, 15 countries) or middle-income developing economies (21 companies, six countries), with no representation of countries considered small island developing states (SIDS) or least developed countries (LDCs). This poses a serious concern regarding an equitable transition for shipping's decarbonisation. While this analysis only examines lead stakeholders and their respective country headquarters, potentially excluding other stakeholders that could show more representation of developing countries, it is still relevant to point out the significant gap in industry collaboration and the lack of lead stakeholders representing the Global South.

16 Note that country classification was based on **UNCTAD Statistics definition of "developed"** *(1500 Developed economies) and "developing" countries (2623 Low-income developing economies; 2622 Middle-income developing economies; and 2621 High-income developing economies; 1610 LDCs (Least developed countries); 1640 SIDS (Small island developing States) (UN-OHRLLS)).*

Developing countries that have the most projects are Singapore (69), India (18), China (16), Nigeria (13), and the United Arab Emirates (12). For the most part, the presence of companies from these countries is unsurprising, as they are highly relevant to international maritime transport and represent key maritime hubs or exporting countries. These numbers include both projects with developed countries as well as other developing countries. When examining collaboration between developing countries, these numbers drop significantly and highlight the potential lack of collaboration between Global South countries without the presence of a company from a developed country (see Figure 7).

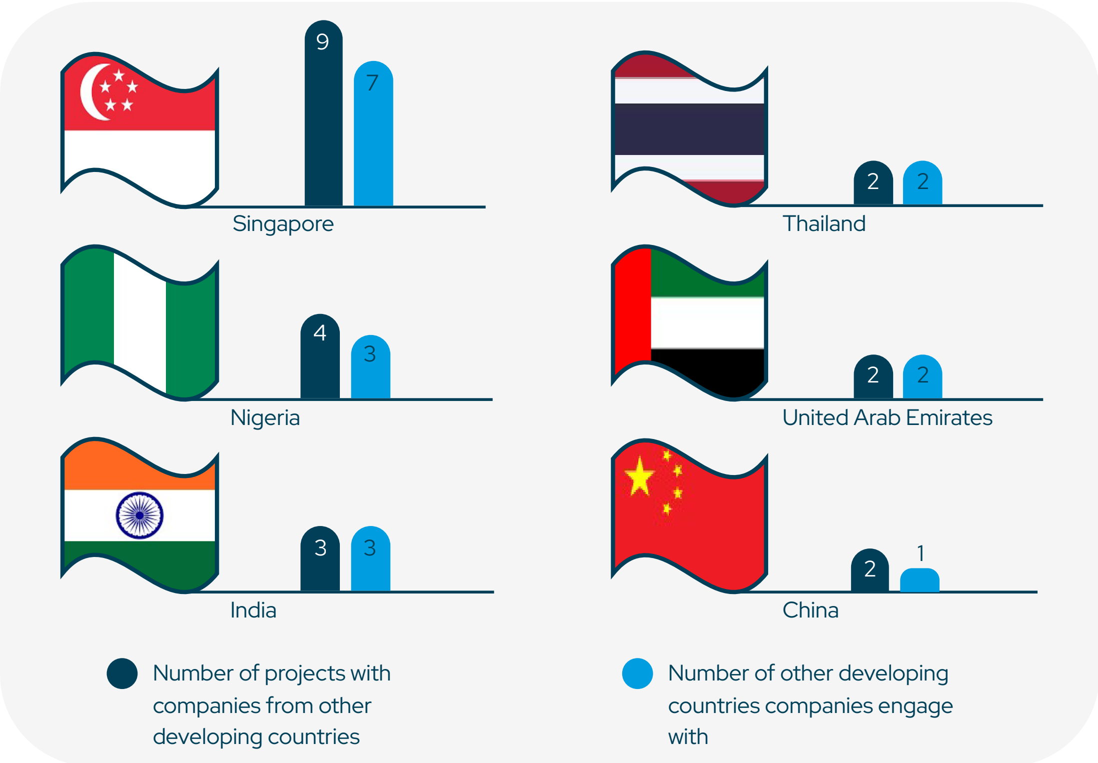


Figure 7: Collaboration between top developing countries with other developing countries

Value chain collaboration

When looking into industry involvement, it is relevant to investigate representation of different value chain segments. Similar to the last edition, energy, equipment/technology, shipowner/ship operator, research and development, and shipbuilders make up 65% of all companies involved in zero-emission pilots and demonstration projects (see Figure 8).

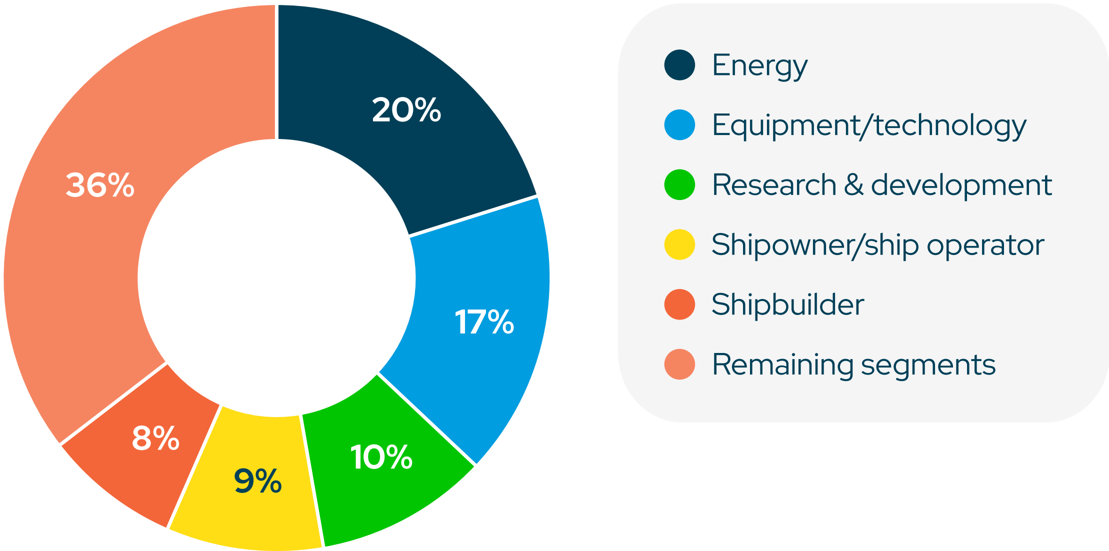


Figure 8: Main value chain segments according to number of companies involved in this edition[17]

Of the 340 projects included in this edition, only 3% include a single segment even if represented by two or more actors. This implies that in a vast majority of projects, there are a high number of collaborations between at least two different value chain segments. Therefore, it is not only important to consider the largest presence of value chain segments by the number of actors but also to closely examine the collaborations between different value chain segments to better understand which segments are working together more frequently.

When considering the number of projects rather than just the number of actors, 82% of projects include eight out of the 15 value chain segments, with some segments having a strong presence across the total number of projects. The energy segment remains the most active, appearing in 54% of all projects, followed by equipment/technology and shipowner/ship operator segments, which are present in 40% and 30% of the projects respectively (see Figure 9).[18]

17 Category 'remaining segments' includes association or organisation, charterer, classification society, financial institution, freight forwarder/ customer/ cargo owner, government, other (i.e., companies in real estate, tourism, data centres, etc.), other services or consultancy, port/ terminal, and ship manager.

18 The involvement of more than one segment in a single project means that the percentual representation of the segments according to the total number of projects will be higher than 100% when summed.

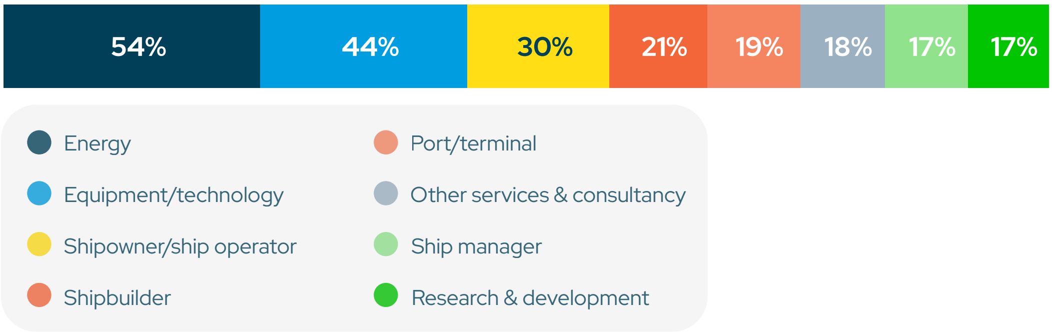


Figure 9: Main value chain segments according to their presence in the total number of projects

Lastly, as expected due to their number of projects, the collaboration between actors is the strongest when considering these eight segments, with the energy and equipment/technology segments standing out by working together in 21% of all projects (Figure 10 shows the segments that collaborate in over 7% of all projects).

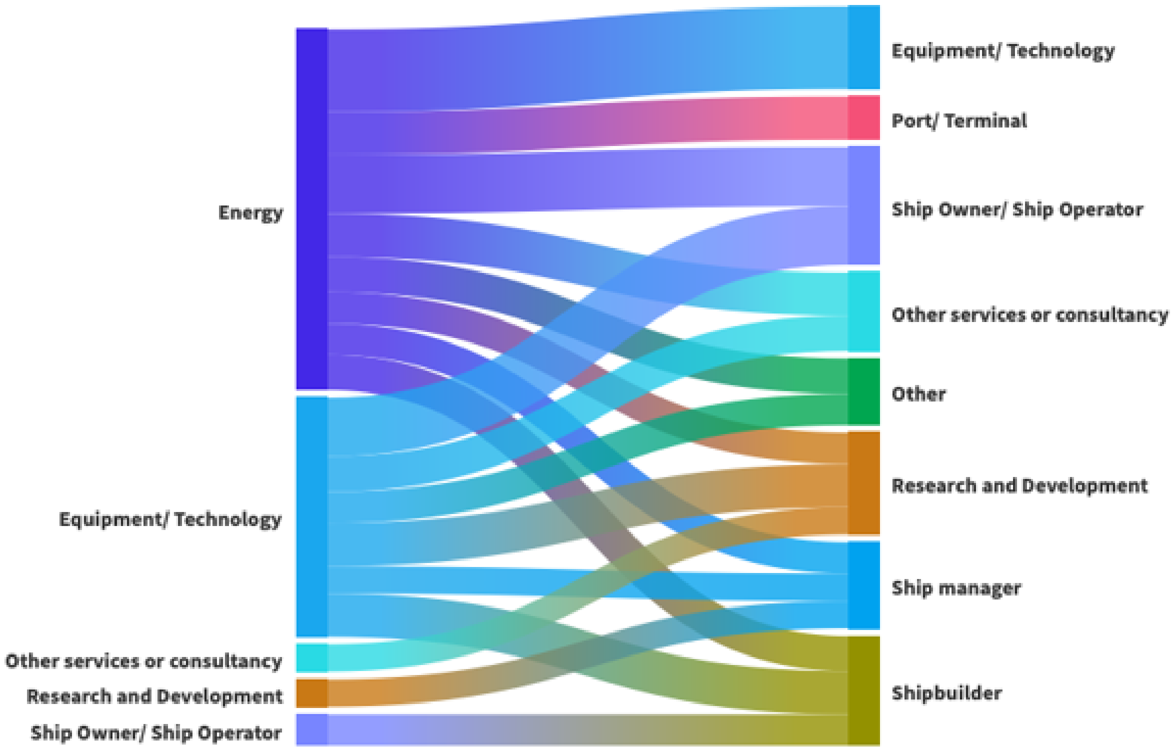


Figure 10: Key value chain segment collaborations

Regarding the value chain collaboration per project focus, concept studies have the lowest average of value chain segments while demonstration projects have the most segments on average. Similarly, when looking at it from the perspective of project type, fuel production projects have a lower average of value chain segments than bunkering and infrastructure projects, which involve the most segments on average.[19] These collaboration numbers align with the assumption that the involvement of stakeholders can vary in two ways: as the project scales or the nature of the project itself.

19 *These numbers can be found in Appendix 4.*

Government collaboration

Many projects include government representation in the form of municipalities, the public sector, and public services. While it is important to note that governments can and do participate in zero-emission pilots and demonstration projects as one of the main stakeholders, this does not necessarily translate into the existence of public funding for such projects.[20] Indeed only 32% of the projects with government representation have received some type of public funding.

Government participation was present in 11% of all projects, more than doubling the 5% participation in the previous edition of this report. Projects where government representatives are present often have larger consortia of collaborators, with an average of seven actors per project. Within these public-private collaborations, the energy sector is most often present (55%), followed by equipment/technology companies (47%), shipowners/ship operators (39%), and the research and development segment (34%).[21] Government participation is mostly seen in concept studies (61%) and more commonly involved in projects focusing on ship technology (42%).

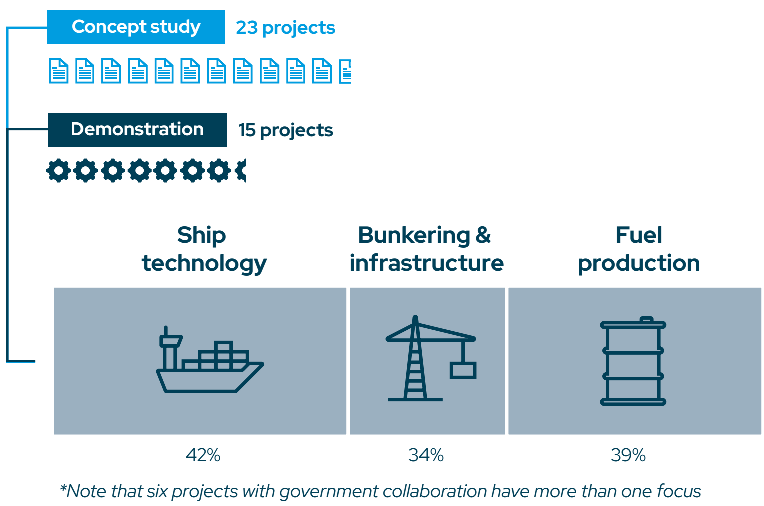


Figure 11: Government participation per project type and focus

20 It is relevant to mention that from the projects publicly funded, only 18% of them have the involvement of this value chain segment.

21 In smaller numbers this segment collaborates with all other segments except for charterer. These numbers of collaboration sum up to over 100% since this segment usually collaborates with more than one other segment.

Government participation in projects mirrors company participation, with Japan, Norway, and the United States active in the most projects. Of the 38 projects with a government participating as a lead stakeholder, ten had representation of a developing country. While this represents a large proportion of projects in this category, only the governments of Singapore (six projects) and Egypt (four projects) were involved.

Figure 12: Government participation in projects as a lead stakeholder

Public funding

Nearly a quarter of all the projects included in this edition have received some level of public funding, with 36 new projects added since last year. Although this is a decrease from the 37% noted in the previous edition,[22] this is due to a more rigorous analysis wherein only projects that clearly state the source of the funding are included. Thus, it may be the case that the share of publicly funded projects is actually higher than 24% but transparency is lacking.

To better understand the different sources of funding, an attempt was made to distinguish between funding from governments, agencies, and programmes. Most public funding (71%) originates from a programme, such as Horizon 2020 (see Figure 13).[23]

22 *Note that from the previous edition of this report, five projects that received project funding were excluded.*

23 *See Appendix 5 for an overview of the funding sources per project type and focus.*

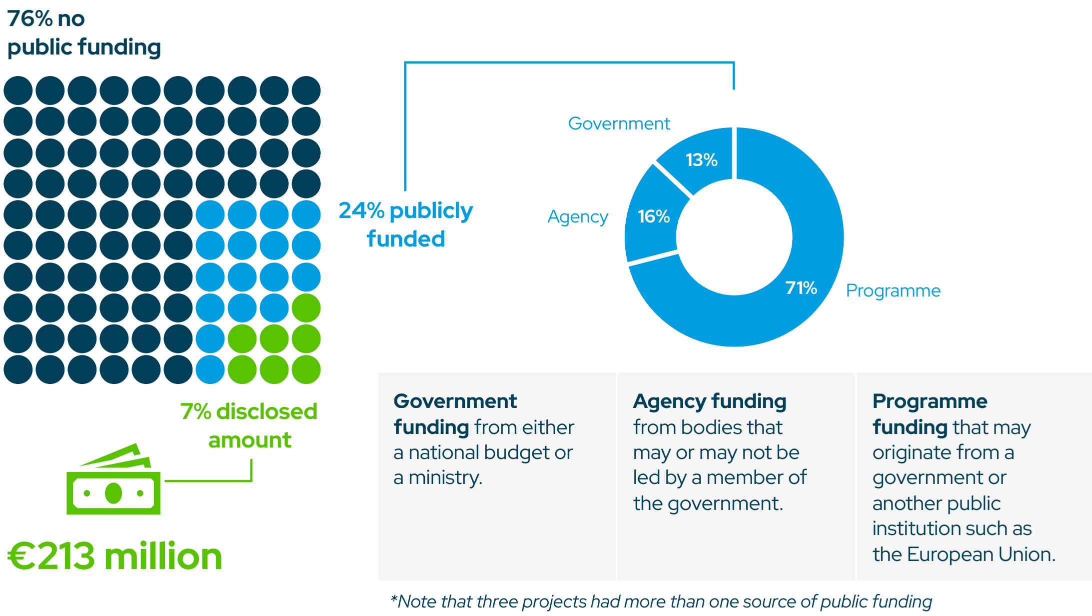


Figure 13: Share of publicly funded projects, their funding sources, and share of funded projects that disclosed their total amount funded

A small portion of these projects disclosed the total amount of public funding they received, which equates to roughly €213 million.[24] Of these, only 17 disclosed both the amount funded and the total cost of the project. The majority of these, 13 projects, originate from a programme. Additionally, only one project funded by a government and three by an agency disclosed their funding amounts. Furthermore, the percentages funded varied from 35% to 100%.

Regarding their type and focus, most projects that received public funds are concept studies (66%), with half of publicly funded projects focusing on fuel production (50%) (see Figure 14).

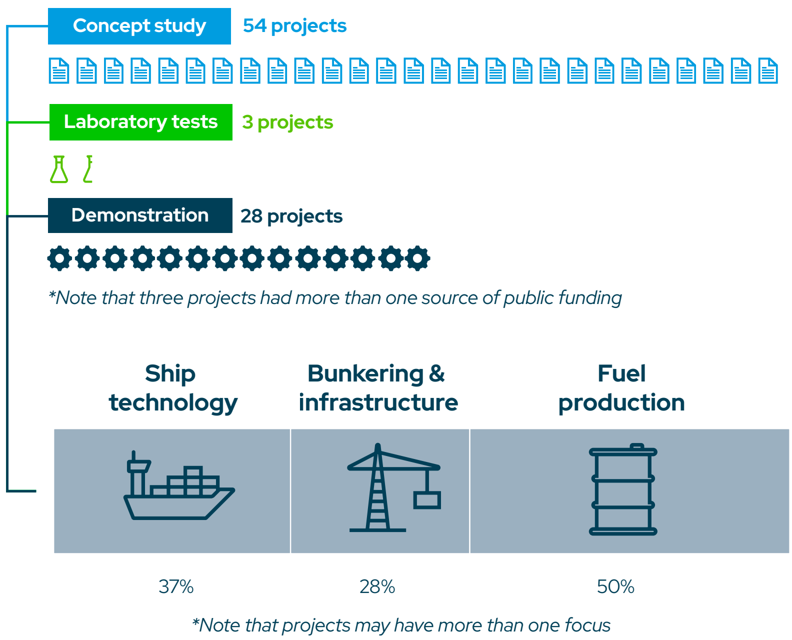
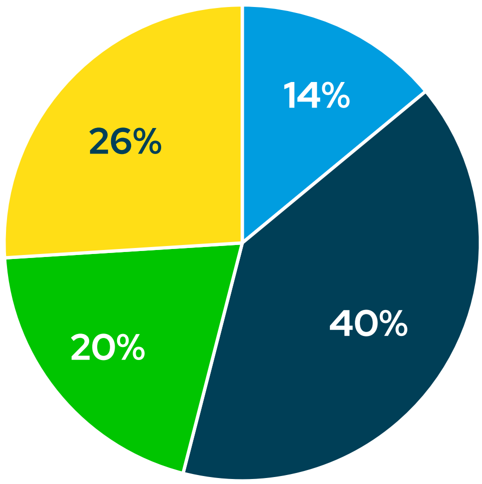


Figure 14: Share of funded projects by type and focus

24 Project funding varies by currency, so all funding was converted into EUR by using Forbes Currency Converter as of 14 June 2024.

Hydrogen predominance

When it comes to the fuel source of publicly funded projects, hydrogen has the most backing (40%), followed by methanol (20%), and ammonia (14%). The higher percentage of public funding supporting hydrogen projects is congruent with geopolitical developments. This includes the development of national hydrogen strategies and an increased interest in hydrogen-derived fuels, especially for their use in hard-to-abate sectors like shipping. Figure 15 provides an overview of the most funded categories among all project types, i.e., propulsion technologies, bunkering infrastructures, and production pathways.



Ammonia

Projects that include both blue and green ammonia, utilising technologies:
- electrochemical synthesis
- Haber-Bosch synthesis (AE, PEM, or SOEC)
- non-thermal plasma synthesis
- natural gas with CCS
- fuel cell
- internal combustion engine/dual fuel engine

Hydrogen

Projects that include both blue and green hydrogen, utilising technologies:
- electrolysis
- direct solar production
- biomass fermentation and conversion
- natural gas with CCS
- fuel cell
- internal combustion engine/dual fuel engine
- internal combustion engine/monofuel spark ignition

Methanol

Projects that include both blue and green methanol, utilising technologies:
- electrolysis from renewable energy
- gasification/reforming from biomass
- reforming with CCS, natural gas based
- CCS/CCU
- fuel cell (DMFC)

Other

Projects that focus on other energy sources or technologies:
- battery power
- biofuels from ligno-cellulosic & algae/marine feedstocks
- CCS/CCU
- etc.

Figure 15: Share publicly funded projects by energy source and technologies

Geographical distribution and timeline

Most public funding for projects originates from Europe, with European funds[25] representing 72% of the funding sources and over 80% of all funded projects. Two projects have two separate funding sources (one project funded equally by the governments of Australia and Singapore, and another project receiving funding

25 Countries included in 'European funds' are Denmark, Finland, Germany, Norway, Spain, Sweden, and the United Kingdom. Additionally, funding sources from the European Union are also included in this category.

from two Danish agencies). Additionally, one programme, the German-Australian Hydrogen Innovation and Technology Incubator (HyGATE), is managed by both Germany and Australia. Developing countries that provided public funding for zero-emission pilots and demonstration projects included Brazil, Chile, Egypt, and Singapore, with these countries funding one project each (see Figure 16). Most projects that received public funding started in 2023 (28%), while another 23% began in 2021. Half of all publicly funded projects are expected to be completed after 2025 (see Figure 17).

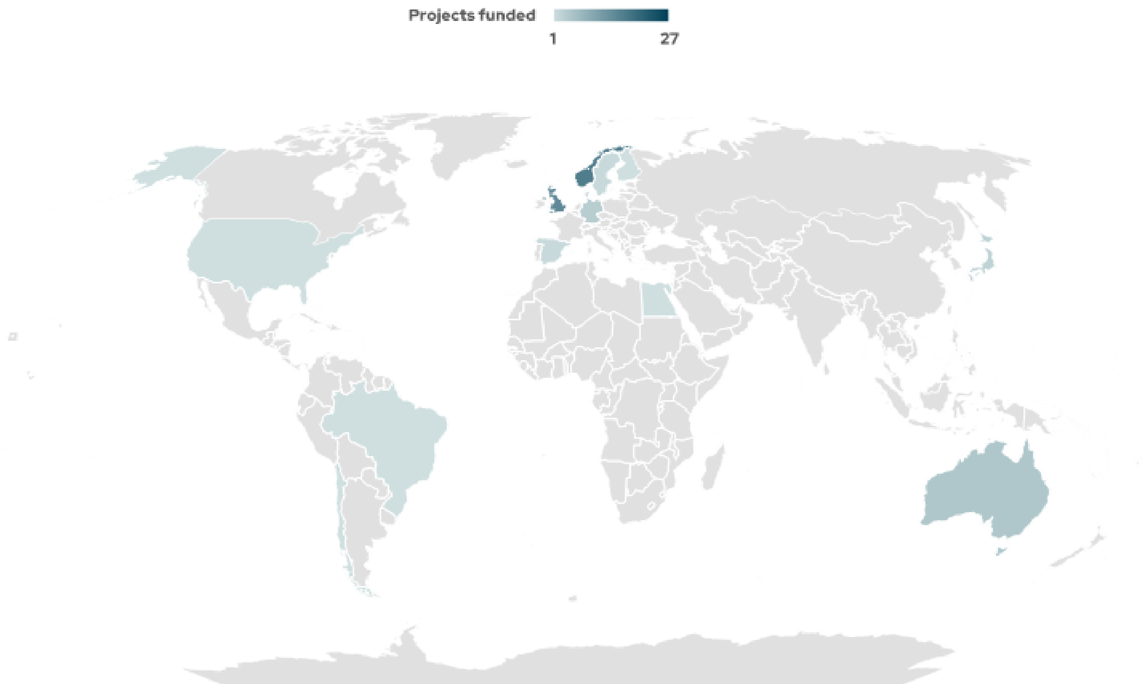


Figure 16: Geographical location of funding sources according to the number of projects funded[26]

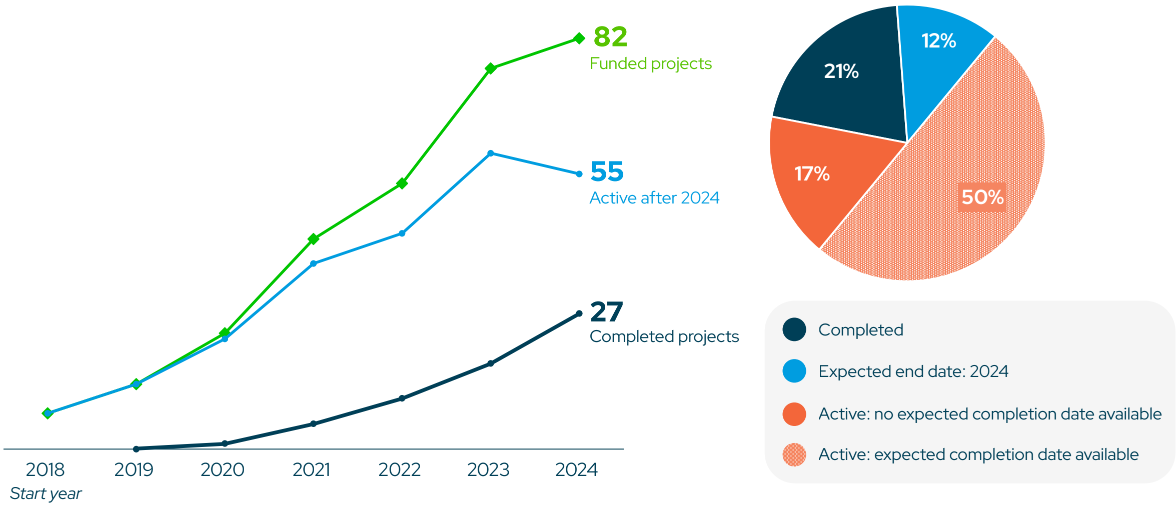


Figure 17: Cumulative number of projects funded and status of projects

26 The European Union accounts for 32% of projects funded (27 projects). However, geographically, they are not represented in this figure since the European Union is an intergovernmental organisation.

Key insights and challenges

This study focuses on zero-emission projects at the concept, laboratory test, and demonstration phases that can facilitate shipping's decarbonisation. Despite the ever-evolving context for this analysis, this work aims to retain focus on research and development efforts that move nascent fuel and technology solutions closer to market. Over the past year, some of these solutions have matured enough to reach commercialisation and have therefore been excluded from this report.

While efforts to document global industry action related to emerging technologies in shipping decarbonisation are important, they present only part of a larger narrative. As such, the work undertaken here should be seen as complementary to other resources that track industry progress, including **Climate Action in Shipping: Progress towards Shipping's 2030 Breakthrough**, the **Annual Progress Report on Green Shipping Corridors**, and the International Energy Agency's **Hydrogen Projects Database**.

The overarching takeaways from this year's report clearly show the ongoing focus on ammonia and hydrogen projects, with most methanol technologies maturing out of this analysis into commercial availability. While the majority of projects are concept studies and represent early stages of innovation, there has been limited progress in the number of projects advancing to the lab testing and demonstration stages. This perhaps reflects the myriad commercialisation challenges related to competitiveness, safety, and supply chain development.

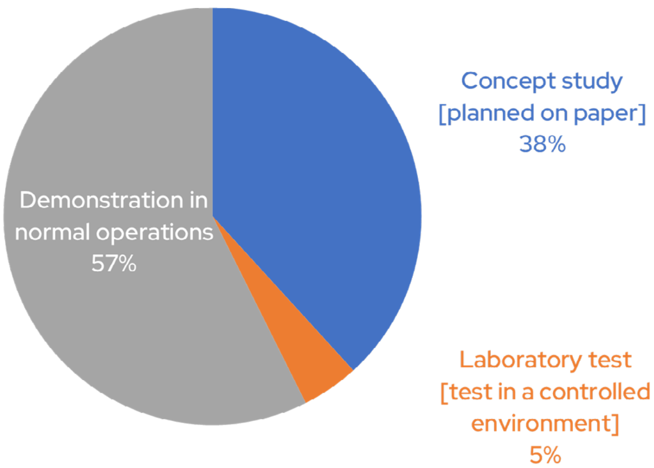
Collaboration remains a vital component of overcoming these challenges, and this edition found a high level of partnership across companies and countries, as well as an increase in governmental participation. While public funding towards such projects totals over €200 million, it remains unclear just how much of the total project costs is covered by this funding, as transparency in this area remains low. Thus, despite this growth in collaboration and public sector involvement, most projects still rely heavily on private funding, underscoring the need for increased governmental financial support to ensure project scalability and market readiness.

The prevalence of EU and European countries among funded projects highlights the need for additional geographical collaboration and sharing of lessons learned with the broader maritime community, especially in under-represented regions such as Latin America and Africa as well as SIDS and LDCs. As the shipping industry strives to reach global decarbonisation targets, many innovations can still benefit from a cooperative approach. Increased collaboration between governments, private sector entities, and companies can help chart a common course. No single country or entity can tackle this challenge alone. By fostering inclusivity and leveraging the strengths and insights of all regions, the industry can collectively meet its ambitious targets.

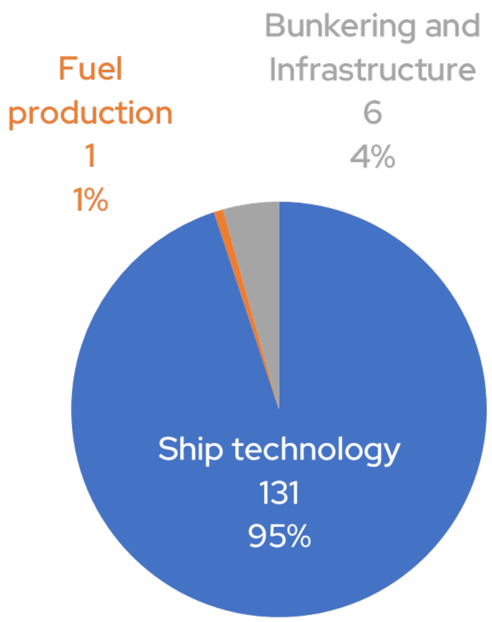
Appendices

Appendix 1: Projects excluded due to update in methodology

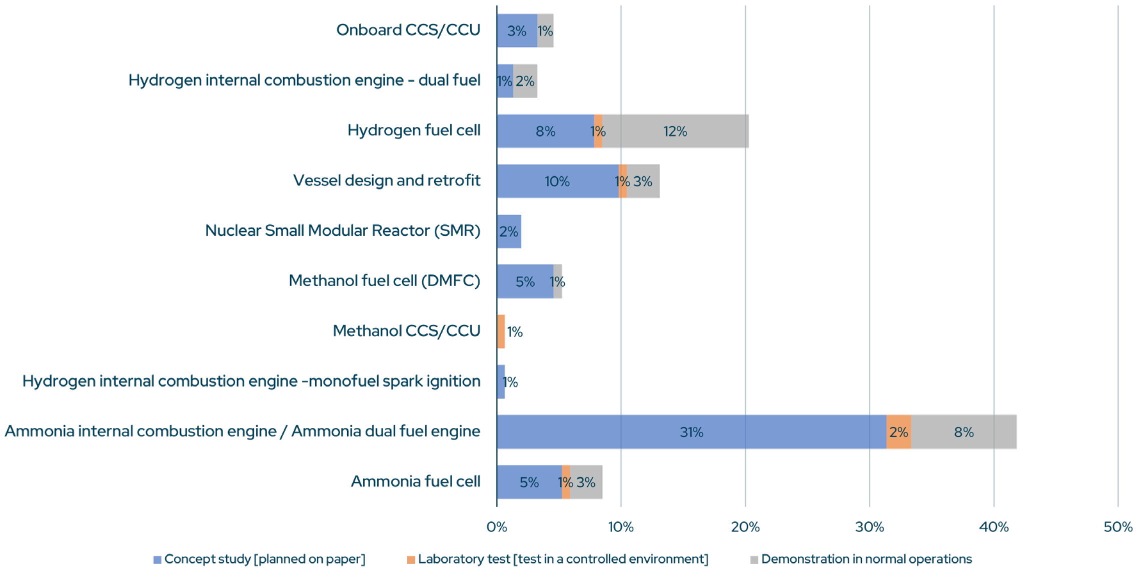
Share of excluded projects by project type



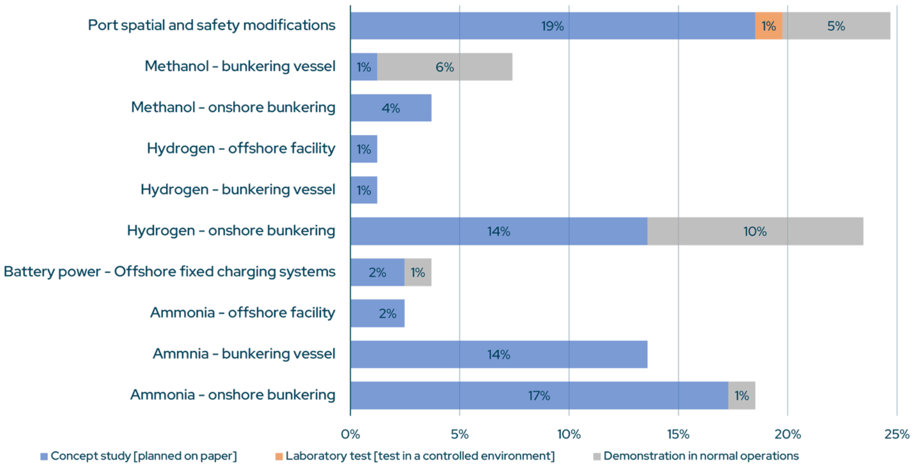
Share and number of excluded projects by project focus



Appendix 2: Share of ship technologies and their project type

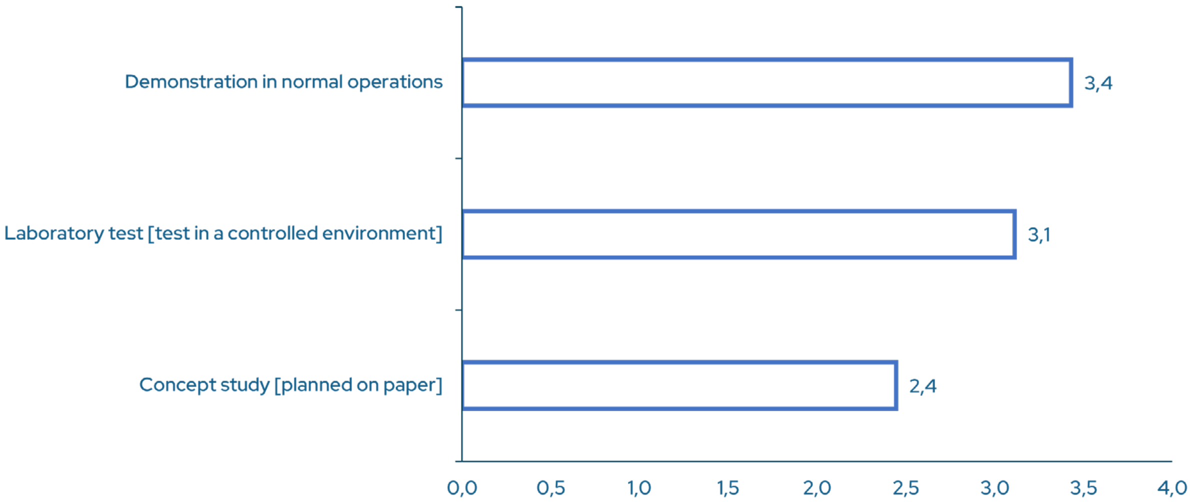


Appendix 3: Share of bunkering and infrastructure projects and their project type

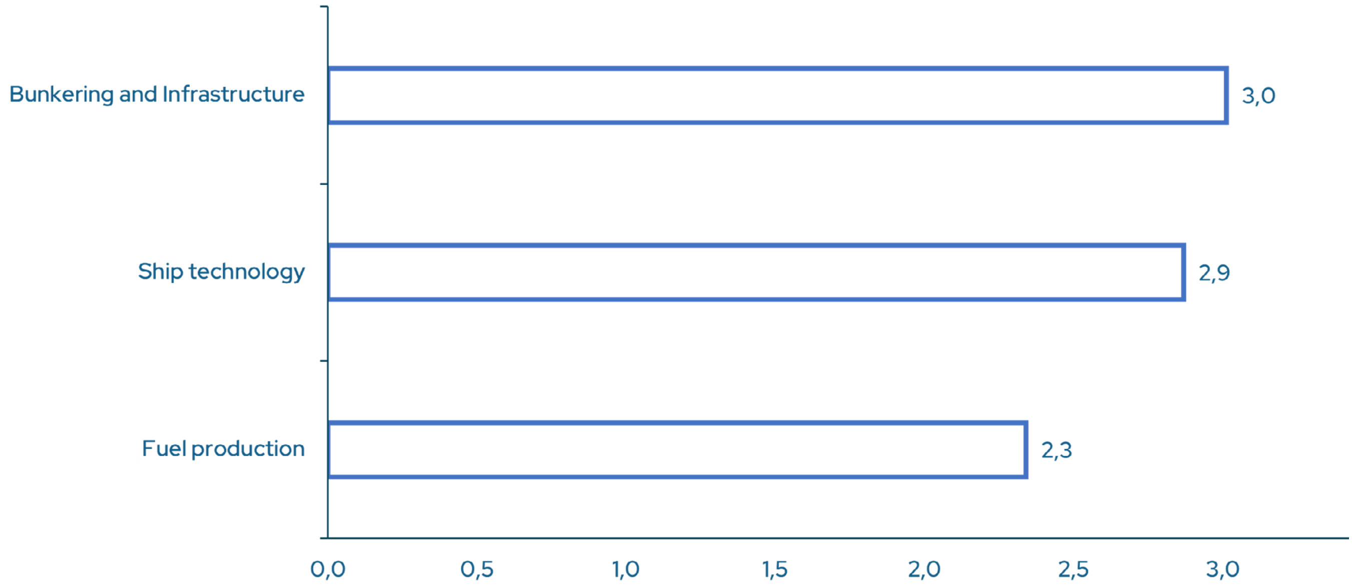


Appendix 4: Average participation of value chain actors

Average number of value chain segments per project, according to project type

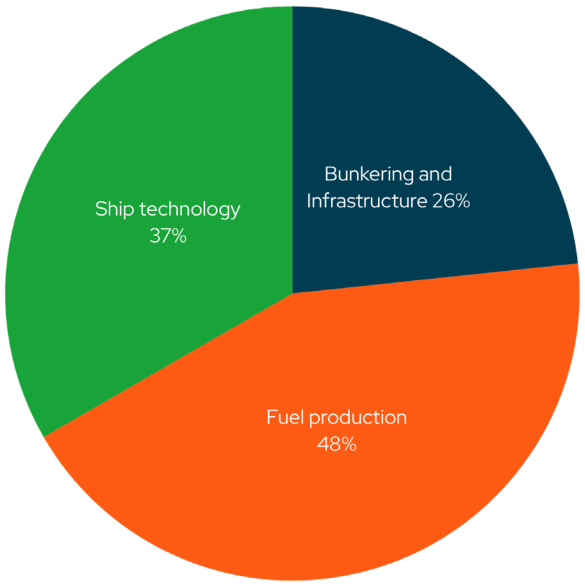


Average number of value chain segments per project, according to project focus

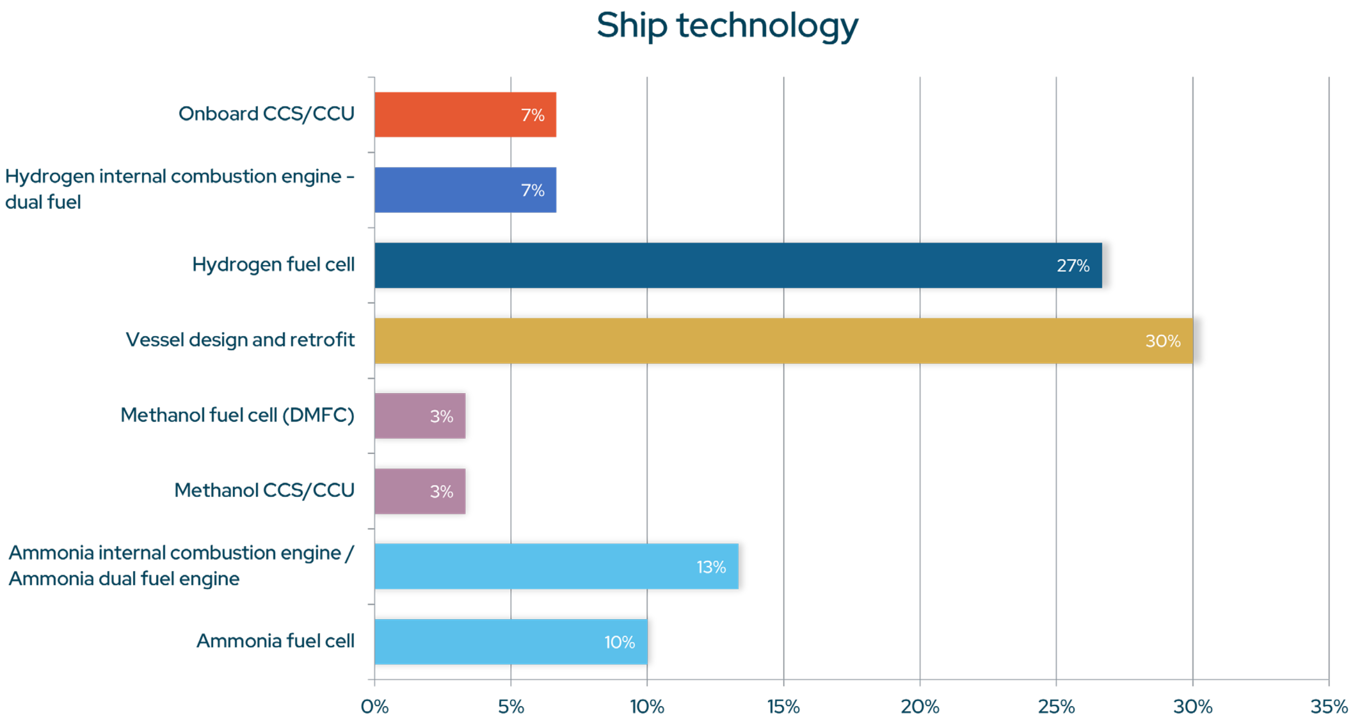


Appendix 5: Detailed view of publicly funded projects

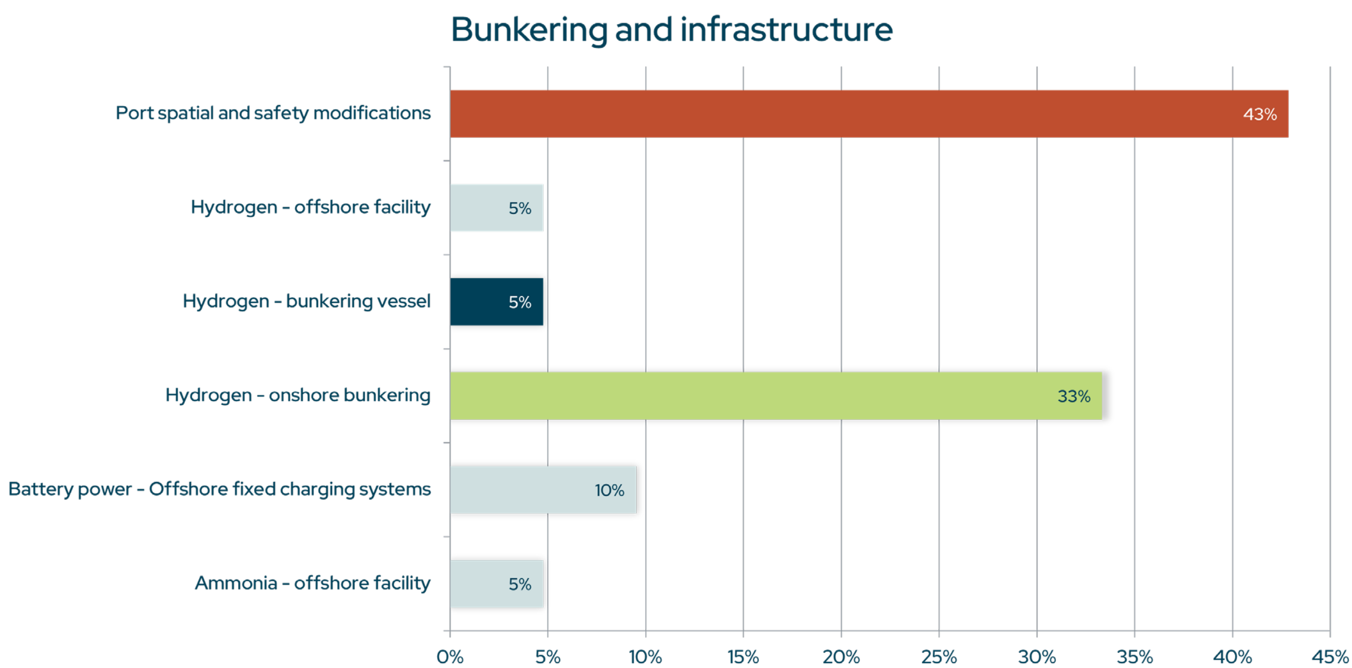
Share of publicly funded projects according to project focus



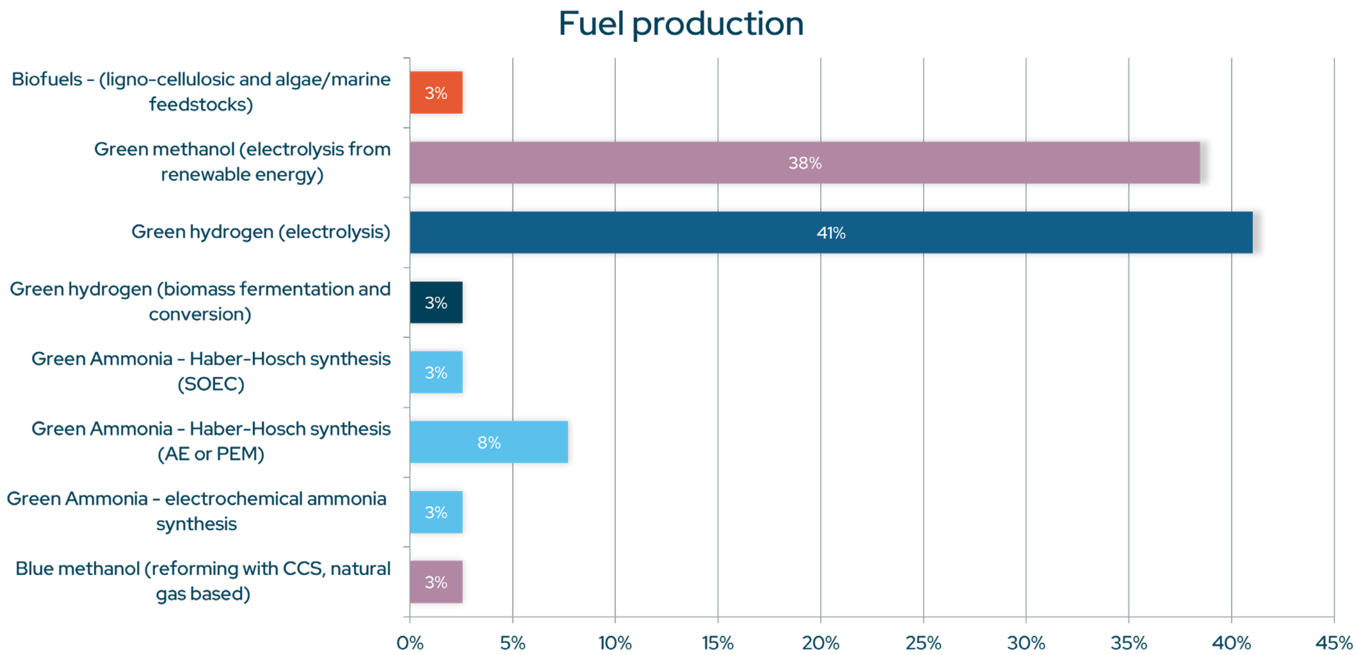
Ship technology projects funded



Bunkering and infrastructure projects funded



Fuel production projects funded



About the Getting to Zero Coalition

The Getting to Zero Coalition is an industry-led platform for collaboration that brings together leading stakeholders from across the maritime- and fuels value chains with the financial sector and others committed to making commercially viable zero-emission vessels a scalable reality by 2030, towards full decarbonisation by 2050.

It is managed by the Global Maritime Forum, who initially founded the Coalition together with the World Economic Forum and Friends of Ocean Action.