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Mapping of Zero Emission Pilots and Demonstration Projects

Second edition | March 2021



March 2021

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This insight brief is based on analysis by the Global Maritime Forum for the Getting to Zero Coalition's Motivating First Movers workstream. The Getting to Zero Coalition is a partnership between the Global Maritime Forum, the Friends of Ocean Action, and the World Economic Forum.



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 other committed to making commercially viable zero emission vessels a scalable reality by 2030.

The views expressed in this insight brief are those of the authors alone and not the Getting to Zero Coalition or the Global Maritime Forum, Friends of Ocean Action or the World Economic Forum.

New Mapping of Zero Emission Pilots and Demonstration Projects for the maritime industry shows an increasing focus on hydrogen based fuels

The uptake of pilot and demonstration projects is a vital step in pushing forward the transition to zero emission fuels for the maritime industry. The second edition of the *Getting to Zero Coalition's Mapping of Zero Emission Pilots and Demonstration Projects* demonstrates the scale and diversity of projects already underway.

What is in the mapping?

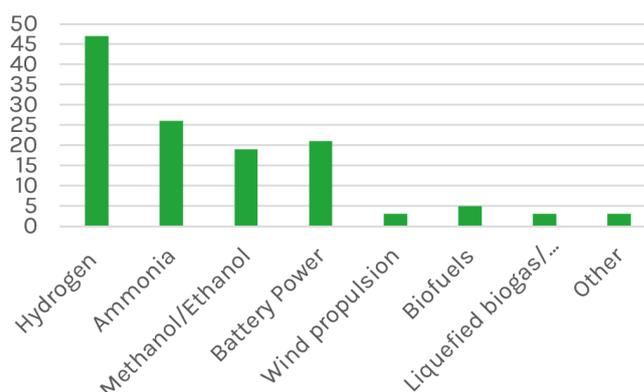
Increasing from 66 projects in the first edition, the *Mapping of Zero Emission Pilots and Demonstration Projects* now includes 106 projects focusing on zero emission pathways for the maritime industry. These projects cover the full value chain, focusing on the different elements needed to facilitate shipping's transition to zero emission fuels. This means that the mapping includes projects focusing on ship technologies, fuel production and bunkering/recharging.

The projects have been categorized in terms of their geographical focus, project focus, project type, fuel choice, and the existence of public funding. By applying and comparing these metrics, we can draw some initial conclusions in terms of some of the key trends emerging in shipping's decarbonization.

Emerging trends

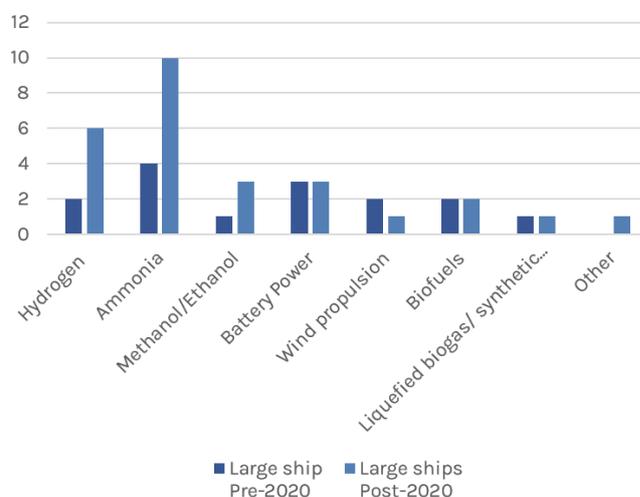
Overall, the mapping demonstrates that significant work is underway on several different **fuels**, with no clear preference shown for a single fuel across the mapping. As noted above, however, it is possible to see some trends emerging with regard to fuel production, small ship technology and large ship technology projects.

Overall fuel focus



For **large ship projects**, comparing projects initiated pre-2020 to post-2020 gives some indication as to emerging trends regarding fuel types. At the outset, this shows an increase in large ship projects focusing on ammonia, methanol/ethanol and hydrogen, with a slight reduction in the share of projects focusing on battery power, biofuels and wind propulsion.

Fuel focus for pre- vs. post-2020 large ship projects



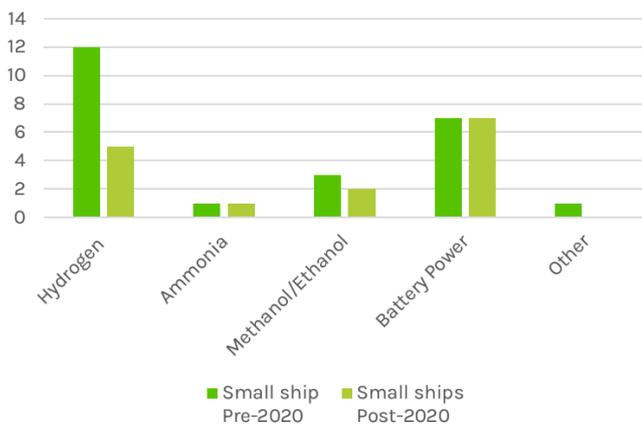
The most significant trend we are seeing with newer large ship technology projects is the post-2020 increase in the uptake of large ammonia vessels. Since the first mapping was released 6 months ago, we have received 4 additional large ammonia ship demonstration projects and are now seeing some of the first orders for these vessels being placed.

The mapping also saw an increase with methanol/ethanol projects, with some large methanol tanker vessels now being built to run on methanol in addition to transporting it. This is a further development from the previous mapping, where the biggest methanol vessels were large passenger ferries.

It is worth noting that the majority of battery powered large ship projects anticipate using batteries as an auxiliary source of power, rather than as the main means of propulsion. This is also the case for a few hydrogen projects addressing the use of fuel cells as a source of auxiliary power.

In terms of the **smaller vessels** in the mapping, we are seeing less of an acute transition towards new fuel types. As was also reflected in the first edition, there appears to be a preference towards using hydrogen, battery power or a combination of the two onboard small ships.

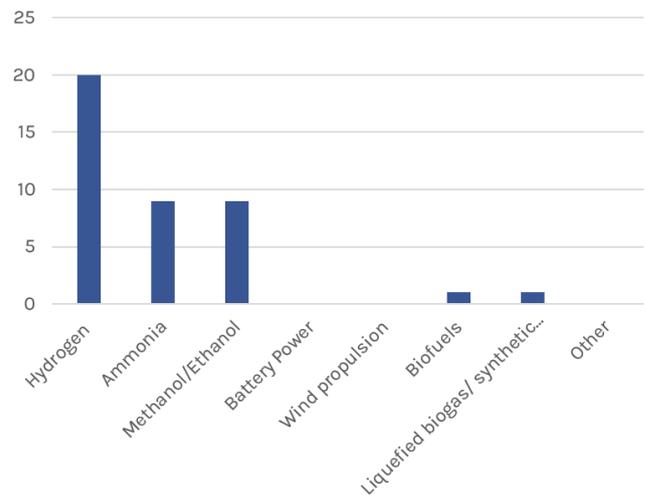
Fuel focus pre- vs post-2020 small ship projects



In terms of **fuel production projects**, the mapping shows a preference towards Power-to-X fuels that are derived from hydrogen. It is worth noting that fuel production projects were included in the

mapping in so far as they anticipate producing marine fuels or have a member of the Getting to Zero Coalition as a project partner.

Fuel focus for fuel production projects

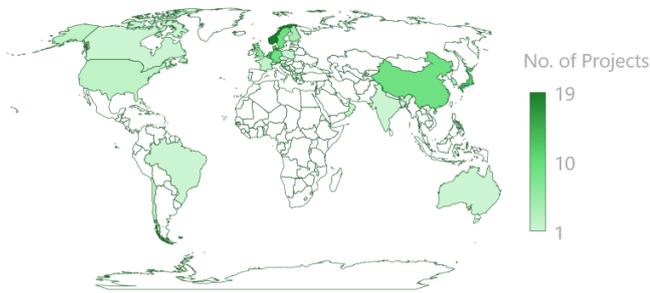


Part of the reason for hydrogen's statistical significance is that where a project focuses on multiple fuels, it will be counted twice for the purposes of the data. As hydrogen is an input for the production of both ammonia and methanol/ethanol, many projects, particularly on the fuel production side, will show a hydrogen component in addition to another fuel. Despite this, the mapping still shows a strong preference for projects focusing on the production of hydrogen and hydrogen derived fuels for the maritime industry.

The big picture

In terms of **geography**, most projects in the mapping have a significant connection to Europe (71), with Norway, the Netherlands, Denmark and Belgium all having over 10 projects in the mapping. Since the first edition, the geographical spread of the mapping has become more representative, which is reflected in the increase of Asian projects from 16 in the first edition to 31 in the second. This is due both to an improvement in terms of research methods as well as a recent proliferation of projects originating from Asia. In Asia, the majority of projects come from Japan and China, with a number also coming from South Korea.

Country heatmap



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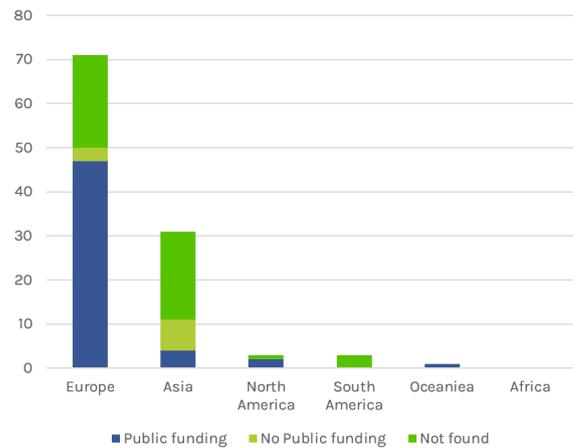
The mapping has also seen an expansion in the number of countries who are now pursuing pilot projects relating to shipping decarbonization, with new projects emerging from countries in, for example, South America and Asia since the last edition.

Project type and developments

In the last 6 months, we have seen around 10% of the projects from the first edition announce new phases of development, increases in size or ambition or move from concept study stage to demonstration stage. This shows that within the projects we have gathered there appears to be a tangible move towards raising ambition and scaling up existing projects.

Of the 106 projects in the mapping, just over half (54) of all projects received some amount of **direct public funding** to the project. The majority of this funding originates in Europe, with a lower proportion of projects from other geographies, particularly with respect to Asia, typically receiving public funding.

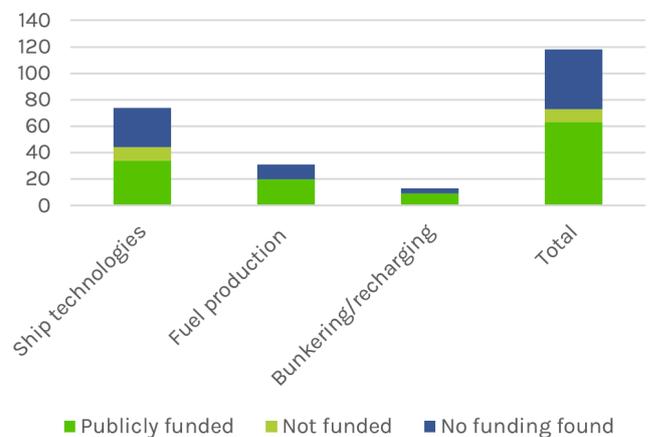
Public funding by geographical focus



It is worth noting that the existence of public funding was only counted where there was a direct award of funding to the project. This doesn't count public funding where one of the partners is a public entity or when the project was partially funded through other sources of funding like subsidies. This can partially explain the lower amount of publicly funded projects outside of Europe, which frequently have public support, but not necessarily direct funding awards in the same way as is done, for example, through the EU.

The largest awards of public funding in the mapping continue to go to large scale fuel production projects. Both these fuel production projects, and bunkering/recharging projects are the most consistently funded projects in the mapping.

Funding status of different project focus



What next?

We hope that by continuing to develop a better understanding of the scale and diversity of zero emission pilot projects already underway, the mapping can continue to raise ambition in working towards a transition to zero-emission fuels for the maritime industry. In this way, we hope that the mapping can provide some support to potential first movers in helping them to draw upon learnings from other projects and improving confidence in undertaking these projects.

We encourage stakeholders from across the maritime spectrum to send us information about new projects or projects we have missed in order to improve the quality and validity of the findings.

We would like to thank all the members of the Getting to Zero Coalition, who have provided us with information about the projects they are involved in. Without their contributions the mapping could not have been produced.

The *Mapping of Zero Emission Pilots and Demonstration Projects* will be updated on a continuing basis by the Getting to Zero Coalition, with future reports being released biannually.

Methodology

Scope

The scope of the mapping covers projects which focus on zero emission pathways for the maritime industry, which includes ship technology, fuel production and bunkering/recharging projects. Please refer to the Getting to Zero Coalition's [technical guidance](#) for a fuller definition of what constitutes zero emission.

Projects which are purely focused on energy efficiency, whilst extremely important in reducing GHG emissions from shipping are not considered within scope for the mapping.

Fuel production projects

Fuel production projects are considered to be within scope for the mapping where they specifically anticipate producing marine fuels. Where a partner on the project is a member of the Getting to Zero coalition, the project will be considered to anticipate the production of marine fuels.

Fuel production projects which use renewable energy, biomass or fossil fuel feedstocks combined with CCS to produce marine fuels are considered to be in scope¹. For synthetic carbon-based fuels, these will be considered within scope if the feedstock is based on biomass, other potentially net-zero feedstocks, or direct air capture.

For biofuel projects, only biofuel production based on second- and third-generation technology (ligno-cellulosic and algae/marine feedstocks) will be considered in scope for the mapping, due to the maturity and commercial viability of other biofuels.

Onshore power projects will be considered within scope in so far as they focus on recharging

batteries for use aboard ships. Projects supplying power for use only during berthing and not ultimately for propulsion will be considered out of scope for the second edition of the mapping.

Ship technology projects

Ship technology projects involving fuels that can be produced from “non-green” sources such as grey ammonia and methanol are considered in scope irrespective of the fuel used in the projects, as they have the potential to transition to green fuels in future.

Onboard CCS projects are included in the mapping as they, in combination with other low carbon fuels, could achieve zero emission vessels.

Smaller vessels (under 5000 dwt) will also be included due to their potential to trial and realise zero emission technologies aboard larger vessels.

For projects focusing on wind propulsion, only large ship projects (over 5000 dwt) which derive over 50% of their propulsion from wind will be included.

Projects dealing purely with fuel transportation are considered out of scope. This includes pressurized/cryogenic technology with a focus solely on transportation.

Definition of pilot and demonstration projects

The mapping covers pilot and demonstration projects, which excludes projects or services which are now readily available to the mass market. This means, for example, that bio-diesel projects are considered out of scope as there is already an existing market for them, whereas new biofuel production processes based on waste products will be considered in scope.

¹ https://www.globalmaritimeforum.org/content/2019/09/Getting-to-Zero-Coalition_Zero-carbon-energy-sources.pdf

Timeline for projects

Projects will only be included in the mapping where their completion date is after January 1st 2018. This is designed to include long-term projects (for example with 10-year timespans).

Categorisation

The following section outlines the different categories which the mapping takes account of. Where a project has a significant connection to two categories (i.e. Asia and Europe for Geographical location), both of these will be counted for the purposes of the data. Examples of categorisations are given in bold.

Project focus

- The project focus is categorised based on whether the project addresses fuel production, ship technologies or bunkering and recharging, some projects may have a dual focus.

Fuel focus

- The main categories of fuels covered by the mapping are ammonia, battery power, biofuels, ethanol/methanol, hydrogen, wind propulsion, liquefied biogas/Synthetic methane, and other.
- The other category includes project with no specific fuel focus or project involving for example, CCS or CCU.

Project type

- The project type refers to the level of development of a given project. This is categorised based on whether the project is a concept study (planned on paper), a laboratory test (test in a controlled environment) or a demonstration in normal operations.

Ship size (for ship technology projects)

- For projects specifically related to ship technologies, the size of the vessel will be included in the mapping. Large vessels are counted as being over 5000 DWT as per IMO Regulations, whilst small vessels are counted as being under 5000 DWT.

- Where the size of a ship was not determinable through reference to publicly available information, the size of the ship was estimated.

Lead partner

- The lead partner is the partner who is overall responsible for the management and delivery of the project.

Geographical location

- The location of the project is determined by looking at where the project is mostly based (continent and country). For projects with no specific geographical focus, the location of the lead partner is used.
- Where a ship technology project has a significant connection to a given route, the geographical location of the route will be counted as the geographical location of the project. The nationality of the lead partner will be used where the route doesn't have a significant connection to the project.

Timeline of project

- The timeline of the project indicates the start date and completion date of the given project.

Other companies/stakeholders involved

- A full list of other organizations who have a role in the project.

Public funding

- Whether the project is considered publicly funded depends on the direct receipt of public funds to the project itself.
- Where a partner is a public entity, or partially publicly funded, this will not be considered as funding for the project.
- This category should also include the source and amount of funding where this was publicly available.

Additional information

- This will provide links to additional publicly available information on the given project.

Definitions

Green Hydrogen - Hydrogen produced through the process of splitting water into hydrogen and oxygen through electrolysis using renewable electricity.

Blue Hydrogen - Hydrogen produced from fossil sources, where the carbon emissions are captured and stored.

Green Ammonia - Green ammonia is produced through combining green hydrogen with nitrogen separated from the air.

Renewable methanol - Renewable methanol can be produced by combining green hydrogen with CO₂. It can also be made from sustainable biomass, where it is commonly referred to as biomethanol.

Biofuels - Refers to liquid fuels, which can be dropped into existing diesel engines (biodiesel). This excludes other types of fuels which can be produced from biomass (i.e. biogas, bioethanol, biomethanol).

Liquefied biogas/Synthetic methane - this category includes natural gas produced from biomass and synthetic methane produced using renewable electricity plus carbon source.

Lignin Ethanol Oil - A blend of ethanol and lignin, lignin is a structural biopolymer which helps to stabilize hydrogen for use as a fuel.

Power-to-X - Power-to-X refers to the use of electricity as primary energy input to create energy carriers in other forms (gases, liquids, heat, cold, chemicals, etc.). Here the term refers to maritime fuels using hydrogen produced by electrolysis.

Links

Please consult the Getting to Zero Coalition's [technical guidance](#) for further information on the types of technologies covered under zero emission pathways.

First edition of the *Mapping of Zero Emission Pilots and Demonstration Projects*- [Full report](#)

Link to [submission template](#).

Project summaries

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Ammonia

Title	50,000 dwt MR ammonia tanker design		
Short description including key deliverables	Hyundai Mipo Dockyard (HMD), a shipbuilding unit of Korea Shipbuilding & Offshore Engineering Co., has secured an Approval in Principle (AiP) from Lloyd's Register for its ammonia-powered design of a 50,000 dwt MR tanker. Under the project, HMD was in charge of the basic design, while MAN Energy Solutions was assigned with the development and specifications of the ammonia dual-fuel engine.		
Timeline of project	July 2020 - 2025	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	Large
Lead partner	Hyundai Mipo Dockyard	Geographical focus/location	Asia - South Korea
Other companies/ stakeholders involved	Lloyd's Register, MAN Energy Solutions		
Public funding	None found		
Additional information	https://www.offshore-energy.biz/hyundai-mipo-dockyard-wins-lr-approval-for-ammonia-powered-ship/		

Title	Ammonia fuelled VLCC concept design		
Short description including key deliverables	This project is aiming to carry out the relevant research on the application of ammonia as marine fuel, develop a concept design for VLCC. All drawings and documents should comply with the safety requirements and be approved by the Classification Society.		
Timeline of Project	2020 - 2021	Fuel focus	Ammonia
Type of project	Concept study	Ship Size	Large
Lead partner	CSSC	Geographical focus/location	Asia - China
Other companies/ stakeholders involved	China State Shipbuilding Corp. Ltd, China Classification Society, etc.		
Public funding	None		
Additional information			

Title	Ammonia-fueled Chittagongmax container		
Short description including key deliverables	SDARI will develop the ship design and engineering, which will utilize MAN's dual fuel technology and ABS will assess safety-related issues and contribute to the development of rules and standards in relation to ammonia as a fuel. Conceptual design development is the initial phase of the JDP, with the second phase moving to engagement with owners to develop designs tailored to their specific operational requirements.		
Timeline of Project	Agreed late 2019	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	Large
Lead partner	MAN Energy Solutions and Shanghai Merchant Ship Design & Research	Geographical focus/location	Asia- China
Other companies/ stakeholders involved	ABS		
Public funding	None found		
Additional information	https://ww2.eagle.org/en/news/press-room/abs-man-sdari-develop-ammonia-fueled-feeder-vessel.html		

Title	Avin International orders landmark ammonia-ready suezmax series		
Short description including key deliverables	Greece's Avin International has ordered the first ammonia fuel ready vessel in the world. The suezmax tanker has been ordered at China's New Times Shipbuilding. The contract comes with options for two more. Currently conventionally fuelled, the vessel complies with the ABS Ammonia Ready Level 1 requirements, indicating it is designed to be converted to run on ammonia in the future.		
Timeline of Project	2021 -	Fuel focus	Ammonia
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Avin International	Geographical focus/location	Europe - Greece
Other companies/ stakeholders involved	China's New Times Shipbuilding		
Public funding	None found		
Additional information	https://splash247.com/greeces-avin-international-orders-landmark-ammonia-ready-suezmax-series/		

Title	Dalian Shipbuilding Industry Ammonia Concept Study		
Short description including key deliverables	Lloyd's Register (LR) has granted Approval in Principle to Dalian Shipbuilding Industry Co. (DSIC), and MAN Energy Solutions for an ammonia-fuelled 23,000 TEU Ultra-Large Container Ship (ULCS) concept design, the first ammonia as fuel design of its kind in China. LR facilitated hazard identification (HAZID) workshops to determine potential hazards throughout the design phase, and provides technical guidance regarding the ship's design, technical materials, in accordance with the goals and requirements from regulatory rules, procedures and guidelines.		
Timeline of Project	Initiated late 2019	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	Large
Lead partner	Dalian Shipbuilding Industry Co.	Geographical focus/location	Asia - China
Other companies/ stakeholders involved	Lloyd's Register and MAN Energy Solutions		
Public funding	None found		
Additional information	https://www.lr.org/en/latest-news/aip-ammonia-fuelled-ulcs/		

Title	Joint Agreement Reached for GHG Zero-Emission Ship		
Short description including key deliverables	Joint agreement to develop ships equipped with a main engine using ammonia as its main fuel (“Ammonia-fueled Engine”). The purpose of the joint agreement is not limited to the development of ships equipped with an Ammonia-fueled Engine, but extends to the question of owning and operating the ships, supplying ammonia fuel and developing ammonia supply facilities. The consortium intends to promote initiatives to reduce GHGs with the cooperation of domestic and overseas companies, as well as the relevant government agencies.		
Timeline of Project	April 2020-	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	Large
Lead partner	Imabari Shipbuilding, MAN Energy Solutions, Mitsui E&S Machinery Co, ClassNK, ITOCHU ENEX and ITOCHU Corporation	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved			
Public funding	None found		
Additional information	https://www.classnk.or.jp/hp/en/hp_news.aspx?id=4944&type=press_release&layout=1		

Title	Joint Development Project for DSME NH3 fueled Container Ship		
Short description including key deliverables	LR has granted Approval in Principle (AiP) to Daewoo Shipbuilding & Marine Engineering (DSME) and MAN Energy Solutions for its ammonia (NH3) fuelled 23,000 TEU ultra-large container ship design, a key result from a Joint Development Project (JDP) launched earlier this year focused on developing ammonia propulsion ships. It is the first AiP to be awarded in Korea for an ammonia-fuelled ultra-large container ship design.		
Timeline of Project	2020 - 2025	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	Large
Lead partner	Lloyd's Register	Geographical focus/location	Asia- South Korea
Other companies/ stakeholders involved	DSME, MAN Energy Solutions		
Public funding	No funding		
Additional information	https://www.lr.org/en/latest-news/lr-awards-aip-to-ammonia-fuelled-23000-teu-ultra-large-container-ship/		

Title	LR and SHI ammonia-fuelled tanker design		
Short description including key deliverables	LR has granted Approval in Principle (AiP) to Samsung Heavy Industries (SHI) for its ammonia-fuelled tanker design, a key progress milestone in the joint development project LR and SHI announced with industry leading partners MISC Berhad and MAN Energy Solutions in January 2020.		
Timeline of Project	2019 - 2024	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	Large
Lead partner	MISC Berhad, Samsung Heavy Industries, Lloyd's Register MAN ES	Geographical focus/location	Asia/Europe- South Korea
Other companies/ stakeholders involved	None		
Public funding	None found		
Additional information	https://www.lr.org/en/latest-news/samsung-heavy-industries-aip-ammonia-fuelled-tanker/		

Title	Mejillones ammonia plant		
Short description including key deliverables	<p>ENAEX and ENGIE will through a strategic partnership carry out a feasibility study of a pilot plant. The project consists in the design, construction and operation of a green ammonia production complex based on renewable hydrogen to be used by ENAEX to produce explosives for the mining sector. This will also give Chile another opportunity to make green ammonia available for other uses, such as fertilizers or the export of renewable energy using this product as a transport vector.</p>		
Timeline of Project	July 2019-	Fuel focus	Ammonia
Type of project	Concept study	Ship Size	
Lead partner	ENAEX and ENGIE	Geographical focus/location	South America- Chile
Other companies/ stakeholders involved			
Public funding	None found		
Additional information	https://www.enaex.com/en/enaex-engie-on-the-path-to-a-smooth-zero-carbon-transition-in-the-chilean-mining-sector/		

Title	Memorandum of Understanding to study ammonia marine fuel supply chain in Singapore		
Short description including key deliverables	<p>Vopak Terminals in Singapore will support Itochu in the feasibility study and promote the development of an independent, onshore facility for the storage and handling of ammonia with loading/unloading functions in Singapore.</p> <p>Itochu Enex will promote the development of ammonia fuel supply chain in Singapore, while Itochu will promote the establishment of offshore facilities such as floating tank and/or fuel supply ships as well as formation of global partnerships. The joint agreement aims to develop the establishment of supply chain of ammonia marine fuel in Singapore, integrating the project with developing zero-emission ships by Itochu and Itochu Enex with other partners.</p>		
Timeline of Project	2020 -	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	
Lead partner	Itochu group and Vopak Singapore	Geographical focus/location	Asia - Singapore
Other companies/ stakeholders involved	ITOCHU ENEX Co. Ltd., ITOCHU Corporation and Vopak Terminals Singapore Pte Ltd		
Public funding	None found		
Additional information	https://www.itochu.co.jp/en/news/press/2020/200612.html		

Title	NoGAPS		
Short description including key deliverables	The NoGAPS project consists of companies from across the shipping and ammonia value chain, to develop a holistic proof of concept and roadmap for the construction of the world's first ammonia powered deep sea vessel. The proof of concept will address both the ship design and safety aspects, the production and supply of green ammonia as well as the business models to make the project economically viable, and will thus serve as the basis for launching concrete projects that can lead to the deployment of the first ammonia powered vessel by 2025.		
Timeline of Project	April 2020 - August 2021	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	Large
Lead partner	Global Maritime Forum	Geographical focus/location	Europe- Denmark
Other companies/ stakeholders involved	Lauritzen-Kosan, Yara, Ørsted, Wartsila, MAN Energy Solutions, DNV-GL, Danish Ship Finance, DNB, Fürstenberg Maritime Advisory.		
Public funding	Nordic Innovation Mobility Mission: Sea Meets Land 1,000,000 NOK		
Additional information	https://www.nordicinnovation.org/programs/nordic-green-ammonia-powered-ships-nogaps		

Title	NYK ammonia-fueled ammonia gas carrier and Ammonia Floating Storage and Regasification Barge		
Short description including key deliverables	<p>In this project, we will be engaged in the R&D of a liquefied ammonia gas carrier. It is expected that the use of ammonia, which is the cargo, as a marine fuel will contribute to the early realization of zero emissions for oceangoing vessels, and commercialization of an ammonia-fueled ammonia gas carrier (AFAGC) that would use ammonia as the main fuel, in addition to an ammonia floating storage and regasification barge (A-FSRB). This joint R&D aims not only to utilize ammonia as a marine fuel but also to establish methods for the mass transportation and supply of ammonia and to become a solution for introducing a mixed combustion of ammonia into coal-fired power stations operated by Japanese electric power companies.</p>		
Timeline of Project	2020 -	Fuel focus	Ammonia
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	NYK Line	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved	Japan Marine United Corporation, and Nippon Kaiji Kyokai (ClassNK)		
Public funding	None found		
Additional information	https://www.nyk.com/english/news/2020/20200812_01.html		

Title	NYK ammonia-fueled tugboat		
Short description including key deliverables	<p>This joint R&D envisions the implementation of ammonia marine fuel in tugboats that require high output, and we will firmly establish the technical and operational requirements for that purpose. Specifically, in fiscal 2020 we will tackle themes such as technological development of the hull, engine, and fuel supply system, and development of safety navigation methods. After evaluating the practicality of the R&D results, we will begin study of the construction of the ammonia-fueled tugboat and the plan for construction.</p>		
Timeline of Project	2020-	Fuel focus	Ammonia
Type of project	Concept study	Ship Size	Small
Lead partner	NYK Line	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved	IHI Power Systems Co., Ltd., and Nippon Kaiji Kyokai (ClassNK)		
Public funding	None found		
Additional information	https://www.nyk.com/english/news/2020/20200903_01.html		

Title	SDARI ammonia-fueled Bulk Carrier		
Short description including key deliverables	Lloyd's Register (LR) has granted Approval in Principle to Shanghai Merchant Ship Design & Research Institute (SDARI), for an ammonia-fuelled Bulk Carrier concept design. Based on full research, discussion and demonstration in the early stage, combined with the latest achievement from MAN B&W, SDARI has completed the development and design of 180,000 tons of ammonia fuel bulk carrier. The ship's full-range ammonia fuel propulsion meets the requirements of the zero carbon emissions.		
Timeline of Project	2019	Fuel focus	Ammonia
Type of project	Concept Study	Ship Size	Large
Lead partner	Shanghai Merchant Ship Design & Research Institute	Geographical focus/location	Asia - China
Other companies/ stakeholders involved			
Public funding	No funding		
Additional information	https://www.ammoniaenergy.org/articles/ammonia-fueled-ships-entering-the-design-phase/		

Title	SOC4NH3		
Short description including key deliverables	<p>Haldor Topsoe has announced a demonstration of its next-generation ammonia synthesis plant. The new technology uses a solid oxide electrolysis cell to make synthesis gas (hydrogen and nitrogen), which feeds Haldor Topsoe's existing technology: the Haber-Bosch plant. The product is ammonia, made from air, water, and renewable electricity.</p> <p>The "SOC4NH3" project will demonstrate the system with its academic partners, and to deliver a feasibility study for a small industrial-scale green ammonia pilot plant, which it hopes to build by 2025.</p>		
Timeline of Project	2020 - 2024	Fuel focus	Ammonia
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Haldor Topsoe	Geographical focus/location	Europe - Denmark
Other companies/ stakeholders involved	Energinet, Vestas, Equinor and Ørsted Wind Power		
Public funding	SOC4NH3 is one of 46 projects that were awarded grants at the end of 2018 totaling DKK 234 million (USD \$36 million) by the Danish Energy Agency, through its Energy Technology Development and Demonstration Program (EUDP)		
Additional information	https://ammoniaindustry.com/haldor-topsoes-solid-oxide-electrolyzer/		

Title	The ShipFC project - Viking Energy Ship		
Short description including key deliverables	<p>The ShipFC project will demonstrate that long-range zero-emission voyages with high power on larger ships is possible.</p> <p>The project will see an offshore vessel, Viking Energy, which is owned and operated by Eidesvik and on contract to energy major Equinor, have a large 2MW ammonia fuel cell retrofitted, allowing it to sail solely on the clean fuel for up to 3,000 hours annually.</p>		
Timeline of Project	April 2020 - late 2023	Fuel focus	Ammonia
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Ship FC Consortium (NCE Maritime Clean Tech coordinator)	Geographical focus/location	Europe- Norway
Other companies/ stakeholders involved	Equinor, Eidesvik Offshore, Wärtsilä, Prototech, Yara, Fraunhofer IMM, SME Persee, The University of Strathclyde, National Centre for Scientific Research Demokritis, North Sea Shipping, Capital-Executive Ship Management, Star Bulk Ship Management, Sustaina		
Public funding	10 million EUR in funding from EU's 'Fuel Cells and Hydrogen Joint Undertaking (FCH JU)'.		
Additional information	https://shipfc.eu/about/		

Title	The world's first green ammonia fueled tanker: MS Green Ammonia		
Short description including key deliverables	Grieg Edge and Wärtsilä Norway are jointly running the project to launch the GHG emission-free tanker in 2024. The partnership aims to build the world's first green ammonia fueled tanker - to ship green ammonia. The project is a result of a Nordic industrial collaboration group initiated by Zeeds (Zero Emission Energy Distribution at Sea).		
Timeline of Project	2020 - 2024	Fuel focus	Ammonia
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Grieg and Wärtsilä	Geographical focus/location	Europe - Norway
Other companies/ stakeholders involved			
Public funding	Pilot-E confirmed they will support the MS Green Ammonia project with 46,3 million NOK		
Additional information	https://www.griegstar.com/grieg-and-wartsila-to-build-groundbreaking-green-ammonia-tanker/		

Title	Zeeds (Zero Emission Energy Distribution at Sea initiative)		
Short description including key deliverables	Project exploring the opportunities to construct ammonia production and refuelling stations offshore and onshore. The infrastructure of the future is composed of fuel hubs set up next to offshore/onshore wind turbines, built as two-level platforms. The ZEEDS initiative work in four different work streams: Onshore green NH3 production and distribution, offshore green NH3 production and distribution, pilot a new build green ammonia bunker vessel, also powered by green ammonia it selves, and pilot an upgrade of a vessel powered by green ammonia.		
Timeline of Project	2019-2024	Fuel focus	Ammonia
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Wärtsilä	Geographical focus/location	Europe- Finland
Other companies/ stakeholders involved	Aker Solutions, DFDS, Equinor, Grieg Star		
Public funding	Received funding 1 NOK million from from Nordic Innovation- Sea Meets Land Received funding for engine tests from The Norwegian Research Council – Demo2000		
Additional information	https://zeedsinitiative.com/		

Title	Pilbara Ammonia Plant		
Short description including key deliverables	The collaboration between Yara and ENGIE on the feasibility study aims to assess the first step towards converting the Yara Pilbara plant from one that relies completely on natural gas for its hydrogen, to one where a share of its hydrogen comes from renewable power. Reaching that goal would further reduce the plant's CO ₂ emissions.		
Timeline of Project	Initiated 2019, planned completed 2023	Fuel focus	Ammonia, Hydrogen
Type of project	Concept Study	Ship Size	
Lead partner	Yara International and ENGIE	Geographical focus/location	Oceania - Australia
Other companies/ stakeholders involved	Partnerships under development		
Public funding	Granted support from ARENA to conduct the feasibility study		
Additional information	https://www.yara.com/news-and-media/news/archive/2020/arena-announces-funding-for-yara-pilbara-and-engies-feasibility-study-on-a-renewable-hydrogen-to-ammonia-solution-in-fertiliser-production/		

Title	Porsgrunn Plant Project		
Short description including key deliverables	<p>The goal is to produce hydrogen from renewable sources to be fed into our existing ammonia plant, which will either be used in fertilizer production or used as green ammonia. The technology is based on Nel's next generation water electrolyser development that will be tested at Yara's existing plant in Porsgrunn, Norway. Yara further plans to fully electrify its ammonia plant with the potential to cut 800,000 tonnes of CO2 per annum, equivalent to the emissions from 300,000 passenger cars. If the required public co-funding and regulatory framework is in place, this further project could be operational in 2026.</p>		
Timeline of Project	In operation by end of 2022/ beginning of 2023 (full electrification planned for 2026)	Fuel focus	Ammonia, Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Yara, Nel	Geographical focus/location	Europe- Norway
Other companies/ stakeholders involved			
Public funding	Norway's Research Council, Innovation Norway and Enova through the PILOT-E program.		
Additional information	https://www.yara.com/news-and-media/news/archive/2019/yara-and-nel-carbon-free-hydrogen-for-fertilizer-production/		

Title	SOFC4Maritime		
Short description including key deliverables	<p>The project, SOFC4Maritime, will target optimal utilization of future green fuels via application of SOFCs for power production on marine vessels. When based on fuels such as ammonia, hydrogen or bio-methane, SOFCs hold great promise as a replacement for today's fossil fuels. By electrochemically converting fuel into electricity, SOFCs can potentially produce power with higher efficiency than internal combustion engines running on the same fuel - without creating polluting emissions or particulates.</p>		
Timeline of Project	2020 -	Fuel focus	Ammonia, Hydrogen, Liquefied biogas/ synthetic methane
Type of project	Concept study	Ship Size	
Lead partner	Alfa Laval	Geographical focus/location	Europe - Sweden
Other companies/ stakeholders involved	DTU Energy, Haldor Topsoe, Svitser and the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping		
Public funding	Funded by a grant from Danish Energy Technology Development and Demonstration Program (EUDP)		
Additional information	https://www.alfalaval.com/industries/marine-transportation/marine/marine-news/maritime-industry-players-join-forces-to-realize-the-decarbonization-potential-of-solid-oxide-fuel-cells/		

Battery

Power

Title	300-seat battery-powered ferry "Junlu"		
Short description including key deliverables	This project is the biggest pure battery-powered ferry in China, this vessel now is navigating in Yangtze River for tour and sightseeing, and can meet the requirement of zero emission on board.		
Timeline of Project	2018 - 2019	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Wuhan Tourism Development Investment Group	Geographical focus/location	Asia - China
Other companies/ stakeholders involved	China State Shipbuilding Corp Ltd, Wuhan Yangtze Shipping Co., Ltd, China Classification Society, etc.		
Public funding	None found		
Additional information	http://www.eworldship.com/html/2020/OperatingShip_0106/155863.html		

Title	AEGIS: Autonomous ships meet automated ports		
Short description including key deliverables	EU Horizon 2020 project aimed at developing connected and automated waterways. Small ships and inland barges will operate on batteries or other non-carbon fuels to provide green transport solutions. By automating ports and terminals and use these to integrate longer distance ship operations with the smaller ships, a completely new European transport system can be developed. The AEGIS consortium will design Europe's next generation sustainable and highly competitive waterborne logistics system comprising more autonomous ships and automated cargo handling.		
Timeline of Project	2020-	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	SINTEF Ocean	Geographical focus/location	Europe - Norway, Denmark, Finland and Germany
Other companies/ stakeholders involved	Cargotec, MacGregor, Grieg Connect, ISE, DTU, AAU, Port of Aalborg, DFDS, NCL, Trondheim Havn, Vordingborg Havn		
Public funding	7,5 M€ from the European Union's Horizon 2020 research and innovation program under Grant Agreement N°859992		
Additional information	http://aegis.autonomous-ship.org/		

Title	Asahi Tanker electric-powered bunker tankers		
Short description including key deliverables	Asahi Tanker has confirmed orders at two local yards to build the world's first two zero-emissions electric bunker tankers. Asahi has chosen Koa Sangyou and Imura Zosen to build one of the vessels each, with delivery scheduled in March 2022 and March 2023. The tankers will be powered by large-capacity lithium ion batteries, and they will enter service in Tokyo Bay as bunker vessels.		
Timeline of Project	2020 - 2022/23	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Asahi Tanker, Koa Sangyou and Imura Zose	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved	Mitsui O.S.K. Lines, Asahi Tanker, Exeno Yamamizu Corporation and Mitsubishi Corporation		
Public funding	None found		
Additional information	https://www.offshore-energy.biz/japanese-company-to-build-worlds-first-all-electric-bunker-tankers/		

Title	Ellen- E-Ferry		
Short description including key deliverables	The groundbreaking E-Ferry, Ellen was launched in Denmark with the help of Danfoss. The electrically powered ferry has the largest battery capacity at sea and navigates without CO2 emissions. On a round trip, Ellen travels 22 nautical miles, seven times further than any other electric ferry in the world today.		
Timeline of Project	Completed 2019	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Danfoss, EU Commission	Geographical focus/location	Europe- Denmark
Other companies/ stakeholders involved	Mobimar Ltd		
Public funding	Received over €15 million in EU funds as part of the Horizon 2020 Research and Innovation programme.		
Additional information	http://e-ferryproject.eu/		

Title	Future of the Fjords		
Short description including key deliverables	<p>Future of the Fjords represents a new standard of environmentally responsible passenger transport, as the first fully electric carbon fiber vessel in the world. The battery-powered propulsion system eliminates NOx and CO2 emissions, and reduces noise and vibrations. The heart of the vessel is the battery pack which drives the two electric motors. When charged, the vessel can run for more than two hours at a speed of 11 knots.</p>		
Timeline of Project	2019	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Inmel d.o.o, Dalmont	Geographical focus/location	Europe - Norway
Other companies/ stakeholders involved	Westcon, Danfoss		
Public funding	None found		
Additional information	https://www.danfoss.com/en/service-and-support/case-studies/dds/future-of-the-fjords-meets-2026-emission-targets-today/		

Title	Hurtigruten battery powered cruise ships		
Short description including key deliverables	<p>Hurtigruten has placed an order for two new hybrid-powered expedition ships, designed by Rolls-Royce®, due to be delivered in 2019 and 2020, that will use a new and environmentally sustainable hybrid technology. The vessels features new hybrid technology that will reduce fuel consumption and demonstrate hybrid technology on larger ships. While the engines run mainly on marine gasoil, the ship's battery pack enables it to run solely on batteries for around 45 to 60 minutes under ideal conditions.</p>		
Timeline of Project	July 2019 - 2020	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Hurtigruten	Geographical focus/location	Europe- Norway
Other companies/ stakeholders involved			
Public funding	Received funding from Norwegian government enterprise Enova		
Additional information	https://www.hurtigruten.com/about-hurtigruten/hurtigruten-news/first-ever-cruise-ship-sails-on-battery-power/		

Title	HYCAS		
Short description including key deliverables	<p>Joint study to explore new cost-effective applications of hybrid power generation on larger ocean-going cargo ships. MAN Energy Solutions, Corvus Energy and DNV GL studied the potential of using batteries in a container feeder vessel, to assess if it is possible to both reduce emissions and save operational costs. The study explored two main scenarios, a vessel built in 2020 with a 500kWh battery system replacing one genset used for peak shaving and as a spinning reserve, and a vessel built in 2030, using a much larger 11MWh hybrid system for zero emission port entry and exit.</p>		
Timeline of Project	2019	Fuel focus	Battery power
Type of project	Concept study	Ship Size	Large
Lead partner	MAN Energy Solutions, Corvus Energy, and DNV GL	Geographical focus/location	Europe - Norway and Germany
Other companies/ stakeholders involved	CIMAC Congress, Neptun Ship Design		
Public funding	None found		
Additional information	https://www.dnvgl.com/news/man-energy-solutions-corvus-energy-and-dnv-gl-present-results-of-hycas-study-on-hybrid-power-generation-150069		

Title	Maersk Cape Town Container Vessel		
Short description including key deliverables	<p>Maersk has teamed up with Trident Maritime Systems to create a 600kWh container battery that can assist in powering a container ship. The battery will be installed in December 2019, with the first voyage expected in early 2020. The vessel is a Singapore-flagged 249-meter long container ship built in 2011 which sails between West Africa and East Asia.</p>		
Timeline of Project	December 2019-	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Maersk	Geographical focus/location	Denmark
Other companies/ stakeholders involved	Trident Maritime Systems		
Public funding	None found		
Additional information	https://www.maersk.com/news/articles/2019/11/06/maersk-to-pilot-a-battery-system-to-improve-power-production		

Title	Maersk Supply Service and Ørsted - Offshore charging buoy		
Short description including key deliverables	<p>Maersk Supply Service A/S and Ørsted, have formed a partnership to test an innovative charging buoy that can bring green electricity to offshore wind farm service vessels and potentially to a wide range of maritime vessels. The buoy can be used to charge the smaller battery- or hybrid-electrical vessels and to supply power to larger vessels, enabling them to turn off their engines when laying idle. By substituting fossil-based fuels with green electricity, virtually all emissions are eliminated while the buoy is in use.</p>		
Timeline of Project	2020 - 2021	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Maersk Supply Service A/S and Ørsted	Geographical focus/location	Europe - Denmark
Other companies/ stakeholders involved			
Public funding	<p>Maersk Supply Service has received one of the largest EUDP grants (Energy Technology Development and Demonstration Programme, under the Danish Energy Agency) in 2020 supporting with DKK 22mn to the engineering and demonstration of the power buoy. The Dani</p>		
Additional information	<p>https://www.maersksupplyservice.com/2020/09/28/maersk-supply-service-and-orsted-to-test-offshore-charging-buoy-to-reduce-vessel-emissions-2/</p>		

Title	Motorways of the Sea CEF Action, “Sea Li-ion”		
Short description including key deliverables	<p>The proposed Motorways of the Sea CEF-T Action Sea Li-ion is designed to map out innovative ideas and sustainable solutions to boost electrification of the maritime sector using lithium-ion batteries on vessels. The Sea Li-ion project consists of projecting two large Energy Storage Systems (ESS) for storing electricity which would allow charging ships fitted with batteries. These ESSs are to be placed in the ports of Gothenburg and Kiel. Whereas the Action is located on the Gothenburg-Kiel route, the Action envisions a fully functioning, scalable, and replicable fastcharging system for all types of electrical vessels using onshore power.</p>		
Timeline of Project	February 2020 - June 2022	Fuel focus	Battery power
Type of project	Concept Study	Ship Size	Large
Lead partner	Stena Rederi AB	Geographical focus/location	Europe - Sweden, Germany
Other companies/ stakeholders involved	Stena Rederi AB, Stena Recycling AB, Göteborgs Hamn AB, SEEHAFEN KIEL GmbH & Co. KG, DNV GL Sweden AB		
Public funding	Euros co-funded by TEN-T EU Motorways of the Seas programme, requested EU funding €1,505,000		
Additional information	https://ec.europa.eu/inea/sites/inea/files/cefpub/cef_transport_map-2019.pdf (page 84)		

Title	Solar-powered river tours protect Krka National Park		
Short description including key deliverables	<p>The vessels are equipped with both solar PV panels and battery storage. When the sun shines, solar cells supply power to the propulsion. When the sun disappears, the propulsion runs on battery power. In this way the e-vessels run reliably emission-free, no matter what the weather. The fully-electric vessels operate a cycle of 8 hours on battery power and 12 hours on solar panels. Service speed is 5 knots, and maximum speed is 9 knots.</p>		
Timeline of Project	2021	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Inmel d.o.o, Dalmont	Geographical focus/location	Europe - Croatia
Other companies/ stakeholders involved	Danfoss, Inmel		
Public funding	Krka National Park		
Additional information	https://www.danfoss.com/en/service-and-support/case-studies/dds/solar-powered-river-tours-protect-krka-national-park/		

Title	TrAM project		
Short description including key deliverables	<p>The aim of the TrAM project is to develop a zero emission fast going passenger vessel through advanced modular production. The project is revolutionary both in terms of zero emission technology and manufacturing methods, and will contribute to making electric-powered high-speed vessels competitive in terms of both cost and the environment. The project will develop a toolkit of methods and software tools to be used by the industry when designing and constructing inshore vessels.</p>		
Timeline of Project	2020 -	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Kolumbus and Fjellstrand	Geographical focus/location	Europe - Norway, United Kingdom, Belgium
Other companies/ stakeholders involved	Wärtsilä, Servogear, HSVA, University of Strathclyde, NTUA, NCE Maritime CleanTech, Fraunhofer IEM, Leirvik, Hydro Extruded Solutions, Rogaland County Council, MBNA Thames Clippers, De Vlaamse Waterveg, Kolumbus		
Public funding	<p>This project has received contribution of € 11 741 430,63 from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769303</p> <p>€ 11 741 430,63</p> <p>€ 11 741 430,63</p>		
Additional information	https://tramproject.eu/about/		

Title	Wärtsilä Hybrid Solution: CBO Flamengo		
Short description including key deliverables	<p>The technology group Wärtsilä and CBO, one of Brazil's leading operators of offshore support vessels, have recently signed an agreement to convert a vessel from CBO's fleet to operate with hybrid propulsion. The 'CBO Flamengo' will be the first vessel in Latin America to be fitted with a battery pack for hybrid propulsion, which will improve the vessel's energy consumption and reduce its carbon footprint. The order with Wärtsilä was placed in October 2020.</p>		
Timeline of Project	2020 - 2021	Fuel focus	Battery Power
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	CBO	Geographical focus/location	South America - Brazil
Other companies/ stakeholders involved	Wärtsilä		
Public funding	None found. The company has as shareholders the Private Equity funds Pátria Investimentos and Vinci Partners, and BNDESPar (Brazilian Development Bank - BNDES - subsidiary).		
Additional information	https://www.wartsila.com/pol/en/media/global/11-11-2020-wartsila-and-cbo-to-partner-in-latin-america-s-first-hybrid-vessel-upgrade-project-2816132		

Title	Washington State Pilot Projects ferries		
Short description including key deliverables	Washington State Ferries (WSF) has announced plans to order 16 new, state-of-the-art electric-fuel hybrids over the next 20 years. Thirteen of these are to replace legacy vessels that will be retired, and three will serve as backup. In addition, WSF is converting their three largest vessels to battery hybrid electric, which will make them among the largest car and passenger battery-hybrid ferries in the world.		
Timeline of Project	20 years	Fuel focus	Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Washington State Ferries	Geographical focus/location	North America- United States (Washington)
Other companies/ stakeholders involved	DNV GL		
Public funding	Washington State initiative		
Additional information	https://www.dnvgl.com/expert-story/maritime-impact/Washington-State-Ferries-realizes-bold-decarbonization-plans.html		

Title	H2SHIPS Port of Amsterdam		
Short description including key deliverables	<p>The objective of the pilot of the Port of Amsterdam is to demonstrate the feasibility of operating an inland port vessel with hydrogen as a fuel. The 20 meter long vessel will operate both in urban areas (Amsterdam's canals) as well as in the seaport area between Amsterdam and IJmuiden. The vessel will be completely emission-free and silent, operating with a battery and a fuel cell. Sodiumborohydrid will be used as hydrogen carrier, which allows for safe storage. This innovative hydrogen solution should enable implementation of this technology on board of other ship types, especially other inland vessels.</p>		
Timeline of Project	2019-2022	Fuel focus	Battery power, hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Port of Amsterdam	Geographical focus/location	Europe - The Netherlands
Other companies/ stakeholders involved	Tata Steel, University of Birmingham and TU Delft		
Public funding	<p>The Project has a total budget of € 6.33 million and receives € 3,47 million from from Interreg North-West Europe between 2019 and 2022. H2SHIPS has 13 Partners from 5 countries and is coordinated by Europäisches Institut für Energieforschung.</p>		
Additional information	https://h2ships.org/port-of-amsterdam/		

Biofuels

Title	CMA CGM White Shark- Biofuel refuelling		
Short description including key deliverables	<p>A partnership between the Swedish furniture retailer IKEA, CMA CGM, the sustainable initiative the GoodShipping Program and the Port of Rotterdam saw the world's first ocean freight bunkered with marine bio-fuel. After having announced their three month biofuel trial, leading short sea shipowner UECC and the GoodShipping Program have now partnered with premium car manufacturer BMW Group to continue to test marine Bio Fuel Oil (BFO) on UECC's 'roll on, roll off' (ro-ro) car carrying vessels. BMW Group joins UECC and the GoodShipping Program in the previously announced trial, where BFO is being tested on UECC's 140m, 2,080-vehicle carrier M/V Autosky.</p>		
Timeline of Project	2020 -	Fuel focus	Biofuels
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	IKEA, CMA CGM, Good Shipping Program and the Port of Rotterdam	Geographical focus/location	Europe- The Netherlands
Other companies/ stakeholders involved	BMW		
Public funding	None found		
Additional information	https://goodshipping.com/2020/06/10/bmw-group-joins-uecc-and-goodshipping-in-further-biofuel-trials-continuing-decarbonisation-of-sea-transport-for-car-carriers/_and_scalability_of_biofuels.html		

Title	DFDS MASH Project		
Short description including key deliverables	DFDS has bought a stake in start-up company MASH Energy, which produces biofuel from agricultural waste, currently from the by-products of nut processing in India. In order to minimise the operational risk involved in implementing the new generation of biofuel, Alfa Laval have agreed to test the biofuel at their test-centre in Aalborg.		
Timeline of Project	2019-	Fuel focus	Biofuels
Type of project	Laboratory test	Ship Size	
Lead partner	DFDS	Geographical focus/location	Europe - Denmark, Asia - India
Other companies/ stakeholders involved	MASH, Alfa Lava		
Public funding	None found		
Additional information	https://www.dfds-news.com/innovation-technology/mash-begins-producing-oil/		

Title	HAM 316		
Short description including key deliverables	<p>Together with Shell, Van Oord is testing the use of biofuel on its trailing suction hopper dredger HAM 316: "We're testing a "second-generation" biofuel made from waste products such as cooking oil. Moreover, it is ISCC certified, which means that the entire chain is certified by a third party. Current calculations show that the biofuel is an effective and affordable method of reducing CO2 emissions. The test will indicate whether the fuel can be used in practice in existing vessels. The local emissions of the vessel will be measured during the work and after completion the engine will be inspected."</p>		
Timeline of Project	2019-	Fuel focus	Biofuels
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Shell, Van Oord	Geographical focus/location	Europe- Germany, The Netherlands
Other companies/ stakeholders involved	None		
Public funding	None found		
Additional information	https://www.vanoord.com/news/2019-van-oord-and-shell-together-biofuel-pilot-vessels		

Title	Maersk Biofuels		
Short description including key deliverables	<p>Convinced of the urgency to act on climate, a group of Dutch multinationals all members of the Dutch Sustainable Growth Coalition (DSGC), will join forces with A.P. Moller - Maersk to take a tangible step towards the decarbonization of ocean shipping. The pilot uses up to 20% sustainable second-generation biofuels on a large triple-E ocean vessel will sail 25.000 nautical miles from Rotterdam to Shanghai and back on biofuel blends alone, a world's first at this scale, saving 1,5 million kilograms CO2 and 20.000 kilograms of sulphur.</p>		
Timeline of Project	March 2019-	Fuel focus	Biofuels
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Maersk	Geographical focus/location	Asia - China and Europe - The Netherlands
Other companies/ stakeholders involved	FrieslandCampina, Heineken, Philips, DSM, Shell and Unilever		
Public funding	None found		
Additional information	https://www.maersk.com/news/articles/2019/03/22/dutch-sustainable-growth-coalition-partners-with-maersk-in-world-s-largest-maritime-biofuel-pilot		

Hydrogen

Title	ABB and CFT - World's First Hydrogen-Powered River Vessel		
Short description including key deliverables	ABB will provide a power and propulsion solution for a newbuild vessel operating along the Rhône river in France to run entirely on hydrogen fuel cells, due for delivery in 2021. With hydrogen for the fuel cells sourced from shore-based renewable energy, the complete vessel energy chain will be emission-free.		
Timeline of Project	2019 - 2021	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	ABB	Geographical focus/location	Europe - France
Other companies/ stakeholders involved	Compagnie Fluviale de Transport (CFT), VTT and Ballard Power Systems Europe		
Public funding	The vessel is one of two new ships that are part of the European innovation project Flagships. The EU granted EUR 5 million (USD 5.6 million) to Flagships to support deploying two zero-emission hydrogen fuel cell vessels in Norway and France.		
Additional information	https://new.abb.com/news/detail/24058/abb-to-enable-worlds-first-hydrogen-powered-river-vessel		

Title	BeHydro		
Short description including key deliverables	The first hydrogen-powered dual-fuel engine with a capacity of 1 megawatt was launched on 17th September by BeHydro, a joint venture between Belgian-based ABC and CMB. The scope of the dual-fuel engine is to burn a mix of up to 85% hydrogen and the rest Marine Gas Oil using a combustion engine. In december 2020, the project received AiP for this solution from DNV.		
Timeline of Project	2018-2021	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	BeHydro (Joint Venture of ABC Engines & CMB)	Geographical focus/location	Europe- Belgium
Other companies/ stakeholders involved			
Public funding	No funding		
Additional information	https://cmb.tech/news/behydro-launch www.behydro.be E: info@abc-engines.com & h2@cmb.be		

Title	BIG HIT		
Short description including key deliverables	BIG HIT will demonstrate the Orkney Islands of Scotland as a replicable Hydrogen Territory, using curtailed renewable energy generated locally to produce hydrogen which can then be used as a clean energy vector to store and use valuable energy for local applications. BIG HIT will demonstrate use of hydrogen as a flexible local energy store and vector, transporting hydrogen by tube trailer to the Orkney mainland. Here it will be used to demonstrate real end-use applications for hydrogen including auxiliary power and heat for ferries in Kirkwall harbour.		
Timeline of Project	2016 - 2022	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	La Fundación para el Desarrollo de Nuevas Tecnologías del Hidrógeno en Aragón	Geographical focus/location	Europe - United Kingdom
Other companies/ stakeholders involved	The Foundation, Calvera, Community Energy Scotland, DTU, The European Marine Energy Centre (EMEC) Ltd, Giacomini, ITM Power, The Ministry for Transport & Infrastructure of Malta, Orkney Islands Council, The Shapinsay Development Trust, SHFCA, Symbio Fcell		
Public funding	The BIG HIT project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 700092 of € 5 000 000. The Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme.		
Additional information	https://www.bighit.eu/about		

Title	CMB.TECH - hydrogen refuelling station		
Short description including key deliverables	The refuelling station will be able to produce its own green hydrogen and offer it to cars, trucks, tube-trailers and ships. The hydrogen refuelling station will be built near the Port House. This location on the boundary between the city and the port has been purposely selected to provide the many industrial applications in the port with hydrogen, whilst at the same time keeping it easily accessible to the general public.		
Timeline of Project	2020 -	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	CMB.TECH	Geographical focus/location	Europe - Belgium
Other companies/ stakeholders involved	AG VESPA & the port of Antwerp		
Public funding	None found		
Additional information	http://www.cmb.be/en/new/start-of-works-first-hydrogen-refuelling-station		

Title	CTV Hydrogen Ship		
Short description including key deliverables	The Joint Venture between CMB and Windcat Workboats will design and build the first crew transfer vessel (CTV) which will be powered by dual fuel hydrogen - diesel combustion engines. The vessel will store 205kg of pressurized hydrogen at 350bar. The hydrogen CTV, called Hydrocat, will be able to transport 24 service engineers towards an offshore wind park at a cruise speed of 25kn. The maximum speed will be 31kn.		
Timeline of Project	2019 -2021	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	CMB, Windcat Workboats	Geographical focus/location	Europe- The Netherlands
Other companies/ stakeholders involved	None		
Public funding	£100k support from the Carbon Trust in the framework of the Low Emissions Vessels competition		
Additional information	https://www.cmb.be/en/new/cmb-technologies-and-windcat-develop-hydrogen-ctv-project		

Title	Feasibility study of the Power2AX project on green hydrogen production and use in ferries in the Åland archipelago		
Short description including key deliverables	<p>The Finnish project development company Flexens Oy Ab will finish a feasibility study of the Power2AX project in November 2020. The project aims at implementing green hydrogen production and use in fuel ferries in the Åland archipelago. The Power2AX contributes to the Smart Energy Åland project in which Flexens is demonstrating 100 % renewable energy system in the Åland Islands. The assessment provides the first estimate for technical and economic feasibility of the concept covering hydrogen production at a wind farm and using the hydrogen in fuel cell ferries in the Åland archipelago. Flexens and the Government of Åland have started planning the next project phase, which could be expected at the earliest in the beginning of year 2024.</p>		
Timeline of Project	2020-	Fuel focus	Hydrogen
Type of project	Concept study	Ship Size	
Lead partner	Flexens, Government of Åland (Finland)	Geographical focus/location	Europe - Finland
Other companies/ stakeholders involved			
Public funding	Funding from Government of Åland, Finland has also applied to EU Innovation Fund		
Additional information	https://flexens.com/hydrogen-ferries-might-soon-traffic-the-baltic-sea/		

Title	Ferguson Marine Hydrogen Ferry – HySeas III		
Short description including key deliverables	<p>The HySeas III project will bring to market the world’s first zero emission, sea-going ferry that will be powered by hydrogen from renewable sources. The project will not only develop and validate this advanced ferry concept but a prototype version will be constructed and demonstrated in operational service with co-funding from the regional Government in Scotland (which will commission the building of the ferry). It will also demonstrate a novel circular economy model for the local production of hydrogen fuel that could transform the coastal and island economies around Europe.</p>		
Timeline of Project	2018 - 2021	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Ferguson Marine	Geographical focus/location	Europe - United Kingdom (Scotland)
Other companies/ stakeholders involved	University of St Andrews, Orkney Islands Council, Kongsberg Maritime, Ballard Power Systems Europe, McPhy, DLR and Interferry		
Public funding	€9.3million has been awarded by the European Union’s Horizon 2020 research and innovation fund		
Additional information	https://cordis.europa.eu/project/id/769417		

Title	Gigastack Project		
Short description including key deliverables	As part of the initial feasibility phase of the Gigastack project, which finished in 2019, ITM Power developed designs for a low-cost modular 5 megawatt (MW) electrolyser 'stack', collaborating with Ørsted to understand the potential synergies with offshore wind farms and with Element Energy to undertake a market analysis and explore business models for the first industrial-scale 100MW electrolysers. For the second phase of the project the consortium will conduct a Front-End Engineering Design ('FEED') study on a 100MW electrolyser system using staged installations with a nominal capacity of 20MW. The hydrogen will be supplied to the Phillips 66 Limited's Humber Refinery.		
Timeline of Project	Phase 1 of the project has been completed. Phase 2 is ongoing	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	ITM Power	Geographical focus/location	Europe- United Kingdom
Other companies/ stakeholders involved	Ørsted, PowerPhillips 66 Limited and Element Energy		
Public funding	GBP 7.5 million from Department for Business, Energy and Industrial Strategy (BEIS) Hydrogen Supply Competition		
Additional information	https://orsted.co.uk/Media/Newsroom/News/2020/02/Gigastack-phase-2		

Title	H2RES Project		
Short description including key deliverables	Together with partners Everfuel Europe A/S, NEL Hydrogen A/S, GreenHydrogen A/S, DSV Panalpina A/S, Hydrogen Denmark and Energinet Elsystemansvar A/S, Ørsted will construct of a 2MW electrolysis plant with appurtenant hydrogen storage. The production and distribution facility will demonstrate flexible use electricity from offshore wind turbines to produce renewable hydrogen for zero emission vehicles such as buses, lorries and taxis.		
Timeline of Project	2020-2023	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Ørsted	Geographical focus/location	Europe- Denmark
Other companies/ stakeholders involved	Everfuel Europe A/S, NEL Hydrogen A/S, GreenHydrogen A/S, DSV Panalpina A/S, Hydrogen Denmark and Energinet Elsystemansvar A/S		
Public funding	34.6 million DKK from EUDP.		
Additional information	https://www.greencarcongress.com/2019/12/20191223-orsted.html		

Title	H2SHIPS The port of Oostende (PO)		
Short description including key deliverables	<p>The objective of this pilot is to develop and test a modular plug and play H2 bunkering system, that can be used in marine conditions. 2 different systems will be implemented: a floating pontoon with special handling equipment that will deliver exchangeable gas bottles to small hydrogen passenger vessels. And a barge that will be shifted to deliver exchangeable plug and play H2 containers to larger cargo ships operating in open sea conditions. With this solution ships can be fuelled offshore without mooring in the port.</p>		
Timeline of Project	2019-2022	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	The port of Oostende (PO)	Geographical focus/location	Europe - Belgium
Other companies/ stakeholders involved	University of Gent and TU Delft		
Public funding	<p>The Project has a total budget of € 6.33 million and receives € 3,47 million from from Interreg North-West Europe between 2019 and 2022. H2SHIPS has 13 Partners from 5 countries and is coordinated by Europäisches Institut für Energieforschung.</p>		
Additional information	https://h2ships.org/port-of-oostende/		

Title	Havyard Group's FreeCO2ast development project		
Short description including key deliverables	<p>Bergen-based system integrator Norwegian Electrical Systems (NES) intends to plant a 3.2MW hydrogen fuel cell onto a large tourist ferry currently being designed by Havyard Design for the shipowner Havila.</p> <p>It would be the largest fuel cell ever placed on a major ship, replacing the more frequently used compressed gas. Batteries are planned to store additional energy to make the system fully emissions-free.</p>		
Timeline of Project	2020-2023	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Norwegian Electrical Systems, Havyard Design, Havila	Geographical focus/location	Europe- Norway
Other companies/ stakeholders involved	Linde, PowerCell		
Public funding	Received NOK 104 million from Pilot-E Program		
Additional information	https://www.havyard.com/news/2018/granted-nok-104-million-to-develop-hydrogen-powered-coastal-route-vessels/		

Title	Heide refinery project: WESTKUESTE 100		
Short description including key deliverables	Companies involved in a hydrogen project at the Heide oil refinery near Hamburg will build a 30 megawatts (MW) electrolysis plant as a first step towards developing commercial-scale carbon-free energy. The size of the plant - at 30 MW - is a considered a game changer in the development of hydrogen as a fuel.		
Timeline of Project	2020 -	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	EDF, Orsted and Heide refinery	Geographical focus/location	Europe - Germany
Other companies/ stakeholders involved	Holcim, Open Grid Europe (OGE), Heide municipal utility, Thuega and Thyssenkrupp Industrial Solutions.		
Public funding	Received approval for 30 million euros in funding from the economy ministry		
Additional information	https://energy.economictimes.indiatimes.com/news/oil-and-gas/german-oil-refinery-to-build-30-mw-hydrogen-electrolysis-plant/77331548		

Title	Hellesylt Hydrogen Hub		
Short description including key deliverables	A consortium of leading players has joined forces to achieve zero-emission operations in the Geirangerfjord, one of two World Heritage Fjords in Norway. The hydrogen will be available at Hellesylt by producing green hydrogen locally from abundant and stranded power. The project will start its activities in January 2020 and aims to deliver green hydrogen latest by 2023. In addition, hydrogen will also be delivered to other vessels, trucks, buses and other vehicles in the region.		
Timeline of Project	2020 - 2023	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Flakk Gruppen	Geographical focus/location	Europe - Norway
Other companies/ stakeholders involved	Hexagon Composites, HYON, TAFJORD, Fiskerstrand, Gexcon, SINTEF and the local municipality of Stranda		
Public funding	The project was awarded PILOT-E funding from the Norwegian Research Council and Norway Innovation with a total of NOK 37.6m		
Additional information	https://fuelcellsworks.com/news/norway-hellesylt-hydrogen-hub-consortium-granted-nok-37-6-million-to-deliver-hydrogen-to-ferries-and-cruise-ships-in-the-geirangerfjord/		

Title	Hydrobingo		
Short description including key deliverables	<p>In a Joint Venture between Tsuneishi Facilities & Craft Co., Ltd (TFC) and CMB, a hydrogen powered ferry for the Japan inland waters will be designed and built in Onomichi, Japan. The vessel will be equipped with 2 dual fuel hydrogen - diesel combustion engines and will be capable of transporting up to 80 passengers. The cruise speed will be between 18-22kn, the maximum speed will be 27kn. The vessel is built within the 19GRT class. The hydrogen is stored inside a mobile trailer which can brought to the refuelling facility. With the roll on roll off (ro-ro) principle the trailer can easibly be exchanged.</p>		
Timeline of Project	Start Q2 2019 and the vessel will be launched Q4 2020	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Joint Venture of TFC and CMB	Geographical focus/location	Asia- Japan
Other companies/ stakeholders involved			
Public funding	No funding		
Additional information	https://www.cmb.be/en/new/cmb-and-tsuneishi-join-forces-to-build-a-hydrogen-powered-ferry		

Title	Hydrogen electrolysis plant, Port of Hamburg		
Short description including key deliverables	Germany has announced plans to construct the world's largest hydrogen electrolysis plant at the Port of Hamburg. The plant will run on electricity from wind turbines and would be able to produce about 22,000 cubic metres of hydrogen per hour, enough to power a passenger car for a range of 200,000 kilometres. Initially, the plant will produce energy for nearby factories, with the shipping anticipated as a user of fuels in the future. It will cost a three-digit million euro sum and will be funded with German and EU support. Seimens Gamesa have currently undertaken feasibility work on the potential size and requirements of the plant.		
Timeline of Project	Announced 2019	Fuel focus	Hydrogen
Type of project	Concept Study	Ship Size	
Lead partner	Port of Hamburg	Geographical focus/location	Europe- Germany
Other companies/ stakeholders involved	Industry alliance includes Audi and BMW, Siemens and energy supplier Bayernwerk		
Public funding	Awaiting EU funding, expected to receive a 3 figure		
Additional information	https://fuelcellsworks.com/news/hamburg-to-build-the-worlds-largest-hydrogen-plant-in-its-port/		

Title	Hydrotug		
Short description including key deliverables	<p>The Port of Antwerp signed a contract with CMB to build a tug powered by hydrogen, the first in the world. This unique "Hydrotug" is driven by combustion engines that burn hydrogen in combination with diesel. The motors also comply with the strict standards, the EU Stage V, making them the lowest-rated for emissions on the market. This ultra-low-emission tug chartered from Compagnie Maritime Belge (CMB), a pioneer in the field of hydrogen power for shipping. BeHydro will deliver the engines (2x2MW), which will be the first medium speed dual fuel hydrogen diesel engines to be installed on a ship for propulsion.</p>		
Timeline of Project	2020 - 2022	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	CMB	Geographical focus/location	Europe- Belgium
Other companies/ stakeholders involved	Port of Antwerp, ABC Engines, CMB.TECH		
Public funding	None found		
Additional information	http://www.cmb.be/en/new/a-world-first-project-the-hydrotug		

Title	Hyport- Green Hydrogen Plant, Ostend		
Short description including key deliverables	<p>The goal of the project is to have a plant operational in the port area of Ostend by 2025 that produces green hydrogen. This end product, green hydrogen, will both serve as an energy source for electricity, transport, heat and fuel purposes and as a raw material for industrial purposes. In the first phase of the process, the general feasibility will be further investigated and a development plan will be worked out. An innovative demonstration project with mobile shore-based power will then be started. A demonstration project with an innovative electrolyser of around 50 MW is also scheduled. By 2022, the roll-out of a large-scale shore-based power project, running on green hydrogen, will start.</p>		
Timeline of Project	2020 - 2022	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Port of Oostende, DEME Concessions and PMV	Geographical focus/location	Europe - Belgium
Other companies/ stakeholders involved			
Public funding	None found		
Additional information	https://www.deme-group.com/news/hyportr-green-hydrogen-plant-ostend		

Title	MAN Cryo marine fuel-gas system for liquefied hydrogen		
Short description including key deliverables	MAN Cryo (owned subsidiary of MAN Energy Solutions) has - in close cooperation with Fjord1 and Multi Maritime in Norway - developed a marine fuel-gas system for liquefied hydrogen. Multi Maritime's hydrogen vessel design was granted preliminary approval in principle, "AIP", by the DNV-GL Classification society in 2018. The award is significant in that the system is the first marine-system design globally to secure such an approval.		
Timeline of Project	2018	Fuel focus	Hydrogen
Type of project	Laboratory Test	Ship Size	
Lead partner	MAN Cryo	Geographical focus/location	Europe - Sweden
Other companies/ stakeholders involved	Fjord1, Multi Maritime		
Public funding	None found		
Additional information	https://www.man-es.com/company/press-releases/press-details/2018/12/05/man-cryo-takes-further-step-towards-cleaner-shipping-in-world-first-liquid-hydrogen-fuel-gas-system		

Title	Mongstad Industrial Park: production plant for liquid hydrogen		
Short description including key deliverables	Mongstad Industrial Park has been selected as the location for what could become Norway's first production plant for liquid hydrogen serving the maritime market. The first users of the hydrogen are envisaged to be two common goods carrier vessels under development by Wilhelmsen group. The consortium partners are in parallel developing solutions for storage and transportation to end users in the maritime sector. The project aims to make liquid hydrogen available for commercial shipping by early 2024.		
Timeline of Project	2019 - 2024	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	BKK	Geographical focus/location	Europe - Norway
Other companies/ stakeholders involved	Air Liquide, Equinor, Wilhelmsen, NorSea, Norled, Viking Ocean Cruises, NCE Maritime CleanTech, Arena Ocean Hyway Cluster, Mongstad Industrial Park and NORCE		
Public funding	Awarded a US\$3.24M grant by the Pilot-E scheme		
Additional information	https://maritimecleantech.no/2020/05/11/mongstad-selected-for-planned-hydrogen-production-plant-in-norway/		

Title	MOU between ABB and HDF		
Short description including key deliverables	<p>The MOU between ABB and hydrogen technologies specialist Hydrogène de France (HDF) envisages close collaboration on the assembly and production of the fuel cell power plant for marine applications. Building on an existing collaboration with Ballard Power Systems, the leading global provider of proton exchange membrane (PEM) fuel cell solutions, ABB and HDF intend to optimize fuel cell manufacturing capabilities to produce a megawatt-scale power plant for marine vessels. The new system will be based on the megawatt-scale fuel cell power plant jointly developed by ABB and Ballard, and will be manufactured at HDF's new facility in Bordeaux, France.</p>		
Timeline of Project	2020-	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	ABB, Hydrogène de France (HDF)	Geographical focus/location	Europe- France
Other companies/ stakeholders involved	Ballard		
Public funding	None found		
Additional information	https://new.abb.com/news/detail/60096/abb-brings-fuel-cell-technology-a-step-closer-to-powering-large-ships		

Title	Nedstack & OSD-IMT - worlds first hydrogen fuel cell powered tugboat		
Short description including key deliverables	Ship design and marine consultancy firm OSD-IMT and PEM Fuel Cell Market Leader Nedstack have joined to develop a concept design for a 65 tonnes bollard pull harbour tug, fully electric driven. The electric power for the propulsion motors is generated onboard by hydrogen fuel cells, creating a totally emission free tug.		
Timeline of Project	2019 - 2020	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	OSD-IMT and Nedstack	Geographical focus/location	Europe - The Netherlands
Other companies/ stakeholders involved			
Public funding	None found		
Additional information	https://nedstack.com/en/news/osd-imt-and-nedstack-join-forces-hydrogen-fuel-cell-powered-tug		

Title	NorthH2		
Short description including key deliverables	<p>Plan to establish 3 to 4 gigawatts of offshore wind capacity in the North Sea by 2030 purely for the manufacture of green hydrogen with the potential to expand to 10 gigawatts by 2040. As part of the project, Gasunine will also develop network infrastructure required for the storage and distribution of Hydrogen.</p> <p>Plan is to initially deliver hydrogen to industrial users in the Netherlands and Northwestern Europe. The project is inviting others to join the one-year feasibility study and ultimately development of a “European Hydrogen Valley” cluster.</p>		
Timeline of Project	2020 until 2030/2040	Fuel focus	Hydrogen
Type of project	Concept Study	Ship Size	
Lead partner	Shell	Geographical focus/location	Europe- The Netherlands
Other companies/ stakeholders involved	Gasunine, Port of Groningen, Equinor and RWE		
Public funding	Awaiting approval of funding		
Additional information	https://www.greentechmedia.com/articles/read/shell-exploring-worlds-largest-green-hydrogen-project		

Title	NYK Hydrogen-Powered Ferry		
Short description including key deliverables	<p>The Japanese consortium headed by NYK Line plans to develop and deploy a 100-passenger tour boat powered by electric batteries and hydrogen fuel cells. The project will begin a feasibility study for the project, followed by design work on the boat and its hydrogen fuel supply system in 2021. The project will entail the development of new shipboard technology, including the fuel supply system and an energy management system to combine power from the battery with power from the fuel cell.</p>		
Timeline of Project	2020 - 2024	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	NYK Line	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved	Toshiba, Eneos, ClassNK		
Public funding	None found		
Additional information	https://www.maritime-executive.com/article/nyk-leads-project-to-develop-hydrogen-powered-ferry		

Title	NYK Super Eco Ship 2050		
Short description including key deliverables	<p>NYK's Super Eco Ship 2050 plan is a concept design determining what a future zero emissions vessel might look like. "Together with MTI, the maritime R&D arm of NYK, and Elomatic, an engineering and consulting company based in Finland, we have taken advantage of advancements in hull remodeling, hull weight reduction, energy conservation, and digitalization to newly design an emission-free future concept ship."</p>		
Timeline of Project	Completed	Fuel focus	Hydrogen
Type of project	Concept Study	Ship Size	Large
Lead partner	NYK	Geographical focus/location	Asia-Japan
Other companies/ stakeholders involved	Elomatic		
Public funding	None found		
Additional information	https://www.nyk.com/english/csr/pdf/ecoship2050_en.pdf		

Title	Project H-Vision		
Short description including key deliverables	In H-vision sixteen parties, predominantly from the port of Rotterdam industrial area, collaborate in a detailed study to explore the large-scale production and application of blue hydrogen in the Rotterdam industrial area. The objective is supply decarbonized energy by replacing natural gas and coal with blue hydrogen. It is also studying how residual gases from the refining and chemical industry can be utilized to further enhance sustainability.		
Timeline of Project	2019-	Fuel focus	Hydrogen
Type of project	Concept Study	Ship Size	
Lead partner	Port of Rotterdam	Geographical focus/location	Europe- The Netherlands
Other companies/ stakeholders involved	Deltalinqs, TNO, Air Liquide, BP, EBN, Engie, Equinor, Gasunie, GasTerra, Linde, OCI Nitrogen, Port of Rotterdam authority, Shell, TAQA, Uniper and Koninklijke Vopak		
Public funding	None found		
Additional information	https://www.deltalinqs.nl/h-vision https://www.h-vision.nl/ (Page in Dutch)		

Title	Project MARANDA - a new fuel cell powertrain		
Short description including key deliverables	<p>In the MARANDA project, an emission-free hydrogen fuelled PEMFC based hybrid powertrain system is developed for marine applications and validated both in test benches and on board the research vessel Aranda. One of the major obstacles for wider implementation of fuel cells in the marine sector is the hydrogen infrastructure. To alleviate this problem, a mobile hydrogen storage container, refillable in any 350 bar hydrogen refuelling station will be developed in this project. The project will increase the market potential of hydrogen fuel cells in marine sector, which have for long lagged behind road transportation.</p>		
Timeline of Project	2017 - 2021	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	ABB OY	Geographical focus/location	Europe - Finland
Other companies/ stakeholders involved	Persee, Powercell AB Sweden, OMB SALERI SPA, SUOMEN YMPARISTOKESKUS, SWISS HYDROGEN SA		
Public funding	European Union through FCH JU: Grant agreement 735717 funding: 2,939,457.50 €		
Additional information	https://hydrogeneurope.eu/project/maranda		

Title	Project Seashuttle		
Short description including key deliverables	<p>The project seeking to bring emissions-free, autonomous container ships to market that also compete on cost is named 'Seashuttle'.</p> <p>Norwegian government has awarded €6 million to the 'Project SeaShuttle'.</p> <p>The project is expected to develop two all-electric ships slated to connect Poland, Swedish west coast ports and the Oslo fjord. The vessels will draw on state-of-the-art hydrogen fuel cells for their propulsion power.</p>		
Timeline of Project	2018-	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Samskip	Geographical focus/location	Europe- Sweden, Norway, Poland
Other companies/ stakeholders involved	FlowChange, Kongsberg Maritime, HYON, Massterly		
Public funding	Norwegian Government awarded 6 million EUR.		
Additional information	https://safety4sea.com/samskip-will-develop-autonomous-zero-emissions-containerships/		

Title	Shell - Solid Oxide Fuel Cell Pilot Project		
Short description including key deliverables	<p>Fuel cell technology is a high potential future technology that offers a significant efficiency benefit compared to today's maritime power sources. They can have an efficiency of over 60% when converting the chemical energy stored in the fuel to electricity. If the heat they produce is also harnessed, their overall efficiency in converting fuel to energy can be over 80%.</p> <p>Fuel cell technology is essential if hydrogen is to emerge as a future maritime fuel. ICE and gas turbine solutions are challenged when considering hydrogen and have limited scope to improve further in efficiency terms. The potential efficiency offered by SOFC technology is very attractive and can be available to shipping in the medium term if it is pursued now. SOFC technology is fuel flexible and can be developed using LNG as fuel and switched to use any one of the future fuels when they become available.</p>		
Timeline of Project	2020 - 2024	Fuel focus	Hydrogen
Type of project	Concept Study	Ship Size	
Lead partner	Shell	Geographical focus/location	Europe - United Kingdom
Other companies/ stakeholders involved	Ship owners, Classification societies, fuel vendors and integrators, port authorities, shipyards, end customers		
Public funding	No funding expected		
Additional information	https://www.shell.com/promos/energy-and-innovation/de-carbonising-shipping-setting-shells-course/_jcr_content.stream/1601385103966/709d83f692075a4f1880104fc5c-c466168e8a26a/decarbonising-shipping-setting-shells-course.pdf		

Title	SOHAR Port and Freezone Going Green		
Short description including key deliverables	SOHAR Port and Freezone plans to become the first green hydrogen hub in Oman by producing carbon-free green hydrogen using low-cost solar power to help fuel clean vehicles and cut onsite emissions. This new hydrogen hub should be mostly powered by several solar plants under development in the port's area. This plan envisages the deployment of around 3.5 GW of PV capacity, which is equivalent to the port's total electricity consumption		
Timeline of Project	2020 -	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	SOHAR Port and Freezone	Geographical focus/location	Asia - Oman
Other companies/ stakeholders involved	Port of Amsterdam, Hydrogen Rise AG		
Public funding	None found		
Additional information	https://www.pv-magazine.com/2020/11/04/solar-powered-hydrogen-generation-hub-in-oman/		

Title	The RH2INE collaboration		
Short description including key deliverables	RH2INE is taking the first step towards a zero-emission transport corridor by developing the right conditions and infrastructure for the use of hydrogen for the inland transport chain e.g. inland shipping, freight transportation by road and rail for the last mile. RH2INE will stimulate a targeted structural demand for hydrogen in the mobility sector, aligned with a sustainable hydrogen supply network.		
Timeline of Project	2020 - 2024	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Dutch Ministry of Infrastructure and Water Management	Geographical focus/location	Europe - The Netherlands, Germany
Other companies/ stakeholders involved	The collaboration include all the relevant regional ministries, the ports, several maritime companies		
Public funding	The EU Commission has granted the consortium 500,000 euros for further research into the project		
Additional information	https://www.rh2ine.eu/		

Title	ULSTEIN SX190 Zero Emission		
Short description including key deliverables	The ULSTEIN SX190 Zero Emission DP2 construction support vessel is Ulstein's first hydrogen powered offshore vessel, featuring a Nedstack fuel cell power system. The DP2 vessel can cater for a large variety of offshore support operations. This design uses proven and available technology, enabling clean shipping operations to reduce the environmental footprint of offshore projects. The vessel could be marked ready by 2022.		
Timeline of Project	2019 -	Fuel focus	Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Ulstein Design & Solutions BV and Nedstack fuel cell technology BV	Geographical focus/location	Europe - Norway, The Netherlands
Other companies/ stakeholders involved			
Public funding	None found		
Additional information	https://nedstack.com/en/news/zero-emission-operations-offshore-construction-market		

Title	Inland river Hydrogen-fueled demonstration ship as part of "Green Pearl River"		
Short description including key deliverables	<p>The hydrogen fuel cell demonstration ship is designed and developed by China State Shipbuilding Corporation as an important part of the special project of "Green Pearl River" in Guangdong Province. The ship is a 2,000-ton inland river self-unloading ship with a endurance of 140 kilometers. The 4x125kW proton exchange membrane hydrogen fuel cell is used as the main power source of the ship, and the 4x250kWh lithium battery pack is used for peak shaving compensation. Meanwhile, while the ship carries 35MPa high-pressure hydrogen cylinder group to store hydrogen fuel. At present, the overall technical design of the ship and the principle design of hydrogen- powered fuel cell system have been basically completed.</p>		
Timeline of Project	2020 - 2021	Fuel focus	Hydrogen and battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	The 605th Research Institute of Chinese State Shipbuilding Corporation	Geographical focus/location	Asia - China
Other companies/ stakeholders involved	the 712th Research Institute, the 718th Research Institute of the Chinese State Shipbuilding Corporation		
Public funding	No funding		
Additional information	http://www.gdasi.org.cn/index.php/xydt/1517.html		

Title	Norled Hydrogen Ferry		
Short description including key deliverables	In January 2019, Norled and the Norwegian Public Roads Administration signed an agreement for the world's first hydrogen-electric ferry after Norled won the development contract in competition with Fjord 1 and Boreal. The contract includes the development, construction and operation of the vessel where at least 50 percent of the energy requirement is covered by hydrogen.		
Timeline of Project	2019 -2021	Fuel focus	Hydrogen and battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Norled and Westcon the Norwegian Public Roads Administration	Geographical focus/location	Europe - Norway
Other companies/ stakeholders involved	Fjord 1 and Boreal		
Public funding	The vessel is one of two new ships that are part of the European innovation project Flagships. The EU granted EUR 5 million (USD 5.6 million) to Flagships to support deploying two zero-emission hydrogen fuel cell vessels in Norway and France.		
Additional information	https://www.offshore-energy.biz/norled-picks-westcon-to-build-worlds-1st-hydrogen-ferry/		

Title	Water-Go-Round		
Short description including key deliverables	When launched in late 2020 the Water-Go-Round will be the first fuel cell vessel in the US and the first commercial fuel cell ferry in the world. The Water-Go-Round will serve as a demonstration to the commercial, regulatory and global community at large. It will demonstrate that hydrogen fuel cell powertrains are perfectly suited for a broad range of maritime applications while offering a compelling business case for adoption.		
Timeline of Project	2020-	Fuel focus	Hydrogen and battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	GOLDEN GATE ZERO EMISSION MARINE	Geographical focus/location	North America - United States (California)
Other companies/ stakeholders involved	SW/TCH MARITIME, CALIFORNIA AIR RESOURCES BOARD, BAE, BAY AREA AIR QUALITY MANAGEMENT DISTRICT, HEXAGON COMPOSITES, HYDROGENICS CORPORATION, INCAT CROWTHER, MARSEC, PORT OF SAN FRANCISCO, RED AND WHITE FLEET, SANDIA LABS		
Public funding	Funding comes from California Climate Investments, a statewide program that puts billions of Cap-and-Trade dollars to work reducing greenhouse gas emissions, strengthening the economy and improving public health and the environment.		
Additional information	https://watergoround.com/		

Title	ZeFF - Zero-emission Fast Ferry		
Short description including key deliverables	The concept will be developed in a battery version for shorter routes and a hydrogen version for longer routes. The project that has received funding will also cover development of the supply chains needed for shore power and hydrogen. During 2019 the actors will develop, validate, analyse and get approval for all parts of the concept. The vessel shall be market ready in 2020.		
Timeline of Project	2018 - 2020	Fuel focus	Hydrogen and battery power
Type of project	Concept Study	Ship Size	Small
Lead partner	Selfa Arctic	Geographical focus/location	Europe - Norway
Other companies/ stakeholders involved	Norled, Servogear, HYON, LMG Marin		
Public funding	In December 2018 the ferry concept ZeFF (Zero Emission Fast Ferry) was awarded 10.5 MNOK from the public support scheme PILOT-E		
Additional information	https://maritimecleantech.no/project/zeff-zero-emission-fast-ferry/		

Title	Yara and Ørsted - Sluiskil plant		
Short description including key deliverables	<p>Yara and Ørsted plan to develop a 100 MW wind powered electrolyser plant for renewable hydrogen production, aiming to replace fossil-based hydrogen with renewable hydrogen for ammonia production in Yara's Sluiskil plant, located in the Dutch province of Zeeland. The renewable hydrogen would generate around 75,000 tons of green ammonia per year – approximately 10% of the capacity of one of the ammonia plants in Sluiskil – based on dedicated renewable energy supply from Ørsted's offshore wind farms. Ørsted is about to inaugurate its Borssele 1&2 offshore wind farm, the second biggest in the world, located off the coast of Zeeland close to the Sluiskil plant. The green ammonia is intended to be used in the production of carbon neutral fertilizer products, decarbonizing the food value chain, and also has potential as a future climate neutral shipping fuel.</p>		
Timeline of Project	2021 - 2024/25	Fuel focus	Hydrogen, Ammonia
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Yara and Ørsted	Geographical focus/location	Europe - The Netherlands
Other companies/ stakeholders involved			
Public funding	None found		
Additional information	https://splash247.com/yara-and-orsted-set-out-to-develop-green-ammonia-in-the-netherlands/		

Title	Power System As A Service		
Short description including key deliverables	<p>The project pilots a plug-and-play power system as a service concept, powering two zero emission vessels (a container ship and a supply ship). The concept makes it easy to replace energy systems, which is a response to the current situation with considerable uncertainty of the future of zero emission shipping. This project includes a port side infrastructure with bunkering system allowing multiple zero emission fuels, with cooperation on large-scale production of hydrogen, and a plug-and-play zero emission ship infrastructure, where fuel cell power systems, combustion engines (including for hydrogen and ammonia), battery containers and fuel containers (relevant for LH2, NH3 and CH2) can be replaced through plug-and-play connectors tied to a fully electric energy system.</p>		
Timeline of Project	April 2020 – December 2026	Fuel focus	Hydrogen, Ammonia, Biofuels
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Reederei NORD	Geographical focus/location	Europe - Germany, Norway
Other companies/ stakeholders involved	ABB, Hamburg Port Authority, Havstø, Sustainable Energy Catapult, DNV GL SE		
Public funding	Applied for EU funding		
Additional information			

Title	Electrofuels for Shipping Chile Concept Study		
Short description including key deliverables	<p>Concept study showing that Chile’s shipping industry could unlock investment in clean infrastructure worth up to \$90 billion if its ships were to stop using fossil fuels and instead use “green” ammonia and hydrogen made with renewable energy, according to a new study commissioned by Environmental Defense Fund and released at the UN climate talks. The report found that Chile's massive renewable energy production potential, coupled with its connection to the maritime industry, means that transitioning to e-fuels could have massive benefits for the Chilean economy.</p>		
Timeline of Project	Delivered End of 2019	Fuel focus	Hydrogen, Ammonia, Methanol/ethanol
Type of project	Concept Study	Ship Size	
Lead partner	EDF (Environmental Defense Fund)	Geographical focus/location	South America- Chile
Other companies/ stakeholders involved	Ricardo Consulting		
Public funding	None found		
Additional information	https://europe.edf.org/news/2019/10/12/electrofuels-shipping		

Title	Hafnium		
Short description including key deliverables	The project is a three-year project by Swire Pacific Offshore to investigate / prove the viability of radical decarbonisation through the use of H2-based Fuel / H2 Fuel Cells ("H2FC"). The project started in Q3 2018 with a desktop study, moving to later phases involving on-shore test-bedding and then if successful a pilot installation in one of the company's OSVs.		
Timeline of Project	2018 - 2021	Fuel focus	Hydrogen, Ammonia, Methanol/ethanol
Type of project	Laboratory test	Ship Size	Small
Lead partner	Swire Pacific Offshore	Geographical focus/location	Asia - Singapore
Other companies/ stakeholders involved	Maritime Energy and Sustainable Development Centre of Excellence ("MESD CoE") of Nanyang Technological University, Forum for the Future, Original Equipment Manufacturer/s		
Public funding	No funding		
Additional information	https://www.swirespo.com/spo_sd2019/project-hafnium.html		

Title	HYPORTR[®]Duqm		
Short description including key deliverables	<p>DEME Concessions and Omani partners are announcing an exclusive partnership to develop a world leading, green hydrogen plant in Duqm, Oman. The facility will significantly contribute to the decarbonisation of the regional chemical industry in Oman, as well as providing green hydrogen and/or derivatives (such as green methanol or ammonia) to international customers in Europe, for example in the Port of Antwerp. The envisaged electrolyser capacity for a first phase is estimated between 250 and 500 MW. Following this first phase, upscaling of the installation is foreseen. The advantage of the location in Duqm is the availability of cheap renewable energy (solar and wind), as well as large, accessible sites (on- and offshore).</p>		
Timeline of Project	Final investment decision 2021	Fuel focus	Hydrogen, Ammonia, Methanol/ethanol
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	DEME Concessions	Geographical focus/location	Asia- Oman
Other companies/ stakeholders involved	Port of Antwerp		
Public funding	None found		
Additional information	https://www.deme-group.com/news/deme-and-partners-present-hyportrduqm-large-scale-green-hydrogen-project-oman-1		

Title	ARK GERMANY Fuel Cell Test Ship Project		
Short description including key deliverables	<p>The project will upgrade one of DFDS 'freight vessels with an electrical infrastructure that makes it easy and cheap for fuel cell manufacturers to test up to 1 MW of fuel cells in real maritime environments. Manufacturers install their gear in a container that will be placed on the weather deck of ARK GERMANIA and connected to the ship's electrical grid. The fuel for the different types of fuel cells being tested will be placed in tank containers next to the fuel cells.</p>		
Timeline of Project	2020-	Fuel focus	Hydrogen, Battery power
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	DFDS	Geographical focus/location	Europe- Denmark
Other companies/ stakeholders involved	Blue Denmark, Danish Maritime Fund		
Public funding	None found		
Additional information	https://www.dendanskemaritimefond.dk/wp-content/uploads/2020/03/Fuel-cell-testing-moves-forward-on-Ark-Germania.pdf		

Title	HyShip project		
Short description including key deliverables	<p>The HyShip project involves 14 European partners collaborating on the design and construction of a new ro-ro demonstration vessel running on liquid green hydrogen (LH2), as well as the establishment of a viable LH2 supply chain and bunkering platform.</p> <p>The ship, to be named Topeka, will be built for zero emissions through a combination of 1,000 kWh battery capacity and a three-megawatt proton exchange membrane hydrogen fuel cell.</p> <p>It is slated to be operational from 2024 and will be operated by Wilhelmsen. It will also distribute LH2 to hydrogen hubs along the Norwegian coast.</p>		
Timeline of Project	2020 - 2024	Fuel focus	Hydrogen/Battery power
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Wilhelmsen	Geographical focus/location	Europe - Norway
Other companies/ stakeholders involved	Kongsberg Maritime, LMG Marin, Equinor, Norled, PersEE, Diana Shipping, Stolt-Nielsen Inland Tanker Service, Air Liquide, NCE Maritime CleanTech, DNV GL, ETH Zürich, Strathclyde University and Demokritos.		
Public funding	EUR8m (\$9.44m) from the EU's Research and Innovation programme Horizon 2020. 219 million Norwegian kroner (MUSD 25) by the Norwegian government-owned organisation Enova		
Additional information	https://splash247.com/hydrogen-fuelled-ship-project-secures-eu-funding/ https://vpoglobal.com/2020/12/22/wilhelmsen-awarded-nok-219m-for-hydrogen-project/		

Liquefied biogas/ **Synthetic methane**

Title	Bio2Bunker		
Short description including key deliverables	The project develops and expands a (Bio)-LNG (BLNG) bunkering supply chain by introducing three bunker barges in Zeebrugge, Rotterdam, and Lübeck. For the Amsterdam-Rotterdam-Antwerp region, Titan LNG will construct a mothership, the “Titan Hyperion” that will resupply the smaller vessels.		
Timeline of Project	July 2020-	Fuel focus	Liquefied biogas/ Synthetic methane
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Titan LNG	Geographical focus/location	Europe- The Netherlands
Other companies/ stakeholders involved			
Public funding	11 million EUR from EU Connecting Europe Facility		
Additional information	https://titan-lng.com/titan-lngs-ambitious-bio-lng-breakthrough-project-receives-eu-funding/		

Title	Wes Amelie Ship Conversion		
Short description including key deliverables	<p>The 2017-retrofitted ‘Wes Amelie’, a 1,036-TEU feeder container ship operated by Unifeeder, will become the first vessel in the World to run on Synthetic Natural Gas (SNG) generated by wind energy. MAN Energy Services, Wessels Marine, Unifeeder and Nauticor are cooperating on the SNG project, which will see ‘Wes Amelie’ use liquefied SNG produced from renewable electrical energy as a drop-in fuel.</p>		
Timeline of Project	2019-	Fuel focus	Liquefied biogas/ Synthetic methane
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Unifeeder	Geographical focus/location	Europe- Denmark
Other companies/ stakeholders involved	Wessels Marine, Nauticor, MAN Energy Solutions		
Public funding	None found		
Additional information	https://www.unifeeder.com/news-and-insights/wes-amelie-sng		

Methanol **and Ethanol**

Title	Waterfront Shipping - new methanol dual-fuel tankers		
Short description including key deliverables	Canada's Waterfront Shipping Company, a subsidiary of methanol producer and supplier Methanex Corporation, is adding eight new methanol dual-fuel tankers to its fleet. The eight 49,999dwt vessels have been ordered at South Korea's Hyundai Mipo Dockyard and are scheduled for delivery between 2021 and 2023. The vessels will feature MAN second-generation B&W ME-LGIM two-stroke dual-fuel engines, which can run on methanol or traditional marine fuels		
Timeline of Project	2020 - 2023	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Waterfront Shipping	Geographical focus/location	North America - Canada and Asia - South Korea
Other companies/ stakeholders involved	Hyundai Mipo Dockyard, Marinvest, MAN Energy Solutions, NYK, Meiji Shipping, KSS Line and MOL		
Public funding	None found		
Additional information	https://splash247.com/waterfront-shipping-orders-eight-methanol-powered-tankers-at-hyundai-mipo/		

Title	Stena Prosperous		
Short description including key deliverables	<p>Proman Stena Bulk has finalised an agreement to build an additional vessel under its joint venture partnership. The methanol-fuelled Stena Prosperous will join the Stena ProPatria and the Stena ProMare in the Proman Stena fleet in H2 2022. Each vessel will use 12,500 tonnes per annum of methanol as a marine fuel, significantly reducing emissions in their normal commercial operations compared to conventional marine fuels.</p>		
Timeline of Project		Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Proman and Stena Bulk Ltd	Geographical focus/location	Europe - Sweden, Switzerland
Other companies/ stakeholders involved			
Public funding	No funding		
Additional information	https://www.stenabulk.com/press-and-news/press-releases/proman-stena-bulk-promote-greener-shipping-future-additional-methanol		

Title	China Waterborne Transportation Research Institute- Methanol Testing		
Short description including key deliverables	China has launched a test aimed at investigating methanol as ship fuel. The goal is to create a set of guidelines and proposals for concrete policies aimed at helping the Chinese shipping sector use methanol as fuel for its ships.		
Timeline of Project	2020-	Fuel focus	Methanol/Ethanol
Type of project	Laboratory test	Ship Size	
Lead partner	Chinese Ministry of Transport	Geographical focus/location	Asia- China
Other companies/ stakeholders involved	Methanex, Shanghai Huayi Group, Methanol Institute		
Public funding	Undertaken by Chinese ministry of transport		
Additional information	https://bioenergyinternational.com/biofuels-oils/methanol-institute-joins-study-on-methanol-as-a-marine-fuel-in-china		

Title	Commercial scale CO2-to-methanol plant in Norway		
Short description including key deliverables	CRI has announced the joint development of a commercial e-methanol project in partnership with renewable energy and industrial companies Statkraft and Finnfjord. With a planned production capacity of 100.000 tons per year it represents the largest e-fuels project announced to date. The plant will use as raw material CO2 captured from the emissions of the Finnfjord ferrosilicon plant and hydrogen generated from the electrolysis of water using renewable electricity. It is one of the most energy-efficient ferrosilicon plants in the world and has a stated goal of becoming the first facility of its kind to achieve carbon neutrality. The partners now seek to capture and convert more than half of its emissions into methanol for fuel and chemical applications.		
Timeline of Project	2020 - 2021	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Carbon Recycling International	Geographical focus/location	Europe- Norway
Other companies/ stakeholders involved	Statkraft and Finnfjord		
Public funding	This project has received €1.8 million in funding from the European Union's Horizon 2020 Research and Innovation Programme		
Additional information	https://www.carbonrecycling.is/news-media/2020/10/23/commercial-scale-etl-plant-under-development-in-norway		

Title	Copenhagen Hydrogen and E-fuel production facility		
Short description including key deliverables	<p>Copenhagen Airports, A.P. Moller - Maersk, DSV Panalpina, DFDS, SAS and Ørsted have brought together the demand and supply side of sustainable fuels in a unique partnership with the concrete vision to develop a new ground-breaking hydrogen and e-fuel production facility. The first stage, which could be operational by 2023, comprises a 10MW electrolyser which can produce renewable hydrogen used directly to fuel buses and trucks. Stage two comprises a 250MW electrolyser facility which could be operational by 2027 when the first offshore wind power from Bornholm could be delivered. Stage three, which could be operational by 2030 when the offshore wind potential at Bornholm has been fully developed, would upgrade the project's electrolyser capacity to 1.3GW and capture more sustainable CO2, enough to supply more than 250,000 tonnes of sustainable fuels to be used in buses, trucks, maritime vessels and airplanes.</p>		
Timeline of Project	2020 -	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Copenhagen Airports, A.P. Moller - Maersk, DSV Panalpina, DFDS, SAS and Ørsted	Geographical focus/location	Europe- Denmark
Other companies/ stakeholders involved	COWI, BCG, City of Copenhagen, Nel, Haldor Topsøe and Everfuel		
Public funding	Awaiting funding, supported by public institutions		
Additional information	https://orsted.com/en/media/newsroom/news/2020/05/485023045545315		

Title	FASTWATER		
Short description including key deliverables	<p>A consortium of Europe's maritime research and technology leaders have launched the FASTWATER project to demonstrate the feasibility of retrofit and newbuild vessels to operate on methanol as a pathway to fossil-free shipping. The project aims to commercialise medium and high-speed methanol fuelled engines for shipping. Consortium members, including original engine manufacturers, shipyards, naval architects, ship owners/operators, port and maritime authorities, classification, fuel producers, and research institutes, will demonstrate feasibility on three vessels running on methanol fuel: a harbour tug, a pilot boat, and a coast guard vessel.</p>		
Timeline of Project	Start June 2020, pilot boat demo and harbour tug demo planned 2021	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Lund University	Geographical focus/location	Europe- Northern Europe
Other companies/ stakeholders involved	Lunds Universitet, Balance Technology Consulting GMBH, Anglo Belgian Corporation nv, Heinzmann GmbH & Co. KG, Havenbedrijf Antwerpen, Universiteit Gent, ScandiNAOS AB, SSPA Sweden AB, MEYER WERFT GmbH & Co. KG, Lloyds Register EMEA IPS, National Technical		
Public funding	Funded by Eu's Horizon 2020 programme under Grant Agreement No 860251 (4.9 million EUR)		
Additional information	http://www.fastwater.eu		

Title	GreenPilot Singapore		
Short description including key deliverables	<p>The project aims to evaluate methanol as a marine fuel in Asia. The first of the two-phase project includes desktop and bench-testing a methanol-powered engine in the GreenPilot program in Gothenburg, Sweden. The second phase will see the engine installed on-board a harbour craft vessel in Singapore for a six-month sea trial. Engine teardown will test clearances and material compatibility following. Data collected from the trials will be shared with official observers to improve the knowledge on methanol as a viable and efficient marine fuel</p>		
Timeline of Project	2019 -	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Nanyang Technological University	Geographical focus/location	Asia - Singapore
Other companies/ stakeholders involved	Methanol Institute, ScandiNAOS, Stena Line and Lund Technical University		
Public funding	No funding		
Additional information	https://www.einpresswire.com/article/472937200/nanyang-technological-university-brings-methanol-power-to-singapore-waters		

Title	HyMethShip		
Short description including key deliverables	The project will develop and test a system for marine propulsion that is capable of reducing CO2 emissions by more than 97%, using renewable methanol as the energy carrier and implementing pre-combustion carbon capture. The system will be demonstrated onshore at full scale.		
Timeline of Project	2018-	Fuel focus	Methanol/Ethanol
Type of project	Laboratory test	Ship Size	Large
Lead partner	LEC (Project Coordinator)	Geographical focus/location	Europe - Sweden, The Netherlands, Germany, United Kingdom, Austria, Belgium
Other companies/ stakeholders involved	Chalmers University of Technology, Colibri, Exmar Marine, Fraunhofer IKTS, INNIO Jenbacher, Graz University of Technology, HOERBIGER Wien, Lloyd's Register, MEYER Werft, MUW Screentec, SE.S, SSPA Sweden		
Public funding	Received € 8.4 million in funding from EU Horizon 2020 research and innovation programme		
Additional information	https://www.hymethship.com/		

Title	Jianglong methanol-fueled ship		
Short description including key deliverables	China's first methanol-fueled ship was developed and successfully tested in inland water. The ship is mainly used in commercial experiments and verification work, in the ship's fuel tank, fuel injection, ventilation, fire extinguishing, gas detection and alarm system and have accumulated a large number of test data and valuable practical experience.		
Timeline of Project	2019	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Jianglong Boat Technology Co., Ltd.	Geographical focus/location	Asia - China
Other companies/ stakeholders involved	Guangxi Yuchai Machine Co., Ltd., Tianjin University, Guangdong Yichang Lishi Machine Co., Ltd.		
Public funding	No funding		
Additional information	http://www.eworldship.com/html/2019/NewShipUnderConstruction_0724/151301.html		

Title	LeanShips: The potential of methanol as alternative fuel		
Short description including key deliverables	In this Demo Case, a high speed marine diesel engine has been converted with a methanol retrofit solution to dual-fuel operation in which the engine runs on both methanol and diesel to show case technologies for efficient and less polluting vessels with end-users' needs and requirements. The design requirements were to provide an easy and cost-effective retrofit solution that makes use of non-proprietary equipment, still providing full redundancy by enabling switching instantaneously between diesel and dual-fuel operation.		
Timeline of Project	2020	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Ghent University	Geographical focus/location	Europe - Belgium
Other companies/ stakeholders involved	Dredging International, Volvo Marine & Industry Center, Abeking & Rasmussen, Damen Shipyards and Methanex Europe		
Public funding	The project has received funding from the European Union's Horizon 2020 research and innovation programme (Contract No.: 636146) for € 15 752 357,97		
Additional information	https://www.leanships-project.eu/demo-cases/demo-case-05/overview/		

Title	LEO Coalition		
Short description including key deliverables	<p>Ship operators linking up with major customers to develop the new sustainable marine fuel LEO, a blend of lignin and ethanol. Copenhagen University is currently running the laboratory-scale development of this potential marine fuel. The project aims to move into phase II - testing the fuel on actual vessel engines - in the second quarter of 2020. Following a successful phase II, the scaling up of LEO fuel production will begin.</p>		
Timeline of Project	2020-	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Maersk	Geographical focus/location	Europe - Denmark
Other companies/ stakeholders involved	Wallenius Wilhelmsen, Copenhagen University, BMW Group, H&M Group, Levi Strauss & Co. and Marks & Spencer		
Public funding	None Found		
Additional information	https://www.maersk.com/news/articles/2019/10/29/maersk-join-forces-with-industry-peers-and-customers-to-develop-leo		

Title	North-C-Methanol		
Short description including key deliverables	<p>North-C-Methanol is the first large scale demonstrator project of North-CCU-Hub, which will be the largest renewable hydrogen-to-methanol complex in the world. It consists of an electrolyser plant with a power of 63 MW, splitting water in green hydrogen and oxygen, using renewable energy from off-shore wind. Oxygen will be used locally in the steel industry. Green hydrogen will be combined with captured CO₂, originating from industrial point sources, in a catalytic methanol synthesis plant with a production capacity of 45.000 ton methanol per year. The North-C-Methanol project will be the first implementation of the North-CCU-Hub Roadmap, followed by a North C upgrade to full scale of 300 MW electrolyser methanol and ammonia synthesis by 2028, and North C upgrade to extra large of 600 MW electrolyser methanol, ammonia and formic acid synthesis by 2030.</p>		
Timeline of Project	2020-2024	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Proman	Geographical focus/location	Europe - Belgium
Other companies/ stakeholders involved	The North Sea Port, PMV Doe-en Durfbedrijf, Mitsubishi Power, POM Oost Vlaanderen, Oiltanking, Fluxys, Engie, Arcelor Mittal, Alco Biofuels,		
Public funding	the government of Flanders through the PMV fund		
Additional information	https://northccuhub.eu/north-c-methanol/#The_NorthCMethanol_project		

Title	Power-to-Methanol Antwerp		
Short description including key deliverables	Construction of a demonstration plant at the INOVYN site in Antwerp is scheduled to start by 2022, with the aim of producing 8000 tonnes of sustainable methanol annually, thus avoiding at least an equivalent volume of CO2 emissions. This methanol will be produced from captured CO2 and sustainably generated hydrogen. The carbon dioxide is captured by means of Carbon Capture and Utilisation (CCU), through which CO2 emissions are partially recovered and then combined with hydrogen generated on the basis of green energy produced from renewable electricity. The project initially anticipates producing methanol for industrial processes, but anticipates making increased volumes available for water and road transport in future.		
Timeline of Project	Initiated 2020, next phase 2022	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Port of Antwerp	Geographical focus/location	Europe- Belgium
Other companies/ stakeholders involved	ENGIE, Fluxys, Indaver, INOVYN, Oiltanking, Vlaamse Milieu Holding		
Public funding	None found		
Additional information	https://newsroom.portofantwerp.com/new-milestone-in-sustainable-methanol-production-in-the-port-of-antwerp		

Title	Ship Carbon Recycling WG		
Short description including key deliverables	<p>The WG aims to explore the feasibility of the concept of utilizing methanation technology for zero-emission ship fuels. Through its activities, the WG aims to reduce greenhouse gas emissions to zero in sea transportation, which accounts for 99.6% of Japanese imports and exports, and thereby contribute to the formation of a sustainable society. Specifically, the nine companies listed above plan to assume carbon recycling supply chain of methanation fuel that involves the supply of feedstock CO2 from Japanese steel production, transportation of the feedstock, methanation, and conversion into marine fuel.</p>		
Timeline of Project	July 2020-	Fuel focus	Methanol/Ethanol
Type of project	Concept study	Ship Size	
Lead partner	Japan's Carbon Capture & Reuse (CCR) Study Group	Geographical focus/location	Asia- Japan
Other companies/ stakeholders involved	EX Research Institute Ltd., Hitachi Zosen Corporation, Japan Marine United Corporation, JFE Steel Corporation, JGC Corporation, Mitsui O.S.K. Lines, Ltd., Nippon Kaiji Kyokai(ClassNK), Nippon Steel Corporation, and Sanoyas Shipbuilding Corporation.		
Public funding	None found		
Additional information	https://www.mol.co.jp/en/pr/2020/20037.html		

Title	The FlagshipONE project		
Short description including key deliverables	Liquid Wind will now commence with engineering for FlagshipONE, its first e-methanol facility in Sweden, integrating proven technology from the consortium. E-methanol from the facility could be commercially available from 2023, assuming the investment decision is made and everything else goes to plan. Six initial facilities are planned for Scandinavia, Liquid Wind will then replicate the operation internationally to meet demand and significantly reduce carbon emissions. Each e-methanol facility will capture and recycle 70 000 tonnes of CO2 to produce 54 000 tonnes of e-methanol fuel, enabling a significant CO2 reduction.		
Timeline of Project	2020 - 2023	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Liquid Wind	Geographical focus/location	Europe- Sweden
Other companies/ stakeholders involved	Axpo Nordic, COWI, Carbon Clean Solutions, Haldor Topsoe, Nel Hydrogen and Siemens		
Public funding	EUR 1.7 million from InnoEnergy		
Additional information	https://bioenergyinternational.com/biofuels-oils/expert-consortium-comes-together-for-flagshipone-emethanol-project		

Title	The GreenPilot project		
Short description including key deliverables	<p>The GreenPilot project converted a pilot boat to operate on renewable methanol fuel, demonstrating the improvements to environmental and operational performance that can be achieved for this fuel.</p> <p>The conversion work involved adapting on-board systems, primarily fuel supply and safety, and replacing one of the vessel's two main engines with an engine converted to methanol operation. Two engines, a Weichai and a Scania SI, were converted by project partner ScandiNAOS to run on methanol using spark-ignited port injection technology. Both engines were tested on land and on the pilot boat.</p>		
Timeline of Project	2016-2018	Fuel focus	Methanol/Ethanol
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	SSPA	Geographical focus/location	Europe- Sweden
Other companies/ stakeholders involved	Swedish Maritime Technology Forum at RISE, ScandiNAOS, SSPA Sweden, Swedish Transport Administration, and the Swedish Maritime Administration		
Public funding	The project was co-funded by the Swedish Transport Administration, the Swedish Maritime Administration, and the Methanol Institute.		
Additional information	https://www.sspa.se/greenpilot		

Other

Title	CC-Ocean” (Carbon Capture on the Ocean) Project		
Short description including key deliverables	The marine-use CO2 capture demonstration plant will be based on an onshore plant and designed to capture a portion of a vessel’s gas emissions. This project will not only verify the efficacy of capturing and storing CO2 from a vessel’s gas emissions, but also the operability and safety of CO2 capture facilities at sea. The demonstration involves converting the design of an existing CO2 capture system for onshore power plant to marine environment, and installing on board the bulk carrier Corona Utility, currently in service for Tohoku Electric.		
Timeline of Project	2020 - 2022	Fuel focus	Other
Type of project	Demonstration in normal operations	Ship Size	
Lead partner	Kawasaki Kisen Kaisha (K Line)	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved	Mitsubishi Shipbuilding and Nippon Kaiji Kyokai (ClassNK)		
Public funding	The project is supported by the Maritime Bureau of Japan’s Ministry of Land, Infrastructure, Transport and Tourism (MLIT)		
Additional information	https://www.marinelink.com/news/k-line-trial-co-capture-481347		

Title	Felleskjøpet Agri and HeidelbergCement - Green Flow of Dry Bulk		
Short description including key deliverables	<p>Felleskjøpet Agri and HeidelbergCement aim for a sustainable transport system without emissions of greenhouse gases. The project combines two cargo owners' logistics between the east and the west of Norway, under the hypothesis that the total goods flow combined with long-term chartering contracts can make it possible to realise a zero-emission bulk carrier. HeidelbergCement and Felleskjøpet offer a long-term transport contract with a duration of up to 20 years, to facilitate the selected transport provider to invest in such a ship.</p>		
Timeline of Project	2019 - 2020	Fuel focus	Other
Type of project	Demonstration in normal operations	Ship Size	Small
Lead partner	Felleskjøpet Agri and HeidelbergCement	Geographical focus/location	Europe - Norway
Other companies/ stakeholders involved	<p>The owners of the project were the two cargo owners. Other stakeholders are Green Shipping Programme (GSP), ABB, Enchandia, Flowchange, Gasnor, Grieg Star, Hordaland Fylkeskommune, Hyon, Kongsberg Maritime, Kystverket, Kystrederiene (Roslagen Shipping and</p>		
Public funding	Public funding will be sought for both the development project and the financing of the ship.		
Additional information	<p>https://www.dnvgl.no/maritime/gront-skipsfartsprogram/HC-FKgreenbulk/index.html https://www.heidelbergcement.no/no/Utslippsfri_fraktskip https://www.tradewindsnews.com/bulkers/norwegian-shippers-open-tender-for-zero-emission-bulker-newbuildings/2-1-835206</p>		

Title	Stena Bulk - feasibility study carbon capture onboard vessels		
Short description including key deliverables	The project will demonstrate carbon capture onboard heavy-duty trucks and aims to provide research on a solution that might help shipping reach its IMO 2050 emissions reduction target. The project brings together the energy group's expertise in carbon capture technologies, carbon dioxide handling, and relevant infrastructure with Stena Bulk's shipping, trading, and naval engineering knowledge and experience in a feasibility study on carbon capture onboard ships while at sea.		
Timeline of Project	2020 - 2021	Fuel focus	Other
Type of project	Concept Study	Ship Size	Large
Lead partner	Stena Bulk	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved	Oil and Gas Climate Initiative (OGCI)		
Public funding	None found		
Additional information	https://www.offshore-energy.biz/stena-bulk-ogci-to-explore-potential-of-carbon-capture-in-shipping/		

Wind **Propulsion**

Title	The Oceanbird		
Short description including key deliverables	Oceanbird - the world's first wind powered PCTC concept. The oceanbird concept is being developed for really large vessels designed to transport large, heavy cargoes over long distance trips. Oceanbird shows that the maritime industry can bring about major change and that zero-emission shipping is possible, using wind as the main energy source. The first vessel will be a cargo ship, but the concept can be applied to ships of all types, such as cruise ships.		
Timeline of Project	2019 - 2022	Fuel focus	Wind Propulsion
Type of project	Concept Study	Ship Size	Large
Lead partner	Wallenius Marine	Geographical focus/location	Europe - Sweden
Other companies/ stakeholders involved	KTH Centre for Naval Architecture and maritime tech developer SSPA		
Public funding	The Oceanbird project is supported by the Swedish Transport Administration, also acting as a co-financier		
Additional information	https://www.oceanbirdwallenius.com/		

Title	Wind Challenger		
Short description including key deliverables	MOL and Oshima Shipbuilding Co., Ltd. have jointly obtained "Approval In Principle (AIP)" for the design of a hard sail system. The system converts wind energy to propulsive force with telescopic hard sail, and is a fundamental technology of the "Wind Challenger Project" that MOL and Oshima Shipbuilding are spearheading. The long-term goal is to develop a widely accepted solution to achieve the IMO target in combination with other measures to reduce GHGs by equipping vessels with multiple sails.		
Timeline of Project	2019 -	Fuel focus	Wind Propulsion
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Mitsui O.S.K. Lines, Ltd. Oshima Shipbuilding Co., Ltd.	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved	The University of Tokyo, Ouchi Ocean Consultant, Inc., Kanazawa Institute of Technology Innovative Composite Center, Tokyo Keiki Inc., Iknow Machinery Co., Ltd., Kansai Design Company, Ltd., GH Craft Ltd., ACT Co., Ltd., MOL Techno-Trade, Ltd.		
Public funding	The team has been chosen to receive "Subsidy for Next-generation marine environment-related technology research" by Ministry of Land, Infrastructure, Transport and Tourism.		
Additional information	https://www.mol.co.jp/en/pr/2019/19065.html		

Title	Wind Hunter		
Short description including key deliverables	<p>The "Wind Hunter Project" combines wind propulsion sailing technology and wind energy converted to generate a stable supply of hydrogen. As a first step, the project team will demonstrate feasibility study of such concept using a sailing yacht and verify the function and performance of a series of cycle operations, i.e., turbine power generation, hydrogen generation/storage and fuel cell related propulsion (refer to the conceptual diagram). The next step will be a demonstration using a larger vessel.</p>		
Timeline of Project	2020 -	Fuel focus	Wind Propulsion, Hydrogen
Type of project	Demonstration in normal operations	Ship Size	Large
Lead partner	Mitsui O.S.K. Lines, Ltd. (MOL)	Geographical focus/location	Asia - Japan
Other companies/ stakeholders involved	Ouchi Ocean Consultant, Inc., the National Maritime Research Institute (NMRI) of National Institute of Maritime, Port and Aviation Technology (MPAT), Smart Design Co., Ltd., Graduate School of Frontier Sciences of The University of Tokyo, West Japan Fluid		
Public funding	None found		
Additional information	https://www.mol.co.jp/en/pr/2020/20080.html		



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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 other committed to making commercially viable zero emission vessels a scalable reality by 2030.

The Getting to Zero Coalition is a partnership between the Global Maritime Forum, the Friends of Ocean Action, and the World Economic Forum.

