



Norwegian Government

Action Plan

The Government's action plan for green shipping





Contents

1	Introduction	9
1.1.	Climate targets and political ambitions	10
1.2.	Emissions from domestic shipping and fisheries	11
1.3.	New ambitions for emission cuts in the international shipping sector	12
1.4.	The Norwegian maritime industry	13
1.5.	An attractive shipping register	15
2	Technology and solutions for green shipping	19
2.1.	Zero- and low-emission solutions that are available	19
2.2.	More autonomous vessels	23
2.3.	How rapidly is the green transition taking place in the shipping sector?	25
3	Status, measures and instruments for the different vessel categories	31
3.1.	Scheduled passenger vessels and ferries	32
3.2.	Cruise ships and international passenger ferries	36
3.3.	Cargo vessels	38
3.4.	Offshore support vessels	42
3.5.	Specialised vessels including aquaculture service vessels	44
3.6.	Fishing vessels	46
3.7.	Recreational craft	48
4	Infrastructure for green shipping	51
4.1.	Green ports	51
5	Policy instruments for promoting green shipping	55
5.1.	Regulatory measures and requirements	55
5.2.	Taxation	58
5.3.	Funding agencies	59
5.4.	The NOx agreement and the NOx Fund	65
5.5.	Cooperation between the authorities and the business sector	66



Preface

The Government wishes Norway to make full use of the opportunities arising from the in greening of the economy. Norway will have to undertake a challenging process of fundamental transformation to meet its emission reduction commitments. The labour market will have to be green, smart and innovative. Norway must find cost effective ways of carrying out the transformation process and at the same time ensure that it provides growth opportunities for the Norwegian economy and boosts Norwegian exports of green solutions. Renewal of the Norwegian shipping sector will be an important driver of this process. Norway's maritime industry is a world leader in the development of low- and zero-emission solutions, and there are competitive companies in all segments of the industry.

The Government's ambition is to reduce emissions from domestic shipping and fisheries by half by 2030 and promote the development of low- and zero-emission solutions for all vessel categories. To achieve this ambition, it will be necessary to speed up the green transition in the shipping sector.

The introduction of stricter environmental requirements for international shipping by the International Maritime Organization (IMO) will result in growing global demand for environmental and climate technology in the years ahead. Norway's leading position in green shipping can become an important competitive advantage, giving the maritime industry huge growth potential in international markets. By developing new zero- and low-emission solutions for maritime transport, Norway can make an important contribution to global climate and environmental efforts.

The focus on green shipping will support Government ambitions in several areas. It is important for ensuring that Norway can meet its international climate commitments and its targets for emission reductions in the transport sector. It will also support regional policy by creating opportunities for growth and jobs all along the coast. And the development of Norwegian environmental technology with export potential is in line with Norway's industrial policy.

The Government's policy has been developed through close cooperation between the authorities and the industry. Good examples of this approach are cooperation on the Green Shipping Programme and the environmental agreement between the Norwegian state and business organisations on measures to reduce NOx emissions.

Representatives of relevant interest groups in the maritime industry and from the energy industry, ports and environmental organisations were invited to a meeting in November 2018 in order to obtain up-to-date input to this action plan. Many organisations and stakeholders also submitted written input, which was very useful during the preparation of the action plan.

The close cooperation between the authorities and the business sector will be of crucial importance as we begin a new chapter in efforts to create an even greener maritime industry.



Minister of Climate and Environment
Ola Elvestuen.

Photo: Bjørn H. Stuedal/Ministry of Climate and Environment



Minister of Petroleum and Energy
Kjell-Børge Freiberg

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Summary

The Government's ambition is to reduce emissions from domestic shipping and fishing vessels by half by 2030 and promote the development of zero- and low-emission solutions for all vessel categories. Norway is a world leader in the green transition for all shipping segments, but the pace of change must be increased substantially to achieve these ambitions.

Although the transition will be challenging, it will also open up new opportunities for the maritime industry. Norwegian companies are winning many of the contracts for new, sustainable solutions, and thus building expertise along the entire value chain for green shipping. The International Maritime Organization (IMO) has adopted a strategy including an ambition to reduce emissions from international shipping by at least 50 % by 2050 compared with the 2008 level. This will result in a growing market for companies that can provide zero- and low-emission technology and solutions.

The main approach in this action plan is to consider possible measures and policy instruments for different categories of vessels: scheduled passenger vessels and ferries, cruise ships and international passenger ferries, cargo vessels, offshore support vessels, specialised vessels including aquaculture service vessels, fishing vessels and recreational craft. There are considerable differences between these categories in fleet structure and operating patterns. This means that different measures will be needed to encourage the phase-in of zero- and low-emission solutions for the different segments.

The rapid phase-in of ferries with electric propulsion systems has been driven by requirements included in public procurement processes combined with grants, for example from Enova and the NOx fund, for technology development and for building charging infrastructure. The Government will promote the inclusion of requirements for zero- and low-emission solutions in future procurement processes for ferries and high-speed vessels.

In the revised national budget for 2019, the Government has proposed an allocation of NOK 25 million to promote the introduction of low- and zero-emission solutions for high-speed passenger vessels. The funding will be channelled through a temporary initiative under the 'Klimasats' grant scheme run by the Norwegian Environment Agency, and will provide support for counties that wish to acquire climate-friendly high-speed vessels. The Government will continue to work on a longer-term grant scheme for county authorities that includes requirements for low- and zero-emission solutions in procurement processes for high-speed vessels. When the revenue system for the county authorities is revised in future, the Government will take into account the higher costs that will be a result of requiring low- and zero-emission solutions for ferry and high-speed passenger services.

The Government will initiate a dialogue with relevant industry partners to discuss the possibility of drawing up a letter of intent concerning green renewal of the cargo fleet. This would be based on the main policy instruments already in use. Cooperation between many different parties will be necessary to make progress in the cargo segment. Shipowners, cargo owners and the public sector will have to work together to increase demand for green transport solutions. The Government will invite industry partners to take part in cooperation to develop such solutions.

Offshore support vessels account for roughly 23 % of Norway's emissions from domestic shipping. The industry has already started the process of phasing in green technology. The Government will consider the introduction of requirements to use zero- and low-emission solutions for new offshore support vessels to encourage more rapid phase-in than is being brought about by the carbon tax and existing grant schemes.

The Government will also consider requirements to introduce zero- and low-emission solutions for aquaculture service vessels.

In addition to action to reduce emissions from specific vessel categories, various instruments are already being used that are relevant across all segments. Enova, Innovation Norway, the Research Council of Norway and the NOx Fund all provide support for the development of new technology and of the necessary infrastructure. Instruments like the carbon tax, a lower electricity tax rate for commercial vessels and differential rates for port fees based on environmental grounds are making green solutions more competitive.

Since 2015, Enova has allocated more than NOK 1.6 billion to projects for different kinds of vessels. Of this, NOK 1.5 billion was for projects concerning vessels fitted with batteries or charging facilities for low- or zero-emission vessels using battery technology. Enova has provided support for vessels and projects in most segments of maritime transport. In addition, Enova has in the same period provided around NOK 500 million towards the development of shore power in Norwegian ports following competitive calls for proposals. In cooperation with municipalities and port authorities, the Government is aiming for Norwegian ports, wherever feasible, to be emission-free by 2030.

For 2019, allocations to Enova via the Green Fund for Climate, Renewable Energy and Energy Efficiency Measures have been increased by NOK 485 million. The Government intends to enter into a supplementary agreement with Enova for the new funding to be used to provide more funding to reduce emissions from commercial transport. The new scheme will include investment grants for both commercial vehicles and commercial vessels, and the plan is to put this into practice at an early date.

Increasing the use of biodiesel and biogas may be an important means of achieving the aim of halving emissions from domestic shipping by 2030. The Ministry of Climate and Environment has asked the Norwegian Environment Agency, in cooperation with the Norwegian Maritime Authority, to review the possibility and consequences of introducing a biofuel quota obligation for sustainable biodiesel and biogas for shipping. To ensure that such an arrangement has global climate and environmental benefits, advanced biofuels should be used, based on feedstock such as biological residues and waste.

An attractive ship register is important for Norway's position internationally and for the competitiveness of the Norwegian shipping industry. The Government will consider whether to introduce incentives for zero- and low-emission ships in the Norwegian ship registers (NIS and NOR). This could promote the implementation of environmental measures for ships in the existing Norwegian-flagged fleet and also encourage owners to register zero- and low-emission ships in the Norwegian registers. Incentives could include better services from the Norwegian authorities and financial advantages such as lower fees.

In order to keep up with market developments, the Norwegian Maritime Authority must have sufficient capacity to approve zero- and low-emission solutions and develop the necessary legislation. The same applies to the Norwegian Coastal Administration, which is responsible for facilitating the introduction of intelligent transport systems and autonomous vessels.

The Government will whenever feasible ensure the inclusion of requirements relating to zero-emission transport in public procurement processes. The Government will expand on how this can be done in the forthcoming action plan for green public procurement and green innovation.

Close cooperation between the authorities and the business sector has been of crucial importance in providing impetus, so that the green transition is already well under way in the maritime sector. This cooperation will also be vital to success in speeding up the process in the years ahead.





1

Introduction

Norway's target is to be a low-emission society by 2050. It will be a challenging task to achieve this, but the process will also open up opportunities. In the maritime sector, there will be opportunities for green value creation both within and outside Norway's borders. The Government will take steps to encourage the emergence of Norwegian winners during the green transition in the shipping sector. Norway will play a part in developing a sustainable shipping sector for the 21st century.

This action plan presents the Government's policy for cutting domestic greenhouse gas emissions, strengthening the Norwegian maritime industry and playing a part in the global technological developments needed for the world to achieve the targets of the Paris Agreement. Measures to reduce greenhouse gas emissions often result in cuts in emissions of other pollutants as well, for example sulphur (SO_x) and nitrogen (NO_x) emissions.

Norway is in a leading position globally as regards the deployment of zero- and low-emission technology in the maritime sector. By 2022, more than one third of the country's car ferries will use electric propulsion systems. The *Yara Birkeland* is due to be launched in 2020, and will be the world's first autonomous fully electric container vessel. The grocery wholesaler ASKO is planning to use autonomous vessels for emission-free transport of goods across the Oslofjord. The companies that have won the contract for the Norwegian coastal route Bergen–Kirkenes for the period 2021-2030 will have to ensure that their average annual emissions are at least 25 % below the 2015 level. The first hydrogen-powered car ferry will be put into operation in Norway in 2021, and this may prepare the way for longer range emission-free shipping.

Norwegian companies are already supplying zero- and low-emission technology to the world market, a market that may become much larger in the future. In 2018, the International Maritime Organization (IMO) adopted a strategy including an ambition to cut emissions from international

shipping by at least 50 % by 2050. The Norwegian Government will provide a framework that enables the Norwegian maritime industry to acquire experience and expertise that will put it in a good position to be an important supplier for the forthcoming restructuring of the global shipping sector.

This action plan is divided into five main parts. The first describes important elements of the general framework including Norway's climate targets, developments in the maritime industry and IMO's climate ambitions. The second discusses relevant technologies and solutions and introduces a 'green barometer' for monitoring the transition in the maritime sector. The third part contains an account of the different vessel categories and describes how the Government intends to accelerate the development of low- and zero-emission solutions.¹ The fourth part discusses infrastructure for green shipping, and the fifth and final part gives an account of the Government's policy instruments for promoting green shipping.

The action plan for green shipping was being prepared at the same time as two other plans that also form part of an integrated approach to a green transition in the transport sector. One of these is an action plan for public transport, which describes how the Government will achieve the target of fossil-free public transport by 2025. The second is about alternative fuels for the transport sector, and describes the Government's involvement in efforts to establish infrastructure for alternative transport fuels in order to promote a green transition in the sector.

1.1. Climate targets and political ambitions

The adoption of the Paris Agreement was a turning point in international climate cooperation. Through the agreement, the world's countries are aiming to limit global warming to well below 2 °C and are pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.

Norway's nationally determined contribution under the Paris Agreement is to reduce emissions by at least 40 % by 2030 compared with the 1990 level. The Government is working towards joint fulfilment of this target with the EU. In its political platform, the current Government announced that Norway will submit a more ambitious target for 2030 to the UN in 2020, and that emissions that fall outside the scope of the EU Emissions Trading System (EU ETS) are to be reduced by 45 % by 2030 compared with the 2005 level. The Government's aim is to achieve this target through domestic emission reductions, and it is making plans to this end. If strictly necessary, Norway can make use of the EU flexibility mechanisms.

The Government's target is for Norway to be a low-emission society by 2050. This target has been made legally binding in the Climate Change Act, which specifies that the target means reductions of greenhouse

¹ The vessel categories used and their descriptions are based on a report produced by DNV GL as input to this action plan. DNV GL, 2019 Barometer for grønn omstilling av skipsfarten [Barometer for the green transition in the shipping sector]. Report no.: 2019-0080.

gas emissions of the order of 80–95 % compared with 1990. In the Government's political platform, the undertaking that Norway will be a low-emission society by 2050 was further strengthened by setting out an ambition to reduce greenhouse gas emissions by 90–95 %.

The Government's policy platform also includes the ambition of halving emissions from domestic shipping and fisheries by 2030, which will involve promoting the use of low- and zero-emission solutions in all vessel categories. This is the first time the Government has specified a separate emission target for the shipping sector. Although the transition to a green shipping sector is well under way, the pace of change must be increased substantially to achieve this ambition.

1.2. Emissions from domestic shipping and fisheries

Emissions from domestic shipping and fishing vessels are included in Norway's commitments under the Paris Agreement. Domestic shipping is defined as shipping between two Norwegian ports, including Svalbard and installations on the Norwegian continental shelf.

According to Norway's emission inventory, emissions from domestic shipping and fishing vessels were estimated at 2.95 million tonnes equivalents (CO₂-eq) in 2017.² In addition, there are emissions from recreational craft, estimated at about 530 000 CO₂-eq. These emissions are included in the category 'other transport' in the emission inventory. Together, greenhouse gas emissions from domestic shipping, fishing vessels and recreational craft account for about 22 % of emissions from the transport sector.

There is considerable uncertainty as regards the true level of greenhouse gas emissions from domestic shipping and fishing vessels. This is partly because a number of ships that sail between Norwegian ports bunker fuel abroad, whereas estimates of emissions from domestic shipping are based on registered sales of fuel in Norway only.

This means that the actual emissions from domestic shipping are not fully reflected in the emission statistics. DNV GL was commissioned by the Norwegian Coastal Administration to compile information on shipping along the Norwegian coast using AIS data combined with information from databases containing specific information on individual vessels.³ This makes it possible to estimate emissions from shipping along the Norwegian coast.

There is a considerable difference between the results obtained by the two methods. DNV GL's estimate based on AIS data is 4.8 million tonnes CO₂-eq in 2017.⁴ This is about 1.8 million tonnes higher than the estimate

2 <https://www.ssb.no/en/natur-og-miljo/statistikker/klimagassn/aar-endelige>

3 AIS stands for Automatic Information System. Data from AIS Norway, run by the Norwegian Coastal Administration, provides real-time information on vessel movements: https://www.kystverket.no/en/EN_Maritime-Services/Reporting-and-Information-Services/Automatic-Identification-System-AIS/

4 DNV GL, 2019 *Barometer for grønn omstilling av skipsfarten* [Barometer for the green transition in the shipping sector]. Report no.: 2019-0080.

used in Norway's emission inventory. Emission estimates based on AIS data indicate a certain rise in emissions from domestic shipping and fishing vessels in recent years, whereas the figures in Norway's emission inventory indicate a downward trend in emissions from 2012 to 2017. IMO uses AIS data as a basis for preparing statistics on emissions from shipping.

In this action plan, AIS data is used to disaggregate greenhouse gas emissions by vessel category. However, it is important to remember that Norway's emission reduction commitments are based on the emission inventory from Statistics Norway. A project is under way involving cooperation between Statistics Norway, the Norwegian Coastal Administration and the Norwegian Environment Agency to investigate how AIS data can be used to provide a better understanding of actual greenhouse gas emissions from domestic shipping and fishing vessels. This is also in line with the recommendations of the committee appointed to consider measures to reduce emissions from the fisheries, which submitted its report in spring 2019.

1.3. New ambitions for emission cuts in the international shipping sector

The international shipping sector is about to undergo the greatest change in its recent history. For the first time, the world's countries have reached agreement on drastic cuts in greenhouse gas emissions from shipping. In April 2018, IMO adopted a strategy for reducing greenhouse gas emissions from international shipping, which sets the level of ambition of reducing emissions by at least 50 % by 2050 compared with the level in 2008. The overall vision is to phase out greenhouse gas emissions from the industry as soon as possible in this century.

In addition, the IMO strategy includes ambitions to improve the energy efficiency of each ship and to reduce the carbon intensity of the whole sector by reducing emissions per unit of transport work done by at least 40 % by 2030 and further towards 70 % by 2050.

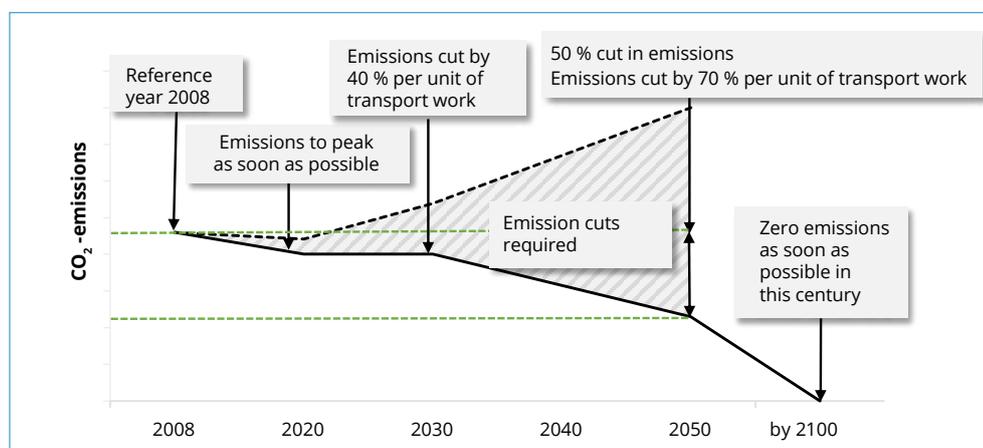


Figure 1: IMO's vision and levels of ambition for greenhouse gas emissions. The dotted line shows the projected emission trend under a business-as-usual scenario. The solid line shows an emission trajectory in line with IMO's strategy.

IMO's strategy is now being translated into concrete action. It will be a very challenging task to combine continued growth in international shipping with a 50 % reduction in emissions. Even stricter rules for energy efficient design of new ships can be expected, together with requirements for energy-efficient operation of all ships. In addition, a large proportion of maritime transport must switch to fossil-free fuels to achieve the 2050 ambition for emission reductions.

IMO's decision will change the entire framework for the maritime industry. The Maersk Group, which includes the world's largest container shipping company, Maersk Line, recently announced its own target of making its fleet carbon-neutral by 2050.⁵ As major stakeholders formulate ambitions on this scale, the global market for zero- and low-emission solutions in the shipping industry is likely to grow rapidly in the years ahead.

Although it will be challenging to achieve IMO's ambitions, the process will also provide new growth opportunities in international markets. Norwegian shipyards and suppliers of services and equipment will be able to draw on experience and expertise from a domestic market developed at an early stage, and could be in a good position to make use of these opportunities.

Norway's approach in the development of IMO's environmental protection rules

Norway is playing a leading role in the green transition in international shipping. Its international efforts are based on three main priorities:

1. Norway intends to be a driving force in efforts to strengthen IMO's environmental protection rules, and will promote the adoption of Norwegian innovations as the international standard. Norway chaired the negotiations that resulted in the climate strategy adopted by IMO in April 2018.
2. Norway will pursue an ambitious national policy for the development of low- and zero-emission solutions with global potential. Some countries must lead the way to ensure that the global targets are achieved, both to demonstrate possibilities and to develop technology that has a potential for global diffusion.
3. Norway will use aid funding to assist developing countries to make the necessary changes in their shipping sectors. NOK 10 million has been allocated for this purpose in the 2019 budget, and Norway plans to increase its efforts in the years ahead.

The Government will give priority to maintaining Norway's leading role in international negotiations, both in IMO and in other relevant cooperation forums. Norway will seek to ensure the establishment of good global solutions that will make it possible to achieve ambitions for emission reductions.

⁵ <https://www.maersk.com/news/2018/12/04/maersk-sets-net-zero-co2-emission-target-by-2050>

1.4. The Norwegian maritime industry

Norway has an internationally leading maritime industry, including shipping companies, maritime services, shipyards and equipment suppliers. The maritime industry is crucially important for settlement, value creation and employment, particularly in rural parts of Norway. There are maritime companies and strong clusters all along the coast, from Finnmark in the north to Østfold in the south east. The sector is strongly specialised in high-tech market segments.

In 2018, the Norwegian maritime industry employed around 85 000 people and value added in the sector was NOK 142 billion. This means that the maritime industry accounted for 8 % of value added in Norway and 17 % of total Norwegian exports.⁶ There is considerable overlap between value added generated by the maritime industry and other ocean industries, particularly the oil and gas industry, but also the seafood industry. The maritime industry is Norway's second largest export industry after oil and gas. Norway is the world's seventh largest shipping nation measured by number of vessels, and the ninth largest measured in terms of gross registered tonnage. Norway was also the fifth largest shipping nation measured by fleet value in 2017. The Norwegian fleet includes a large proportion of advanced, specialised vessels.



Figure 2: Value added in the maritime sector in 2018.

Norwegian shipping companies are represented in all segments, including offshore, deep sea and short sea shipping, fisheries and aquaculture and passenger transport. Shipping companies depend on a wide range of maritime service industries in areas such as financial and legal services, port and logistics services, technological services and trade.

The maritime industry is focusing strongly on the development and testing of technologies for green shipping and zero- and low-emission technologies. Procurement processes for ferries that are part of the public roads system and the development of electric ferries have opened up new opportunities for Norwegian maritime equipment suppliers. High-tech solutions for autonomous vessels and green shipping constitute one of the industry's most important competitive advantages internationally. The proportion of ships using zero- and low-emission technology is growing.

⁶ Figures from *Maritim verdiskapingsrapport 2019* [Report on maritime value added in Norway in 2018] <http://s3-eu-west-1.amazonaws.com/maritimt-forum.no/documents/2019-Maritim-verdiskapingsbok.pdf>

Norwegian maritime equipment suppliers export more than two-thirds of their production to shipyards, shipping companies and maritime companies in other countries. Norwegian shipyards and shipping companies also make a further indirect contribution to exports of Norwegian equipment through the export of ships and services. The growing focus on the development of green solutions and digitalisation is an important driver of developments in maritime equipment in Norway.

Norway is one of few high-cost countries that still have a shipbuilding industry. Norwegian ships are very advanced and use cutting-edge technology, which is an important competitive advantage for the shipyards. However, Norwegian shipyards are not as competitive in less advanced segments such as traditional cargo vessels and fishing vessels. The shipyards, which were mainly building offshore support vessels a few years ago, have restructured and are now building a wider variety of vessels including wellboats, fishing vessels, aquaculture service vessels and passenger and cruise ships (see Figure 3).

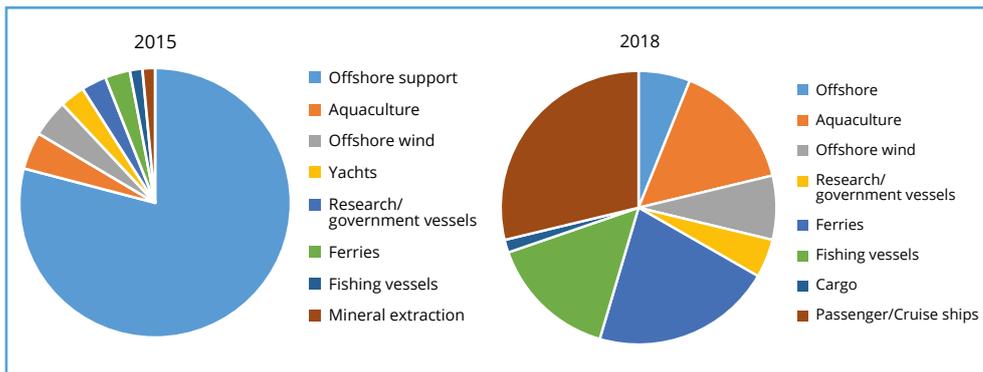


Figure 3: Vessel types on the order books of Norwegian shipyards in 2015 and 2018.

The Norwegian maritime industry is influenced by and responds to international drivers such as economic growth and oil prices. The drop in oil prices in 2014 resulted in a challenging market situation for companies with links to the offshore segment. It has severe effects on shipowners, shipyards and equipment suppliers. At present, rising oil prices, an expected increase in oil and gas investments and growing demand in freight markets are influencing the demand for products and services from the maritime industry. Provided that the shipyards and supplier industry adapt successfully, the prospects for the maritime industry in 2019 are good.

The maritime industry is a priority area of the Government's industrial policy. The Government has taken steps to provide a stable framework for the industry. Green shipping is one of eight priorities in the Government's 2015 maritime strategy. Access to expertise is of crucial importance in developing and maintaining the capacity of the Norwegian maritime industry for generating value added and its competitive position.

1.5. An attractive shipping register

An attractive shipping register is important for Norway's position internationally and for the competitiveness of the Norwegian shipping industry. The overall framework, including costs and the services and expertise available, is of crucial importance when a shipping company is deciding where to register its fleet. Cooperation between the Norwegian Maritime Authority and the industry, and the Authority's involvement in projects to develop new technology, are important in building a strong Norwegian flag. A larger fleet sailing under the Norwegian flag also gives Norway greater influence on the development of international rules, and bolsters Norway's opportunity to play a leading role in the development of stricter IMO climate and environmental rules.

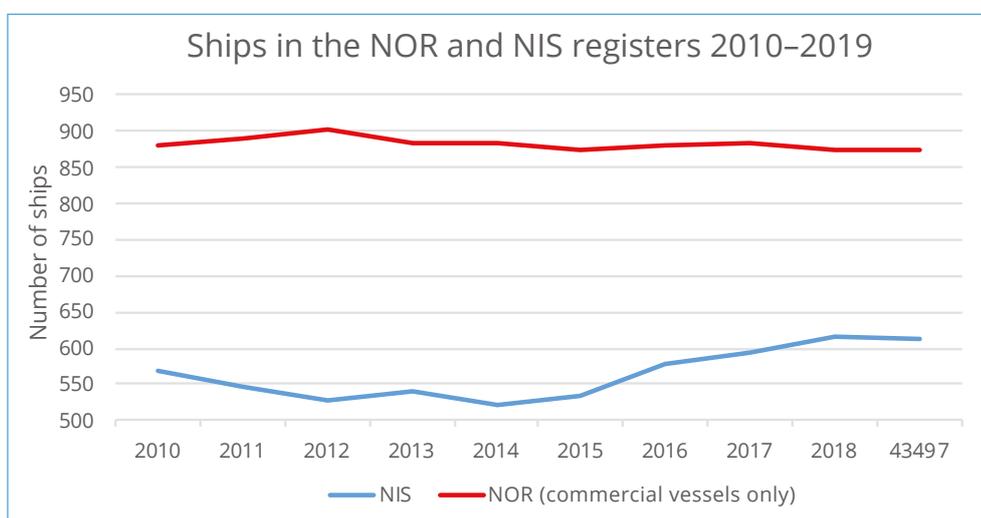


Figure 4: Ships in the Norwegian shipping registers

The Norwegian Maritime Authority is responsible for ensuring that there are predictable, effective processes for approving and certifying ships that use innovative climate and environmentally friendly technology. The Government will consider whether to introduce incentives for zero- and low-emission ships in the NIS and NOR ship registers. The aim would be to promote the implementation of environmental measures for the existing fleet under the Norwegian flag and also encourage owners to register zero- and low-emission ships in the Norwegian registers. Incentives could include better services from the Norwegian authorities and financial advantages such as lower fees. Some flag states have already introduced arrangements of this kind.⁷ Introducing incentives for zero- and low-emission ships in the Norwegian registers would promote the Norwegian flag as a leader in the green transition in the shipping sector internationally. The details of an incentive programme will need to be further reviewed in cooperation with the relevant authorities.

⁷ Two of the world's largest ship registers, Liberia and the Marshall Islands, have introduced discounts for Green Award-certified ships.

The Government will:

- Pursue its ambition of reducing emissions from domestic shipping and fishing vessels by half by 2030
- Promote the deployment of zero- and low-emission solutions in all vessel categories
- Promote further green growth and boost the competitiveness of the Norwegian maritime industry and facilitate an increase in exports of low- and zero-emission technology in the maritime sector
- Ensure that the Norwegian ship registers are in a strong competitive position, so that owners choose to sail under the Norwegian flag
- Consider whether to introduce incentives for zero- and low-emission ships in the Norwegian ship registers (NIS and NOR)
- Play a leading role in IMO's work on reducing greenhouse gas emissions
- Strengthen cooperation with IMO on assistance to developing countries in their efforts to prevent marine pollution and reduce greenhouse gas emissions from ships





2

Technology and solutions for green shipping

Various zero- and low-emission solutions have been developed and deployed in the shipping sector in recent years. The most suitable fuels and technical solutions depend on the vessel type. The choice of technology will depend particularly on ship size and operating patterns. There are also differences in which solutions can be used for existing and new ships. Developments have taken place particularly quickly in the ferry segment, but the proportion of zero- and low-emission solutions is still limited in most vessel categories. With the technology available today, zero- and low-emission solutions are often considerably more costly than diesel-powered vessels. A clear and ambitious green shipping policy at both national and international level will encourage further technology development, which in the long term will help to reduce the costs of the new technologies.

2.1. Zero- and low-emission solutions that are available

Battery-electric operation

With current battery technology, all-electric solutions are suitable for relatively short routes where frequent recharging is possible. Battery solutions are suitable for ferries. Electrification of the ferry fleet is already well under way, and many ferries will be replaced in the next few years. By 2022, it is expected that around 80 ferries will run partly or entirely on batteries.

Various types of workboats and crew transfer vessels for use in the aquaculture industry are also good candidates for battery-electric operation. DNV GL has carried out a study for the Norwegian Seafood Federation and Energy Norway which shows that a substantial proportion of aquaculture service vessels can be electrified at relatively moderate

cost.⁸ The Yara Birkeland project shows that full electrification may be a possibility in the cargo vessel segment on certain short, regular routes. It is also proving possible to operate some sightseeing vessels on a fully electric basis.

Partial electrification (battery hybrids)

Substantial cuts in emissions from most vessel categories can be achieved by various forms of battery hybridisation. The offshore sector was one of the first to start using ships with battery technology, often in combination with liquefied natural gas (LNG). Battery hybrid solutions have already been installed or are to be installed on more than 20 supply ships. In the aquaculture sector, hybrid well boats, fish feed barges and service boats can be used to reduce CO₂ emissions and at the same time improve operational reliability.

Battery hybridisation is also a possibility for international passenger ferries. The Color Line and Hurtigruten shipping companies are both planning this solution for their exploration ships. The companies that have been awarded contracts for the Bergen–Kirkenes coastal route from 2021 will largely be using ships running on a combination of natural gas and batteries.

Battery hybridisation may be a cost-effective solution for some cargo ships, particularly many general cargo ships that have a variable operational profile, with frequent calls at port and loading and unloading operations that require a substantial amount of energy.

Propulsion solutions based on battery hybridisation can also improve the environmental profile of larger ocean-going vessels, for example ships belonging to the Coast Guard and Norwegian Coastal Administration and research vessels. A new Coastal Administration vessel, the *OV Ryvingen*, started operations in 2019. This is a multipurpose battery hybrid vessel that will be used for maintenance of shipping lanes and in oil spill response operations. The capacity of its battery pack is about twice that of the fully electric car ferry *MF Ampere*. Greenhouse gas emissions from the *OV Ryvingen* will be 35 % lower than from the first multipurpose vessels. When the ship has access to an onshore power supply, the reduction may be up to 70 %.

Battery hybridisation will also be an option for fishing vessels, particularly the smaller types. Norway already has one fishing boat that runs on electricity during fishing operations, and a number of battery-hybrid fishing boats have also been built.

Hydrogen

In the longer term, it will be possible to use hydrogen to replace fossil fuels for shipping, particularly in segments where battery-electric solutions

⁸ https://www.energinorge.no/contentassets/ef7f99cb7a954aa99393156203f764ad/fullelektrisk-fiskeoppdrett_endeligversjon.pdf (In Norwegian only.)

are difficult to use or inappropriate. Examples are vessels that have high energy needs or sail long distances between ports, and segments where there are constraints in terms of weight and options for energy storage.

Initially, the vessel types that are suitable for hydrogen trials are ferries, high-speed vessels and other ships that are used on scheduled routes, particularly routes between a small number of ports. From 2021, Norled AS will be operating a hydrogen-electric ferry in Rogaland. If hydrogen fuelling infrastructure is developed in areas where there is a high density of other shipping, this may make hydrogen a more attractive option for other types of ships sailing in the same areas.

Vessels sailing under the Norwegian flag must be approved by the Norwegian Maritime Authority before they are taken into use. An effective approval process must be established for the commercialisation of hydrogen solutions. The necessary legislation will have to be developed in parallel with technology development and testing. At present, the cost of using hydrogen as a fuel is considerably higher than for conventional solutions, and this is the main barrier to implementation of hydrogen as a shipping fuel.

It will also be important to share knowledge throughout the value chain, from shipping companies and shipyards to the supplier industry. Knowledge and experience gained from publicly funded hydrogen projects should be made publicly available. This will make it possible to pool experience across the maritime industry, thus reducing the barriers to wider use of hydrogen.

The Government will develop an integrated strategy for hydrogen as an energy carrier, including research, technology development and scaling up solutions. It will include the use of hydrogen in the maritime industry.

Hydrogen and shipping

A number of funding instruments have been established that can be used to accelerate the development and production of hydrogen technology. Funding is available from Enova and the PILOT-E scheme, and innovation contracts can also be used to promote hydrogen phase-in in various segments of the domestic shipping fleet. With support from Innovation Norway's Arena Programme, the association Hub for Ocean has recently established the Ocean Hyway Cluster. This is for companies in the maritime sector, the energy sector and technology suppliers, and aims to realise maritime hydrogen solutions.

The third call for proposals under the PILOT-E scheme in 2018 focused on emission-free maritime transport and climate-neutral industry. Six ambitious and innovative projects have received grants totalling NOK 107 million. Three of the projects involve hydrogen technology:

- Selfa Arctic AS and Flying Foil AS are each heading a consortium

to develop solutions for high-speed vessels that improve energy efficiency and make it possible to use propulsion systems based on batteries or fuel cells.

- The Havyard Group ASA is heading a project to achieve emission-free operations in the World Heritage Fjords and along parts of the coastal route Bergen–Kirkenes by combining batteries and hydrogen fuel cells.
- Samskip AS is leading a project to develop and realise profitable container transport by sea using hydrogen fuel cells for emission-free propulsion, making it possible to transfer goods from road to sea.

Ammonia

Ammonia is another fuel with a potential for maritime use. However, the technology for maritime use is immature, and widespread use will not be possible for some time.

Like hydrogen, ammonia is carbon-free and will give zero-emission operations. As for hydrogen, emission reductions throughout the life cycle of the fuel depend on how it is produced. Currently, ammonia is largely produced from natural gas by means of energy- and emission-intensive processes. However, it is possible to produce ammonia from renewable sources by electrolysis.

One advantage of ammonia is that it can be liquefied and its energy density is considerably higher than that of hydrogen. In the long term, it will be possible to use ammonia both in fuel cells and in internal combustion engines. Engine manufacturers report that the first engines adapted to use ammonia could be on the market within three years.⁹ There are difficulties that need to be overcome before ammonia can be safely and effectively used as a fuel; it is toxic, and there are challenges related to its combustion characteristics and corrosive nature. Legislation governing the use of ammonia on ships will have to be developed.

Liquefied natural gas (LNG)

Emissions of NO_x , SO_x and particulate matter from maritime transport can be considerably reduced by using LNG. In addition, CO_2 emissions are lower than from diesel operations. However, different types of LNG engines are used in different shipping segments, and the real reduction in greenhouse gas emissions may be considerably lower because of the presence of unburnt methane (CH_4) in the exhaust gas. Methane is a potent greenhouse gas, and the level of emissions varies with the type of LNG engine technology used. The actual reduction in greenhouse gas emissions is very small for most LNG ships operating in Norwegian waters today.¹⁰

⁹ <https://www.ammoniaenergy.org/man-energy-solutions-an-ammonia-engine-for-the-maritime-sector/>

¹⁰ Lindstad E., Torstein I. B. (2018), Potential power setups, fuels and hull designs capable of satisfying future EEDI requirements, Transportation Research Part D: Transport and Environment, Volume 63, August 2018, side 276-290.

An improvement in performance with respect to greenhouse gas emissions is expected with new generations of engines. Given the expected technological advances, DNV GL considers that a reasonable estimate of the average reduction in emissions up to 2040 is 12 %. If LNG is combined with batteries, methane emissions are considerably reduced, and it is estimated that this would allow greenhouse gas emissions to be reduced by about 20 %.¹¹ The LNG engines that give the greatest emission reductions relative to conventional fuels are most suitable for deep-sea shipping and less so for short-sea shipping.

LNG may be of particular interest for vessel categories that have large energy needs and sail long distances between ports, for example cruise ships, cargo ships and offshore support vessels. There are currently 32 cruise ships using LNG as fuel on the order books, about one quarter of the total.

Biodiesel and biogas

Using a greater proportion of biofuels in marine fuels would reduce emissions from shipping. To ensure global climate and environmental benefits, advanced biofuels should be used, based on feedstock such as biological residues and waste.

Biodiesel can be blended with marine diesel and used in existing ships' engines up to a certain percentage that depends on the quality and type of biodiesel used. However, biodiesel may to a varying extent have negative long-term effects on ships' engines, and storage and transport may present challenges. This applies particularly if lower-quality biodiesels are used in blending, typically conventional biodiesel.¹²

Liquefied biogas (LBG) can directly replace or be mixed with LNG using existing infrastructure and engine technology. This will reduce greenhouse gas emissions and local air pollution. There are still substantial barriers to the introduction of biogas relating to availability, infrastructure and price, but Hurtigruten has announced that it will introducing LBG as one fuel for the ships sailing the coastal route Bergen–Kirkenes.¹³ Biogas produced from various types of wet organic waste, including waste from the fishing industry, is an important resource that can also solve a waste problem.

Energy efficiency measures

To achieve reductions in emissions from shipping, it is also important to make further improvements in their energy efficiency. This applies both to ship design and to ship operation. Important measures may include minimising hull resistance, improving the energy performance of the main and auxiliary engines, and reducing speed. Substantial cuts in emissions can also be achieved by improving logistical efficiency and through digitalisation and automation.

11 DNV GL (2018): Analyse av tiltak for reduksjon av klimagassutslipp fra innenriks skipstrafikk [Analysis of measures to reduce greenhouse gas emissions from domestic shipping].

12 <http://www.miljodirektoratet.no/Documents/publikasjoner/M1125/M1125.pdf> (In Norwegian only.)

13 <https://www.hurtigruten.co.uk/about-us/press/press-page---mynewsdesk/#/pressreleases/hurtigruten-to-power-cruise-ships-with-dead-fish-2799848>

Low- and zero-emission ships

In the reports DNV GL provided as input to this action plan, *low-emission ships* were defined as vessels with greenhouse gas emissions at least 40 % lower than those of ships using conventional technology. This can be achieved using hybrid propulsion systems, for example partial electrification or LNG intermixed with biogas. Such reductions can also be achieved by a combination of technical and operational measures (for example optimisation of the hull, propellers and propulsion machinery, lower speed or more automated control systems).

Zero-emission ships were defined as vessels with greenhouse gas emissions at least 95 % lower than those of ships using conventional technology. This is not possible to achieve using fossil fuels. Possible solutions include battery propulsion and hydrogen fuel cells.

2.2. More autonomous vessels

Autonomous vessels will become increasingly important in the shipping industry. More autonomous ships will generally have various positive climate and environmental effects. Improvements in energy efficiency and optimisation of operations are some of the main benefits. The design of autonomous vessels can also be made more aero- and hydrodynamic to reduce wind and water resistance. In combination, these factors will allow autonomous vessels to be highly energy efficient and have low fuel consumption. This will make it possible for example to electrify more ships, and they will be able to operate for longer distances using electric propulsion.

The Government has been encouraging the development of autonomous technology and its use in ships for a number of years. Enova has provided grants of NOK 133 million for the construction of the *Yara Birkeland*, an autonomous electric container ship, and recently granted NOK 119 million for development of the AutoBarge design for the grocery wholesaler ASKO.

The Ministry of Transport has put forward proposals for amendments to the Pilotage Act to pave the way for autonomous navigation in coastal waters. The Norwegian Maritime Authority takes part in all relevant projects at national level involving autonomous ships and that require certification of these vessels. The Norwegian Coastal Administration assesses possible test beds for autonomous ships on an ongoing basis, and the Maritime Authority and the Coastal Administration are both important partners for the industry.

The Norwegian Maritime Authority and the Norwegian Coastal Administration are playing an active part in work on autonomous ships within the International Maritime Organization (IMO). The Norwegian Forum for Autonomous Ships was established in 2016. This is a forum for individuals and organisations established in Norway who are interested in autonomous and unmanned ships. It is an important arena for the exchange of information and cooperation between authorities, research groups and the private sector.

Norwegian authorities with responsibility for green shipping

The Norwegian Maritime Authority is the administrative and supervisory authority for the legislation on ship safety and security and ship-related environmental legislation. The Authority takes part in the development of new technology and approves and certifies new, green technologies and ships.

The Maritime Authority adopted the first rules for LNG-fuelled ships in 2003, and has also approved battery systems and solutions that make it possible to use methanol safely on board ships. The Authority also led efforts to incorporate rules on new green fuels into international legislation under IMO.

The Norwegian Coastal Administration is responsible for maritime safety and the preparedness and response system for acute pollution in Norwegian waters. The Coastal Administration owns, operates and develops maritime infrastructure, pilotage services and traffic monitoring services that ensure safe and efficient maritime transport.

The Coastal Administration is also the authority for the ports, which have a key role to play in the green transition in the shipping sector. In addition, the Coastal Administration can make use of instruments such as differentiating rates of maritime safety fees on environmental grounds and innovative procurement. The award-winning Coastal Administration vessel *OV Ryvingen* is a multipurpose vessel with state-of-the-art green technology.¹⁴

The Government will take steps to ensure that the Norwegian Maritime Authority and the Norwegian Coastal Administration have adequate expertise and capacity relating to new climate friendly technology for shipping. This will be of crucial importance in avoiding bottlenecks in the approval of new ships and the development of legislation during the transition process.

For more information about the Norwegian Directorate for Civil Protection, see its website: <https://www.dsb.no/menyartikler/english/>.

2.3. How rapidly is the green transition taking place in the shipping sector?

AIS data from the Norwegian Coastal Administration show that almost 7 000 ships sailed in Norwegian waters in 2017. Of these, just over 1 000 ships spent at least 80 % of their time in Norway's exclusive economic zone (EEZ). DNV GL was commissioned by the Ministry of Climate and Environment to survey the technology status of different vessel categories in this domestic fleet.

¹⁴ <https://www.kystverket.no/Nyheter/2018/november/miljopris-til-kystverkets-nye-fartoy/> [In Norwegian only]

The results of the survey can be considered as a 'green barometer' of the speed of change in the shipping industry. The barometer shows the status for implementation of low- and zero-emission technology in the current fleet and what changes are expected in the next few years, based on the order book for the Norwegian fleet.

Figure 5 shows that the proportion of low- and zero-emission vessels is very modest at present. In 2017, the domestic fleet included 49 LNG ships and 16 ships with batteries installed, most of them in the categories scheduled passenger vessels and ferries and offshore support vessels. Only one of the vessels with batteries installed in 2017 was all-electric (the car ferry MF Ampere), the rest being hybrids and plug-in hybrids.¹⁵ Most plug-in hybrids operate almost entirely on electricity under normal circumstances provided that there is adequate charging infrastructure. According to DNV GL, only modest reductions in the overall greenhouse gas emissions from shipping are currently being achieved using battery and LNG vessels.

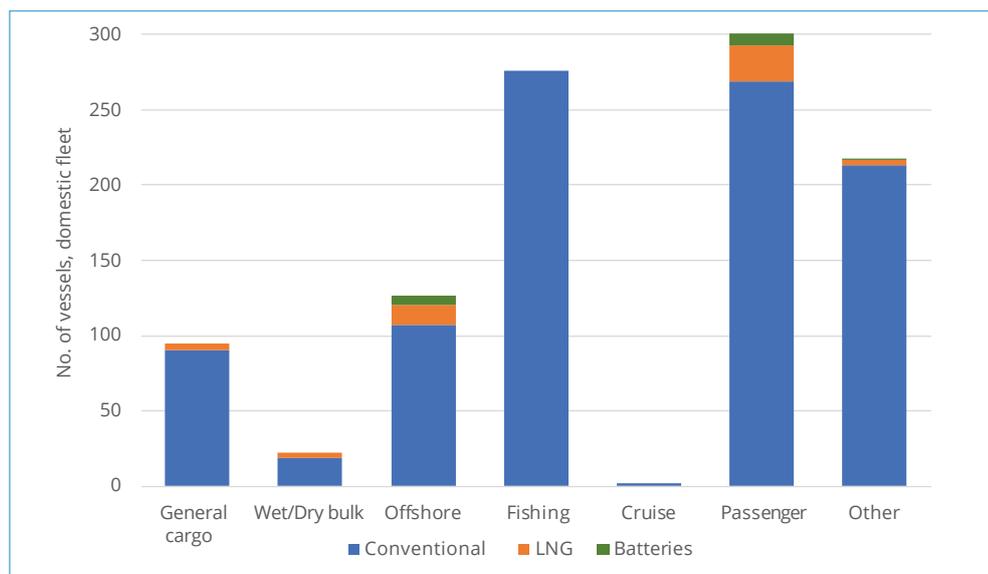


Figure 5: Technology status of the Norwegian domestic fleet (vessels that are in Norwegian waters more than 80 % of the time) in 2017.

¹⁵ Several new zero-emission vessels were taken into service in 2018, including *Future of the Fjords*, which is used for sightseeing trips between Flåm and Gudvangen.

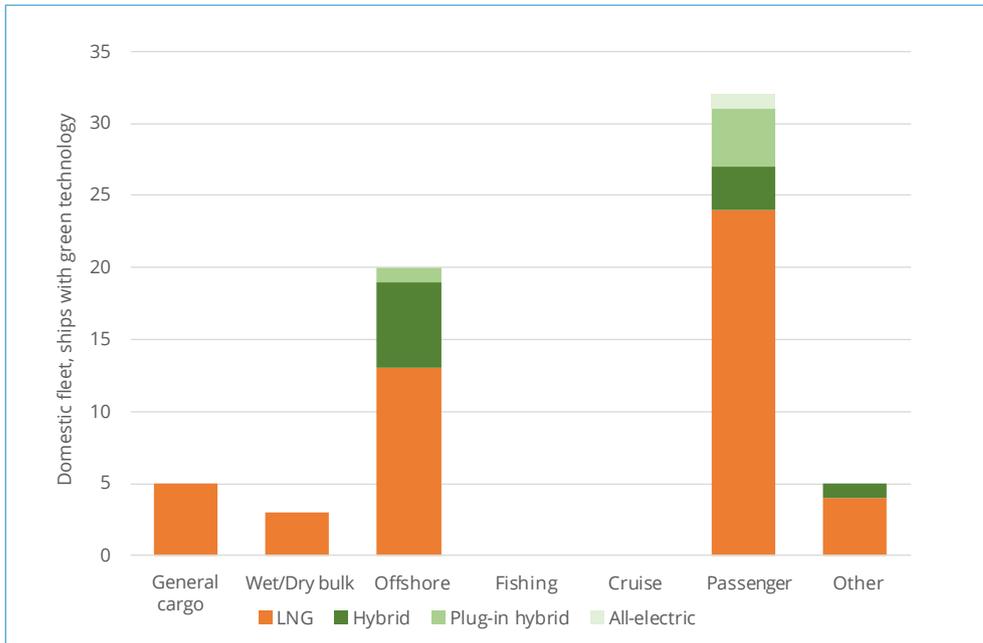


Figure 6: Number of ships equipped with zero- and low-emission technology or LNG/gas propulsion, split by category.

However, ships on the order book at the end of 2017 included a significant proportion equipped with low- and zero-emission technology. Based on information from the global order book, DNV GL estimated that 277 of the ships being built were expected to sail in Norwegian waters.¹⁶ Of these, 187 were classified as conventional, 70 were to be equipped with batteries and 13 were LNG-fuelled. In addition, seven battery-LNG hybrids were on order. These figures include retrofitting of batteries in LNG-fuelled ships. In all, LNG- and battery-propelled vessels accounted for almost half of the ships on order.

Most scheduled passenger vessels and ferries on the order book were to be equipped with low- or zero-emission technology (LNG or battery propulsion), see Figure 7. There was also a substantial proportion of vessels with battery technology in the offshore support and fishing vessel segments. Most vessels in these segments were to be partially electrified, with battery power being used to improve energy efficiency (for areas including spinning reserve and peak shaving). For cargo vessels, the order book largely contained vessels with conventional technology.

¹⁶ The order book for conventional ships is based on the global order book for all ships over 100 GT (IHS Markit World Register of Ships), filtered to find ships that are relevant for Norwegian waters (the method is further described in the report from DNV GL). The order book for 'green ships' is taken from DNV GL's Alternative Fuels Insight portal (<https://afi.dnvgl.com>).

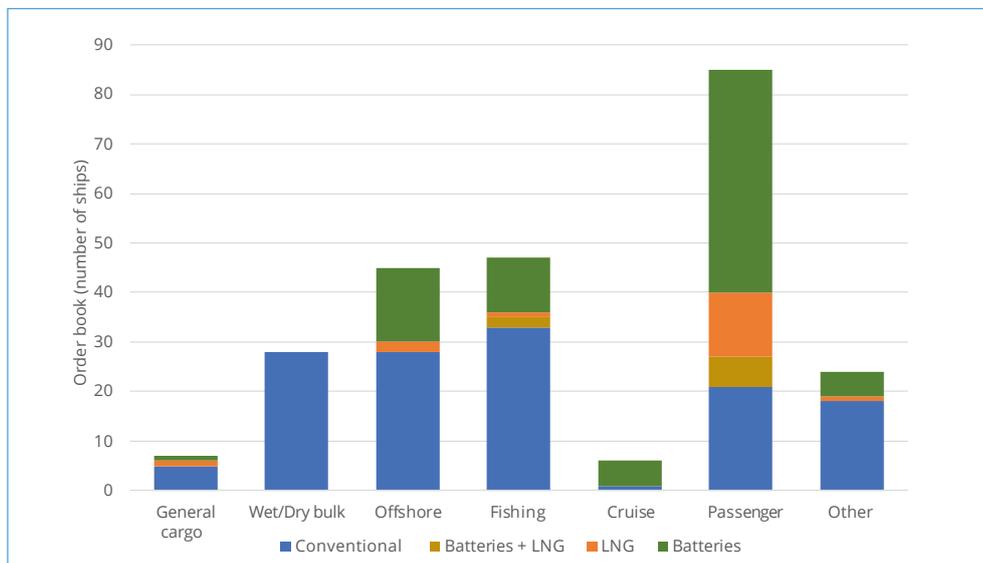


Figure 7: Order book at the end of 2017 for vessels to be operated in Norwegian waters, split by vessel category and type of technology.

The order book indicates that a transition is well under way for several vessel categories, but that there are still more orders for conventional ships than for other types. Although new ships with conventional propulsion technology will be more energy efficient than the existing fleet, the present rate of change will not be sufficient to halve emissions from domestic shipping by 2030. To achieve Norway’s national climate targets, it will be necessary to develop scalable zero- and low-emission solutions for more vessel categories.

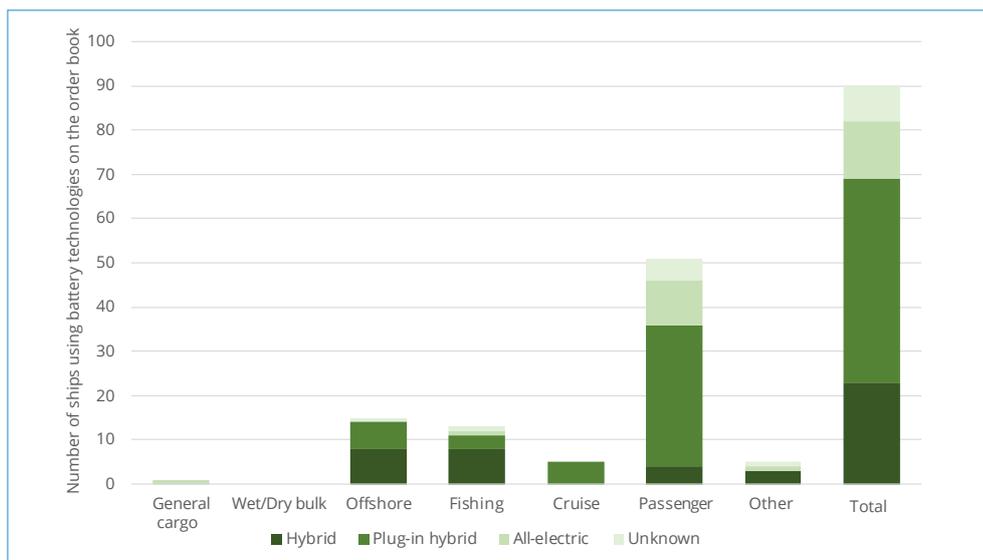


Figure 8: Order book for ships to be equipped with zero- and low-emission technology to be operated in Norwegian waters, split by type of technology.

Further development of a green barometer for shipping

DNV GL's survey of the technology status of the domestic fleet provides a good starting point for further development of a green barometer for shipping. This will be a useful tool for monitoring the deployment of low- and zero-emission solutions over time, and for measuring progress towards climate and environmental targets.

There is considerable potential for developing and improving the barometer. For example, its scope can be expanded to include other measures and technologies such as biofuels, hydrogen, sail technology and energy efficiency measures. In the case of ships using battery technology, it may be useful to distinguish between more or less fully electric operation and ships where batteries are used to improve energy efficiency.

For the moment, there is considerable uncertainty associated with the estimated figures for ships on the order book. This can be reduced through cooperation with industry organisations such as the Maritime Battery Forum, the Norwegian Shipowners' Association, Kystrederiene and the Maritime Forum. In the long term, it would be useful if the barometer could include ripple effects of the technology transition, for example exports of green technology and value added for shipyards and suppliers of equipment. The Norwegian Coastal Administration maintains a webpage that provides as much information as possible on the available infrastructure for low- and zero-emission fuels for maritime transport.¹⁷

The Ministry of Climate and Environment will in cooperation with relevant authorities such as the Norwegian Maritime Authority and the Norwegian Coastal Administration assess the need for further development of the green barometer for shipping.

The Government will:

- Ensure that the Norwegian Maritime Authority and the Norwegian Coastal Administration have sufficient capacity and expertise in new solutions for green shipping, including the development of legislation on the use of hydrogen in maritime industries
- Present an integrated hydrogen strategy including action to promote the use of hydrogen in the maritime sector where appropriate
- Facilitate the use of intelligent traffic systems and autonomous coastal navigation
- Further develop a green shipping barometer in cooperation with relevant authorities

¹⁷ <https://lavutslipp.kystverket.no/en>





3

Status, measures and instruments for the different vessel categories

The Government's green shipping policy is designed to promote market change that allow zero- and low-emission solutions to become profitable. Many of the ships that are built in the next few years will probably have a lifetime of at least 20–25 years. Without strict requirements for environmental performance and action to promote zero- and low-emission solutions, investment decisions made today may result in lock-in to an industry structure that will make it difficult to achieve the climate targets for both 2030 and 2050.

In this action plan, ships sailing in Norwegian waters have been divided into seven different categories. There are considerable differences between these categories in the types of transport for which they are used, where they operate and the age of the fleet. The emission reduction potential therefore also varies from one category to another. The policy instruments needed to trigger the implementation of technical, operational and fuel-related measures will also differ between vessel categories.

The vessel categories used and the descriptions of the categories are based on a report DNV GL provided as input to this action plan.¹⁸ As explained in Chapter 1.2, emissions from the different categories were estimated on the basis of AIS data from the Norwegian Coastal Administration. Using AIS data, total emissions from domestic shipping and fishing vessels in 2017 were estimated at about 4.8 million tonnes CO₂-eq.

18 DNV GL, 2019 *Barometer for grønn omstilling av skipsfarten* [Barometer for the green transition in the shipping sector]. Report no.: 2019-0080.

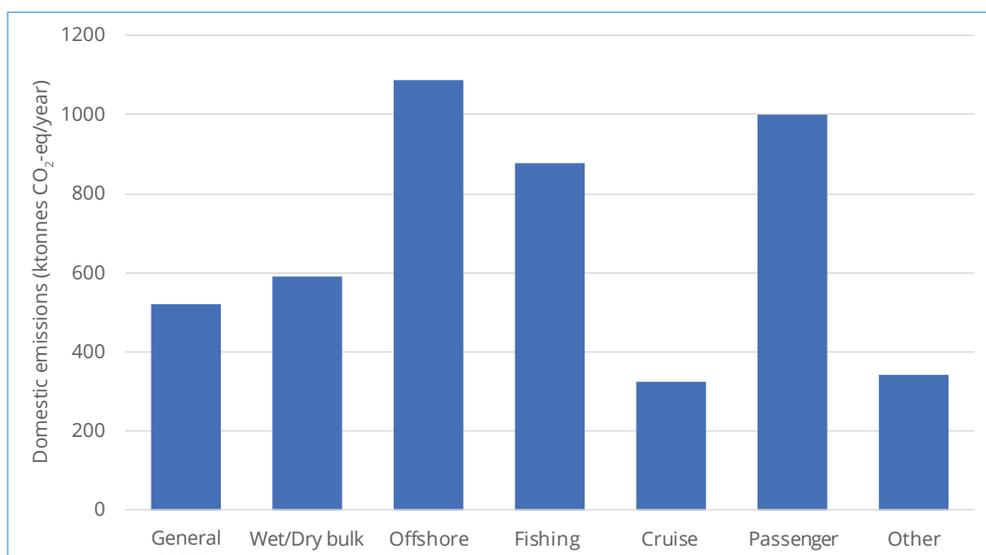


Figure 9: Domestic emissions from shipping and fishing vessels, split by vessel category. Estimates are given in ktonnes CO₂-eq, based on AIS data for 2017.

3.1. Scheduled passenger vessels and ferries



Since 2013, the MF Ampere, the world's first battery-propelled ferry, has provided a service across the Sognefjorden between Lavik and Oppedal. Photo: Norled

Scheduled maritime passenger services are an important part of the transport system in Norway. They include ferries and high-speed vessels providing scheduled domestic services, and also the coastal route Bergen–Kirkenes (see Table 1). In addition, various other types of passenger services such as fjord cruises are included in this category.

There are currently around 140 ferry services in Norway. They include 17 services that are part of the national road system, which means that the central government is responsible for procurement of the services through the Norwegian Public Roads Administration. The rest are part of the county road system, and procurement of the services is the responsibility of the county authorities. In all, 203 passenger and car ferries are in operation in

Norway. In addition, the county authorities operate about 100 high-speed services along the entire coastline.

The coastal route Bergen–Kirkenes is currently operated by Hurtigruten, which normally uses 11 specific ships for the service, but has occasionally used other ships from its fleet. From 2021, Hurtigruten Cruise will share the operation of the coastal route with Havila Kystruten.

Table 1: Scheduled passenger vessels and ferries in 2017.

Sub-category	No. of ships	Average age (years)	Average size (GT)	Domestic emissions (ktonnes CO ₂)	Share of total domestic shipping emissions
Ferries	203	26	1900	605	12.7 %
High-speed vessels*	74	12	250	146	3.1 %
Coastal route/exploration ships	14	25	10 400	242	5.1 %
Other passenger vessels	67	40	3000	27	0.6 %
Vessel category as a whole	358	26	1960	1 020	21.4 %

*In addition, there are approximately 130 scheduled high-speed vessels in Norway that are below the minimum size for mandatory AIS reporting. According to Selfa (2016), emissions from all high-speed vessels in Norway total 233 000 tonnes CO₂.¹⁹ Fuel consumption and emissions were estimated on the basis of route lengths, timetables and vessel properties, and smaller vessels are also included. This estimate indicates that the analyses based on AIS data cover just over 60 % of total emissions from high-speed vessels.

Measures and instruments

The inclusion of environmental requirements in procurement processes by central government agencies and county authorities, combined with support from funding agencies such as Enova and the NOx Fund, has proved to be an effective way of promoting the development of zero- and low-emission ferries.

In all, Enova has allocated NOK 665 million in grants towards charging infrastructure for electric ferries in the counties Hordaland, Møre og Romsdal, Trøndelag, Nordland and Troms. The support from Enova has made it possible for the counties to include stricter environmental requirements in their calls for tenders. As a result, 33 ferry routes are now partly or all electric, and the support has also accelerated the development of a value chain for a zero-emission maritime industry. Growing demand for batteries and the development of better charging infrastructure is making zero-emission solutions more attractive to the entire maritime sector.

High-speed vessels have higher emissions per passenger-kilometre than most other transport segments. There is a substantial emission reduction potential, and development projects for both battery and hydrogen propulsion are under way. Requirements in public procurement processes will be important in ensuring the development of zero- and low-emission

¹⁹ Selfa (2016) Battery/fuel cell fast ferry. Trondheim/Sandtorg 06.04.2017 Rev. 8 <https://www.nho.no/siteassets/nox-fondet/rapporter/2018/nox-report---rev-8.doc-002.pdf>

solutions for high-speed vessels. In the revised national budget for 2019, the Government has allocated NOK 25 million to support the development of zero- and low-emission high-speed vessels.

In 2016, the Government provided grants totalling NOK 20 million to build up local government expertise in municipalities and counties that applied for the funding so that they could include environmental requirements in procurement processes for ferries and high-speed vessels. In 2018, the counties received NOK 100 million in non-earmarked funding to strengthen the ferry and high-speed vessel sector. This allocation was repeated in 2019. The funding has been shared between the counties according to cost of providing ferry and high-speed services in each county.

Experience so far, particularly from Hordaland and Møre og Romsdal, indicates that purchasing battery-propelled ferries has resulted in higher costs for the counties than if they had purchased conventional ferries. Costs over the entire contract period vary widely between ferry services. Using battery-propelled ferries will reduce the costs of some services, whereas in other cases, requirements to use zero- or low-emission ferries will result in substantially higher costs.

DNV GL has looked at nine contracts, and estimates that on average, the net additional cost for the contract period of using zero- and low-emission ferries rather than new diesel ferries is about 5 %. The costs vary between ferry services and also depending on whether or not the ferry company has received support from the NOx Fund. The range of weighted averages is from NOK 650 to NOK 1250 per tonne reduction in CO₂ emissions. The lowest costs are generally for the contracts that result in the largest overall emission reductions.²⁰

No empirical data is available that can be used to estimate the net additional costs of choosing zero-emission solutions for high-speed vessels. However, general estimates of commercial viability carried out by DNV GL together with the Institute of Transport Economics and the consultancy firm Menon indicate that in the near future, it will be considerably more costly to choose zero- and low-emission solutions than conventional solutions in procurement processes for high-speed vessels.²¹

The Government will promote the inclusion of requirements for zero- and low-emission solutions in future procurement processes for ferries and high-speed vessels. In the revised national budget for 2019, the Government has proposed an allocation of NOK 25 million to promote the introduction of low- and zero-emission solutions for high-speed passenger vessels. The funding will be channelled through a temporary initiative under the '*Klimasats*' grant scheme run by the Norwegian Environment Agency, and will provide support for counties that wish to acquire climate-friendly high-speed vessels. The Government will continue to work on a longer-term

²⁰ Memo from DNV GL prepared as input to this action plan.

²¹ Menon-publikasjon no. 79/2018. *Klimatiltak innenfor kollektivtransport [Climate-related measures for public transport]*.

grant scheme for county authorities that includes requirements for low- and zero-emission solutions in procurement processes for high-speed vessels.

When the revenue system for the county authorities is revised in future, the Government will take into account the higher costs that will be a result of requiring low- and zero-emission solutions for ferry and high-speed passenger services.

The costs of zero- and low-emission solutions are expected to decline over time. In the next few years, non-recurrent costs will be incurred in connection with the development of infrastructure. As the market for battery packs and other components expands, there will probably be a drop in costs. The costs of onshore battery banks and grid balancing are also expected to decline.

Innovation contracts for zero-emission ferries and high-speed vessels

The Norwegian Public Roads Administration has awarded a contract and issued a licence for a hydrogen-electric ferry that is to be put into operation in 2021 on the crossing Hjelmeland-Nesvik, which is part of the national road system. The ferry is being built under an innovation contract. The purpose of the contract is to develop a zero-emission solution for a ferry service that is not suitable for all-electric operation. A hydrogen-electric ferry can be operated where electricity supplies are too limited or if the service requires too much energy to be suitable for fully electric operation.

Development of the legislation is a crucial part of these developments in this area. The Norwegian Maritime Authority and the Norwegian Directorate for Civil Protection have drawn up a framework for approval of vessels of this type. In the longer term, the Maritime Authority will contribute to the development of international rules for zero- and low-emission vessels. The Directorate for Civil Protection will prepare guidelines for onshore handling of hydrogen and bunkering ships.

This ferry project is an important step in the green transition in the maritime sector. The results will be widely applicable in other parts of the maritime industry. The ferry will use liquid hydrogen. It is essential to gain experience in using liquid hydrogen so that it can also be used on larger vessels in the long term.

In April 2018, Trøndelag county awarded innovation contracts to five consortia for the development of zero-emission high-speed vessels. The consortia are to demonstrate their projects in the course of 2019. The aim is to publish a call for tenders for the world's first zero-emission high-speed vessel in the early 2020s. The project has received support from the '*Klimasats*' grant scheme run by the Norwegian Environment Agency.

Experience gained from these projects may make it possible to scale up hydrogen solutions for services where battery-only solutions cannot be used at present.

The Government will:

- Continue to work on a grant scheme for county authorities that ensures the inclusion of requirements for low- and zero-emission solutions in procurement processes for high-speed vessels
- In future revisions of the revenue system for the county authorities, take into account the higher costs that will be a result of requiring low- and zero-emission solutions for ferry and high-speed passenger services
- Consider whether to introduce requirements for low- and zero-emission solutions in public procurement processes for ferries and high-speed vessels, where appropriate

3.2. Cruise ships and international passenger ferries



Color Line's new ship the Color Hybrid is to be delivered by the Ulstein shipyard next year, and will be the world's largest hybrid passenger ferry. It will operate on the Sandefjord-Strømstad crossing. It is being equipped with a 4.7 MWh battery pack which will allow it to sail 3.2 nautical miles on battery power alone. The ship will be charged using shore power during the overnight stay in Sandefjord. Photo: Fosen Yard/Ulstein

This category includes both large and small cruise ships that visit Norwegian ports and fjords. In addition, combined car and passenger ferries (RoPax ferries) between Norwegian and foreign ports (mainly in Denmark, Sweden and Germany) are included here.

The volume of cruise traffic in Norwegian waters is large and growing. Based on AIS data, it is estimated that emissions from this segment totalled 0.3 million tonnes CO₂-eq in 2017, or almost 7 % of greenhouse gas emissions from domestic shipping.

In 2017, 110 different cruise ships were registered in Norwegian waters. They landed 3 million passengers in Norwegian ports. Bergen was the port with most calls by cruise ships in 2017 (307), followed by Geiranger (181), Stavanger (181), Flåm (142) and Ålesund (133). Cruise traffic in Norway is largely confined to the summer months. The ships are relatively old, with an average age of 25 years.

International RoPax ferries to and from Norway follow scheduled routes from only a few Norwegian ports. In 2017, there were 13 RoPax ferries between Norwegian and foreign ports. The ports with the highest volume of traffic are Larvik, Oslo, Kristiansand and Sandefjord. The average age of the ferries is 21 years.

Table 2: Cruise ships and RoPax ferries in 2017.

Sub-category	No. of ships	Average age (years)	Average size (GT)	Domestic emissions (ktonnes CO ₂)	Share of total domestic shipping emissions
Cruise ships	110	25	49 800	299	6.3 %
RoPax ferries	13	21	34 000	25	0.5 %
Vessel category as a whole	123	24	48 100	324	6.8 %

Measures and instruments

Cruise traffic and international passenger ferries result in substantial emissions to air of pollutants such as nitrogen oxides (NO_x) and sulphur oxides (SO_x), which have a negative impact on local air quality. In the West Norwegian Fjords World Heritage Site, measurements have shown that emissions from cruise ships can be harmful to public health, in addition to being unsightly and having a negative impact on the characteristics that justified the inscription of the fjords on the UNESCO World Heritage List. Stricter emission standards have therefore been introduced for shipping in these fjords. In practice, these prohibit the use of heavy fuel oil with certain exceptions for ships that have closed-loop scrubbers and reduce visible exhaust from the ship. In addition, stricter standards for NO_x emissions have been introduced, and discharges of sewage and grey water have been prohibited.

To a large extent, it will be possible to comply with these environmental requirements using abatement technology, but reducing greenhouse gas emissions will require greater changes. A number of new passenger ships are being built with LNG engines, which will reduce greenhouse gas emissions to some extent. These ships can also use biogas blends. Hurtigruten has concluded an agreement with Biokraft AS, and has announced that they will be using biogas along parts of the coastal route Bergen–Kirkenes.

Energy efficiency measures and hull design can be used to improve operational energy efficiency and open the way for innovative solutions. Regardless of their propulsion system, ships must be energy efficient to

make use of zero-emission technologies such as batteries and hydrogen. Enova has provided support for highly effective propulsion systems and hybrid technology on Hurtigruten's new exploration ships to maximise the range provided by the installed batteries. Enova has also supported Havila Kyststruten's four new ships for the coastal route so that they can maximise energy recovery and re-use, thus making the ships more energy efficient. Enova's initiative for the development of shore power in Norwegian ports is making it possible for even the large passenger ships to close down their engines while in port.

The Storting has asked the Government to adopt requirements and regulatory measures for emissions from cruise ships and other shipping in fjords that are tourist destinations, and to introduce other suitable instruments that will ensure that low- and zero-emission solutions for shipping are phased in during the period up to 2030. This includes requirements for cruise ships and ferries in the West Norwegian Fjords World Heritage Site to be emission-free as soon as technologically feasible, and at the latest by 2026. The Government will follow up this decision and report back to the Storting at an appropriate time.

The Norwegian Maritime Authority has been commissioned by the Ministry of Climate and Environment to review whether these requirements can be extended to shipping in other Norwegian fjords. The review will consider the feasibility and economic consequences of introducing environmental requirements and regulatory measures. Onshore power for cruise ships is further discussed in Chapter 4.

The Government will:

- Seek to reduce greenhouse gas emissions and local air pollution from cruise ships in Norwegian waters
- Follow up the decision by the Storting to require cruise ships and ferries sailing in the West Norwegian Fjords World Heritage Site to be emission-free as soon as technologically feasible, and at the latest by 2026, and report back to the Storting at an appropriate time
- Consider whether to extend the environmental requirements for shipping in the West Norwegian Fjords World Heritage Site to other fjords in Norway

3.3. Cargo vessels



The Yara Birkeland will be the world's first autonomous zero-emission container vessel. Enova has provided grants of NOK 133 million towards the project. Illustration: Yara/Kongsberg Maritime.

Cargo vessels are a large vessel category that can be divided into two main groups: non-bulk cargo vessels that carry breakbulk, containers and refrigerated/frozen goods (the latter are known as reefers), and tankers and bulk carriers, which carry bulk commodities, either wet bulk such as oil, gas and chemicals or dry bulk such as gravel, sand, grain and steel.

The non-bulk cargo group is dominated in terms of numbers by the many general cargo vessels that carry goods along the coast. They are relatively small vessels, and their average age is high (17 years). The smallest general cargo vessels tend to be the oldest. Almost 100 general cargo vessels that spend at least 80 % of their time in Norway's exclusive economic zone, and their average age is around 30 years.

AIS data indicate that domestic CO₂ emissions from non-bulk cargo vessels total approximately 520 000 tonnes, most of which is from the general cargo group. There are domestic emissions from almost 2000 non-bulk cargo vessels, but 90 % of the total emissions are from about 500 vessels. This is because many non-bulk cargo vessels are engaged in foreign trade or are in transit. The ships that are responsible for the largest share of domestic emissions are considerably smaller and older than the average.

Table 3: Non-bulk cargo vessels in Norwegian waters

Sub-category	No. of ships	Average age (years)	Average size (GT)	Domestic emissions (ktonnes CO ₂)	Share of total domestic shipping emissions
General cargo vessels	1 588	17	8 000	354	7.4 %
Container vessels	126	13	33 100	69	1.4 %
Ro-ro cargo	84	19	13 800	45	0.9 %
Reefers	94	25	7 550	52	1.1 %
Group as a whole	1892	17	9850	520	10.9 %

Tankers and bulk carriers are generally larger and newer than non-bulk cargo vessels (average age around 10 years).

A large proportion of domestic tanker traffic consists of the distribution of oil products from the Mongstad and Slagentangen refineries to smaller facilities along the coast. Larger crude tankers are often engaged in foreign trade. Crude tankers also include the large shuttle tankers that are specially designed to transport oil to land from the offshore fields. In 2017, 80 % of Norwegian crude oil production was transported by ship.

The sailing patterns of bulk carriers vary widely. Some are used only for domestic traffic, while others operate internationally. Competition is international, and a large proportion of the cargo is transported for owners outside Norway. A substantial proportion of the cargo transported consists of building materials such as stone, aggregate, sand and cement for public infrastructure and buildings.

Domestic CO₂ emissions from tankers and bulk carriers total about 594 000 tonnes per year. In all, almost 2400 ships are responsible for emissions in Norway, but about 90 % of the total is from only 160 vessels. These ships are considerably older and smaller than the average for the group as a whole.

In global terms, tankers and bulk carriers together with container vessels are responsible for the largest proportion of CO₂ emissions from the world fleet, and also carry out the largest proportion of transport work.

Table 4: Tankers and bulk carriers in Norwegian waters

Sub-category	No. of ships	Average age (years)	Average size (GT)	Domestic emissions (ktonnes CO ₂)	Share of total domestic shipping emissions
Bulk carriers	1 032	8	64 200	112	2.3 %
Crude carriers	369	10	118 500	174	3.6 %
Product carriers	126	14	36 300	24	0.5 %
Chemical carriers	666	11	26 300	195	4.1 %
Liquefied gas carriers	187	9	25 400	89	1.9 %
Group as a whole	2 380	10	57 500	594	12.4 %

Measures and instruments

With current technology, maritime transport is generally the most energy-efficient mode of transport. Increasing the volume of maritime transport will play a part in reducing congestion on the roads, improving safety, and reducing local pollution and wear and tear on the roads. Tyre wear is the largest direct source of microplastics in Norway, and about half of all microplastics end up in the sea.²² If a shift in freight transport from road to sea helps to reduce the total volume of road traffic, it will be an important means of reducing the spread of microplastics.

The Government has stated that its ambition is for 30 % of goods transported over distances of more than 300 km to be transferred from road to rail and sea by 2030. According to the Norwegian Environment Agency, this could give an accumulated reduction in greenhouse gas emissions from the transport sector of about 1.5 million tonnes CO₂-eq over the period 2021–2030.²³ This means that shifting freight from road to sea is a sound climate and environmental measure, even if it is a shift to ships using conventional technology.

In February 2017, the Government introduced a three-year pilot grant scheme to encourage a modal shift of freight from road to sea. The scheme will make maritime transport more competitive, and will at the same time have positive effects on the environment and climate, and will reduce congestion on the roads and improve safety.

The grant scheme has received a good market response. There have been two rounds of awards so far, in 2017 and 2018. These have resulted in five projects to establish new maritime transport services that are expected to give a permanent shift of transport from road to sea. The Norwegian

²² <https://www.environment.no/topics/waste/avfallstyper/microplastics/>

²³ <https://tema.miljodirektoratet.no/klimatiltak/> (In Norwegian only.)

Coastal Administration estimates that the projects will result in the transfer of up to 1 million tonnes of freight a year from road to sea.

However, shifting freight from road to sea requires an integrated approach to logistics chains. Planning and coordination involving cargo owners, carriers and shipping companies is needed. In particular, it is vital that both the land transport stage and the maritime stage are part of an integrated logistics chain. Enova has supported two projects in which the logistics chain is a key element and where the maritime stage is solved through innovative use of autonomous vessels. Both Yara and ASKO are involved in these projects in several roles – as cargo owners, carriers and shipping companies – and are thus able to create integrated logistics chains. The projects show that using this kind of approach can make it possible to turn a profit from projects to reduce emissions by shifting freight from road to sea.

Increasing the degree of hybridisation by installing batteries, and energy recovery during cargo handling both result in lower emissions combined with lower operating costs. Enova's support for projects in this area is helping to bring about a market change so that solutions of this type gradually become standard.

Renewal of the cargo fleet will be of crucial importance in the development of environmentally friendly freight transport in Norway. The development of competitive zero- and low-emission solutions for cargo vessels will also be globally important. Cargo vessels account for a large share of emissions from international shipping. A policy that ensures the introduction of cargo vessels using zero- and low-emission solutions for short sea shipping will make it more likely that IMO's emission targets can be achieved.

Funding must be available both for refitting and for purchasing new ships if emissions from cargo vessels are to be reduced. Shipping companies' activity and earning power are the basis for fleet renewal on ordinary commercial terms.

The short sea shipping fleet, including both non-bulk cargo vessels and tankers and bulk carriers, tends not to operate under long-term contracts. Margins are small, particularly for smaller general cargo vessels. This makes it difficult to accumulate enough investment capital for renewal projects. The sector includes many small companies, which may not be very robust in financial terms.

Thus, the creditworthiness of the short sea shipping companies appears to be the greatest barrier to use of the existing industry-oriented funding instruments and to obtaining commercial funding for shipbuilding. This is probably because of the structure of the freight markets and the dominance of short-term contracts in the short sea shipping fleet. As a result, the shipping companies have little financial security. More knowledge is needed about the barriers to financing for vessels in this segment.

The Government will initiate a dialogue with relevant industry partners to discuss the possibility of drawing up a letter of intent concerning renewal of the cargo fleet. The purpose of the agreement would be to find areas of cooperation that can stimulate green fleet renewal and better cooperation between public and private stakeholders.

The Government will:

- Initiate a dialogue with relevant industry partners to discuss the possibility of drawing up a letter of intent concerning green renewal of the cargo fleet
- Identify possible challenges relating to funding for green fleet renewal for the short sea cargo fleet with a view to improving the framework for this process
- Review the options available for green fleet renewal within the framework of currently existing funding instruments offered by the Norwegian Export Credit Guarantee Agency (GIEK), Export Credit Norway and Innovation Norway
- Take steps to realise the ambition of a shift in freight transport from road to rail and sea, and give priority to freight-related measures that will reduce greenhouse gas emissions
- Use incentive schemes for short sea shipping as a means of reducing total emissions from freight transport
- Whenever feasible, include requirements relating to zero-emission transport in public procurement processes

3.4. Offshore support vessels



Eidesvik's supply vessel *Viking Energy* was launched in 2003 as the first LNG-powered offshore vessel. The ship made history again in 2016, when it was fitted with an advanced battery system that has reduced annual fuel consumption by 17 %. The battery system has a capacity of 650 kWh/1600 KW. Photo: Eidesvik Offshore

The offshore shipping companies, in cooperation with the oil companies, have played a pioneering role in developing more energy-efficient vessels by introducing battery hybridisation, using LNG as a fuel and testing immature technologies. The offshore support fleet is generally modern and is pioneering environmentally friendly solutions.

AIS data indicate that offshore support vessels accounted for about 23 % of emissions from domestic shipping in 2017, as shown in Table 5. This vessel category includes many advanced vessels that are specifically designed to carry out tasks for the offshore petroleum industry and operate under challenging conditions. The largest group of vessels is platform supply vessels, which are specially adapted to carry equipment and various types of cargo to and from oil and gas installations. Although Table 5 shows that large numbers of offshore support vessels call at Norwegian ports, almost all domestic emissions are from only half of these vessels. Platform supply vessels are often hired on long-term contracts by operators on the continental shelf, and many of the ships operating under such contracts have already been hybridised.

In addition to platform supply vessels, there are many other types of offshore support vessels, for example oil spill response vessels, anchor handling tug vessels, offshore construction vessels and pipe laying vessels. Offshore support vessels are relatively new, with an average age of about 12 years.

Table 5: Offshore support vessels

Sub-category	No. of ships	Average age (years)	Average size (GT)	Domestic emissions (ktonnes CO ₂)	Share of total domestic shipping emissions
Platform supply vessels	358	11	3450	827	17.3 %
Other offshore support vessels	204	12	5620	269	5.6 %
Vessel category as a whole	561	12	4240	1096	23.0 %

Measures and instruments

The relevant industries have already started to phase in technology that will reduce emissions. For example, Equinor now includes requirements to use battery-hybrid vessels and shore power and to implement energy efficiency measures when entering into new long-term contracts. Equinor has also introduced an incentive scheme under which savings from reductions in fuel consumption are shared with the shipping company. However, if consumption is higher than normal, the shipping company must pay 35 % of the additional fuel costs.²⁴

Enova has awarded grants for battery hybridisation of several vessels used in offshore petroleum production or in the offshore wind industry. This is particularly useful for vessels that are used in operations where power requirements vary widely, for example operations in dynamic positioning mode. There are examples of vessels both in Norway and in other countries that are being built with battery-hybrid solutions without public funding. This indicates that the market is developing in the right direction. At the same time, Enova's shore power initiative is reducing emissions from vessels that are in port. Many of the supply bases used by the petroleum industry have established onshore power supplies.

The introduction of environmental requirements may result in more rapid phase-in of low- and zero-emission solutions than is being achieved with the carbon tax and existing grant schemes. The consequences of introducing such requirements must be further reviewed.

The Government will:

- Consider the introduction of requirements to use zero- and low-emission solutions for new support vessels for offshore petroleum production

24 <https://sysla.no/maritim/hver-krone-de-sparer-drivstoff-far-de-50-ore-av-statoil/> (In Norwegian only.)

3.5. Specialised vessels including aquaculture service vessels



Since 2017, Salmar Farming has been using the hybrid-electric workboat *Elfrida*, which runs on electricity 80–90 % of the time. Photo: Enova

This category includes a wide variety of vessels that support the aquaculture industry, including well boats, fish feed barges and various types of service boats, and also other specialised vessels such as research vessels, seismic survey vessels, tugboats and government vessels (Coast Guard vessels and oil recovery vessels). The average age of the vessels for the category as a whole is 21 years. The aquaculture industry is highly profitable and shows considerable willingness to invest combined with growth potential and an increasing focus on sustainability.

Well boats are used to transport live farmed fish and smolt, and are generally chartered or have framework agreements with fish farming companies. The fleet has grown in step with the growth of the aquaculture industry. New requirements for wastewater treatment equipment issued by the Norwegian Food Safety Authority will enter into force in 2021. This is likely to result in a generational shift in the fleet, since it will not be practical to retrofit smaller, older well boats.

Government vessels are owned by the Coast Guard and the Norwegian Coastal Administration. Seismic survey vessels are generally used in connection with oil and gas exploration, and are contracted by oil companies. Research vessels are used for oceanographic and environmental research and monitoring purposes, for example by universities and the Institute of Marine Research.

Tugboats are used to tow and manoeuvre both ships and other floating structures. They are also used for various marine operations within the offshore petroleum industry.

Table 6: Specialised vessels including aquaculture service vessels

Sub-category	No. of ships	Average age (years)	Average size (GT)	Domestic emissions (ktonnes CO ₂)	Share of total domestic shipping emissions
Well boats	76	14	1 600	-	-
Government vessels	25	18	1430	-	-
Research vessels and seismic survey vessels	120	21	2100	-	-
Tugboats	167	24	426	-	-
Vessel category as a whole	388	21	1220	344*	7.2 %

* Total emissions from this category are estimated to correspond to about 7 % of emissions from domestic shipping and fishing vessels. Figures are not available for sub-categories of vessels, for example small workboats for use in fish farms and for transporting personnel to and from fish farms. ABB and Bellona (2018) have estimated that emissions from these boats total around 205 000 tonnes CO₂-eq per year. Note that a further approximately 260 unique vessels/installations were identified through the AIS system. These have been omitted from this analysis since they are not relevant in the context of maritime transport (rigs, etc).

Measures and instruments

The combination of the carbon tax and support from Enova for energy and climate-related measures gives the aquaculture industry incentives to develop and deploy low- and zero-emission solutions. Further increases in the carbon tax, as announced by the Government in its political platform, and continued development of Enova as an important funding agency in connection with climate policy will strengthen these incentives.

Enova has provided support for a number of projects in the aquaculture industry, including grants for workboats and well boats, and also for the industry's shore power initiative. The world's first battery-hybrid workboat for the fish farming industry was launched and put into operation in 2017, and a battery-hybrid fish processing and transport vessel is also in operation. Enova has provided grants for both vessels.

It will be possible to speed up phase-in of new technologies and solutions in this segment through a combination of support from funding agencies and the use of environmental requirements and regulatory measures.

For government vessels (including research vessels) the state is shipowner and has a strong influence on equipment and the vessels' climate and environmental profile. Norway's procurement legislation requires contracting authorities to consider giving weight to environmental considerations in procurement processes for government vessels. The same applies to tugboats that are often hired for government contracts.

The Government will:

- Consider requirements to introduce zero- and low-emission solutions for aquaculture service vessels
- Ensure that central government authorities give weight to climate and environmental considerations in procurement processes for vessels, including vessels that are hired for government contracts

3.6. Fishing vessels



Karoline is the world's first hybrid fishing boat with an electric propulsion system. The vessel is 11 metres long, and has a diesel engine for use to and from the fishing grounds. The battery packs provide the vessel with enough power for two hours fishing and 45 minutes of propulsion.
Photo: SIEMENS

Large numbers of fishing vessels take part in fisheries in Norwegian waters. In 2018, the fleet numbered 5 296 active fishing vessels, and in 2017, 826 fishing vessels were registered via AIS. The average age of these vessels is 25 years, while the average age of smaller fishing boats is higher.

The Norwegian fishing fleet can be divided into two main groups – coastal vessels and ocean-going vessels – based partly on size and partly on their fishing rights and the fishing gear they carry. Smaller boats generally operate along the coast and in the fjords. Ocean-going vessels are mainly engaged in trawling and purse seining, which requires larger vessels and powerful engines. Larger vessels may also use gill nets or longlines. The fisheries are regulated by means of quotas and licences. The activity level and CO₂ emissions from the fishing fleet therefore vary somewhat from year to year.

According to the method used by Statistics Norway up to 2017, emissions from the fisheries totalled around 1.1 million tonnes CO₂-eq in 2016. Statistics Norway is now using a new method based on changes in the energy balance, and this shows much lower emissions. Using the new method, reported greenhouse gas emissions from the fishing fleet in 2017 totalled 339 000 tonnes CO₂-eq.

The fishing fleet can currently benefit from a refund system for part of the carbon tax on fuel bought for use in fisheries less than 250 nautical miles from the coast. Data on applications for refunds and the volume of fuel involved is available, and it is possible to calculate fuel consumption and emissions from these figures. It is likely that the refund figures are a good reflection of fuel consumption, since fishermen have a strong incentive to apply for refunds for the fuel they have purchased. Using figures from the refund scheme gives a considerably higher estimate of emissions than that obtained using Statistics Norway's new method, even though Statistics Norway also includes fuel purchased in Norway for use in distant waters (beyond 250 nautical miles). There is therefore reason to believe that the figures from Statistics Norway are an underestimate. Using figures for tax refunds as a basis, greenhouse gas emissions from fishing vessels operating less than 250 nautical miles from land are estimated at 640 000 tonnes CO₂-eq in 2018.

In the AIS emission inventory, all fishing vessels operating in Norwegian waters are counted as domestic traffic. Using these figures as a basis, domestic emissions from fishing vessels are estimated at 877 000 tonnes CO₂-eq, or 18 % of total shipping emissions.

Table 7: Fishing vessels

	No. of vessels	Average age (years)	Average size (GT)	Domestic emissions (ktonnes CO ₂)	Share of total domestic shipping emissions
Fishing vessels	826	25	680	877*	18.4 %

**) There are additional emissions from small fishing boats that are not included in the estimate from the AIS system. DNV GL's estimate for these emissions is 240 000 tonnes CO₂-eq, or about 20 % of total emissions from the fishing fleet.*

Measures and instruments

Enova has supported many different projects in the fisheries sector. One project category is onshore power. Enova has for example allocated more than NOK 25 million to Båtsfjord port, which is one of Norway's largest fishing ports. Enova has also awarded grants for various technological measures on vessels in different segments of the fishing fleet. They include battery-hybrid propulsion, heat recovery, electrification of fishing gear and other climate- and energy-related measures. These projects are also part of an initiative to develop value chains for zero-emission technology such as batteries and charging infrastructure that can lead to lasting market change for the maritime industry as a whole.

A committee including industry representatives was appointed to consider the possibility of gradually increasing the carbon tax rate for the fishing industry and to propose other measures to reduce greenhouse gas emissions. The committee has completed its work, and its report has been circulated for comment with a deadline of 1 August 2019. The Government intends to follow the committee's recommendations provided that they result in genuine, lasting emission reductions. If they do not, exemptions from the carbon tax and reduced tax rates will be abolished in 2020.

The Government will:

- Follow up the recommendations of the committee appointed to consider measures to reduce emissions from the fisheries
- Abolish exemptions from the carbon tax and reduced tax rates if the proposals from the committee do not result in genuine, lasting emission reductions

3.7. Recreational craft



GreenWaves 601 is an all-electric Norwegian motorboat. The standard motor is 7.5 kW and the standard lithium battery pack allows 5-7 peaceful hours at sea. Photo: Johner Bildbyrå AB

In Norway's emission inventory, recreational craft are included under the category non-road mobile machinery. According to Statistics Norway, emissions from recreational craft totalled about 530 000 tonnes CO₂-eq in 2017.

Norwegian households own more than 600 000 motor and/or sailing boats.²⁵ More than 400 000 of these are motorboats without overnight accommodation, and their number has increased substantially since the previous survey in 2012. The numbers of other boat types have declined somewhat. Overall, the number of recreational craft has risen by about 100 000 since the 2012 survey.

Table 8: Recreational craft²⁶

Type	Number of boats	
	2012	2018
Motorboats without overnight accommodation	291 000	402 000
Motorboats with overnight accommodation	176 000	161 000
Jet skis	-	10 000
Sailing boats without overnight accommodation	17 000	13 000
Sailing boats with overnight accommodation	35 000	27 000
Sum	520 000	614 000

Measures and instruments

Petrol for use in recreational craft is subject to the carbon tax and road use duty. Diesel for use in recreational craft is subject to the carbon tax and the basic tax on mineral oil. The Government has announced that the carbon tax rate will be increased by 5 % per year from 2020 to 2025.

There is at present only a limited choice of off-the-shelf models of recreational craft and larger boat engines based on zero- and low-emission technology. However, it is likely that this situation will change, as it is doing in other parts of the transport sector.

More knowledge is needed about additional ways of reducing emissions from recreational craft, other than the current policy instruments. In 2018, Sweden set up a grant scheme for electric outboard motors, but this has not made any payments so far. The Ministry of Climate and Environment has asked the Norwegian Environment Agency to compile a knowledge base on emissions and emission reduction potential for non-road mobile machinery, including recreational craft.

The Government will:

- Review emissions from recreational craft and the emission reduction potential, and consider policy instruments to promote zero- and low-emission solutions

²⁵ https://knbf.no/images/Presentasjoner/Hovedrapport_Nasjonalt_2018.pdf (In Norwegian only.)

²⁶ https://knbf.no/images/Presentasjoner/Faktafolder_Nasjonalt_2018.pdf (In Norwegian only.)





4

Infrastructure for green shipping

Norway has an effective, reliable and virtually emission-free electricity supply system. This is one of the country's most important assets in the transition to a low-emission society, since electrification results in immediate environmental benefits. The Government will facilitate the rapid development of charging infrastructure throughout the country using a combination of public funding and market-based solutions, in order to keep pace with the expanding use of electric modes of transport.

The action plan for alternative fuels for the transport sector describes how the regulatory framework for the power supply system influences the use of electricity in the transport sector.

4.1. Green ports

In cooperation with municipalities and port authorities, the Government will aim for Norwegian ports, wherever feasible, to be emission-free by 2030. It is vital for the development of a green shipping sector that ports provide onshore power, charging facilities and adequate bunkering services for sustainable fuels such as hydrogen and biogas. The scale of environment-related investments in ports has increased considerably in recent years. Since 2015, Enova has provided grants totalling around NOK 0.5 billion for about 80 onshore power projects. The latest round of calls for proposals was in December 2018.

Ports determine their own prices and other commercial terms for the services they offer. In addition, each municipality may determine port call fees to cover expenses it incurs in carrying out its tasks under the Act relating to ports and navigable waters, which all vessels calling at ports in the municipality are required to pay. A number of Norwegian ports have introduced discounts for green ships based on information from the Environmental Ship Index (ESI). From 2019, several ports are also planning

to introduce a system of rebates based on the Environmental Port Index (EPI). This index was developed in Norway, and shows the environmental performance of cruise ships while in port. This will be an incentive to introduce environmentally friendly solutions for shipping.

The 2019 national budget includes an allocation of NOK 50 million to a temporary three-year grant scheme for investments in effective, environmentally friendly ports. The purpose of the scheme is to use investments in ports to make the logistics chain more efficient. This can reduce transport costs, play a part in shifting freight transport from road to sea, and have climate and environmental benefits.

More and more cruise ships are equipped to use onshore power. In September 2018, the Port of Kristiansand opened Europe's largest onshore power facility for cruise ships. The Port of Bergen is planning to offer onshore power from 2020. Onshore power for cruise ships is a high-cost mitigation measure compared with onshore power for vessels in ordinary traffic. Until recently, projects of this kind have therefore not been successful in obtaining funding from Enova. In order to be eligible for support from Enova, municipalities or other stakeholders need to be willing to meet a larger share of the costs, as the Port of Bergen is doing.

Environmental measures in ports

Oslo has Norway's largest port, and in autumn 2018, the Port of Oslo adopted an action plan to become an emission-free port. The plan establishes the target of reducing greenhouse gas emissions by 85 % by 2030 relative to the current level. The target includes emissions from ships entering and leaving the port and at berth, and from port operations.

Battery hybridisation opens the way for charging from onshore sources and partial electrification of operations. In Bergen, the energy and infrastructure company BKK and the Port of Bergen have established a joint venture to build a shore power facility for cruise ships. In December 2018, Enova granted NOK 50 million towards the facility, which is to open in July 2020. The Port of Oslo has recently opened its shore power facility, which will serve the Stena Line and DFDS ferries. Color Line's ships already run on shore power in Oslo, and the new ferry for the Sandefjord–Strømstad route will be able to run on battery power for part of the crossing.

Thirteen large cruise ports in Norway (Oslo, Bergen, Ålesund, Stavanger, Kristiansand, Trondheim, Stranda (Geiranger and Hellesylt), Eidfjord, Aurland (Flåm), Molde, Rauma, Tromsø and Nordkapp) have recently agreed on a common approach to the cruise industry, with 14 joint measures to reduce emissions and make ports greener.²⁷ They include the following:

27 <https://www.skipsrevyen.no/article/fjorder-og-byer-fronter-felles-krav-til-cruiseskip-om-lavere-utslipp/> (In Norwegian only.)

- Requiring all cruise ships in Norwegian fjords, vulnerable areas in Norwegian waters and Norwegian cruise ports to operate in accordance with the requirements that apply to shipping in the West Norwegian Fjords World Heritage Site.
- Introducing a joint requirement for cruise ships to use onshore power in all Norwegian cruise destinations with effect from 2025.
- Introducing a joint requirement for emission-free operation of cruise ships, including ships entering and leaving port, as soon as this is technically feasible.
- From 2021, give priority when allocating slots and berths to cruise ships that can document that they have implemented climate and environmental measures.
- Work together for annual stepwise increases in central government fees for the use of fairways for cruise ships that do not use shore power when at berth in ports where it is available.
- Make annual stepwise increases in municipal harbour dues for cruise ships that do not use shore power when at berth in ports where it is available.
- Advocate new legislation providing the legal authority for ports to restrict the number of cruise passengers per day and the number of cruise ships calling per day.

The Government will:

- Facilitate the rapid development of charging infrastructure throughout the country using a combination of policy instruments and market-based solutions to keep pace with the expanding use of electric modes of transport
- In cooperation with municipalities and port authorities, aim for Norwegian ports, wherever feasible, to be emission-free by 2030





5

Policy instruments for promoting green shipping

As described in Chapter 3 the Government has already introduced measures and policy instruments to reduce emissions from most categories of vessels. This chapter gives a more complete overview of policy instruments, funding instruments and cooperation arrangements that are relevant for all vessel categories. The main policy instruments are regulatory measures and requirements and economic instruments such as taxation and funding instruments. Policy instruments to promote green shipping have been developed in close cooperation with the industry and cover the entire value chain from research to market regulation in order to increase the demand for climate and environmental technology.

5.1. Regulatory measures and requirements

Norway is a driving force in developing a good international framework for a climate-friendly and environmentally sound shipping industry. In recent years, shipping has become more strictly regulated, with rules limiting emissions to air and water.

The Ship Safety and Security Act provides the legal authority to prescribe regulatory measures for ships flying the Norwegian flag and, subject to the limitations imposed by international law, for foreign ships in Norwegian territorial waters, the Exclusive Economic Zone of Norway and the Norwegian continental shelf. One of the areas the Act covers is environmental safety, and a series of provisions lay down environment-related requirements relating to the construction, equipment and operation of ships. The International Convention for the Prevention of Pollution from Ships (MARPOL) has been implemented in Norwegian law. The convention regulates matters such as oil pollution, noxious liquid

substances in bulk, harmful substances carried by sea in packaged form, sewage, waste and air pollution.

The environmental rules adopted by the International Maritime Organization (IMO) include particularly strict requirements for certain areas, for example the North Sea and the Baltic Sea. The IMO Polar Code sets out specific safety and environmental protection rules for polar waters. Coastal states are also entitled under the Law of the Sea to establish specific legislation in their own waters. Such legislation can be used when it is important to take steps to protect the environment and it is not possible or relevant to find a solution within the IMO system. Norway's prohibition against using heavy bunker oil in the waters around Svalbard is an example of this approach.

The *Pollution Control Act* applies to pollution from ports to the extent decided by the pollution control authority. It has been made applicable to contaminated sediments, noise, local air quality and waste reception facilities in ports. The Act can also be used to regulate greenhouse gas emissions, for example by ordering the provision of onshore power or introducing other technological requirements.

The Act relating to ports and navigable waters is intended to facilitate safe and unimpeded passage and sound use and management of navigable waters. Environmental requirements for ships may be introduced under the Act and can for example be used to reduce harmful emissions to air from maritime transport. They may include matters such as requiring ports to provide onshore power facilities and charging infrastructure or provisions on infrastructure for alternative fuels. The Act authorises ports to charge their customers fees to cover operating costs.

Biofuel quota obligation for biodiesel and biogas

The maritime industry's roadmap *Charting a Course for Green Coastal Shipping* sets out a zero-emission vision for Norwegian shipping by 2050 involving substantial emission cuts achieved through greater use of biodiesel and biogas. The Government is supporting the expansion of biogas production and research and development through Enova, Innovation Norway and the Research Council of Norway.

The Storting has asked the Government to propose a sustainable biofuel quota obligation for shipping. In response, the Ministry of Climate and Environment has asked the Norwegian Environment Agency, in cooperation with the Norwegian Maritime Authority, to review the possibility and consequences of introducing a biofuel quota obligation for sustainable biodiesel and biogas. To ensure that such an arrangement has global climate and environmental benefits, advanced biofuels should be used, based on feedstock such as biological residues and waste.

The two agencies have been asked to evaluate how biogas can be included in a biofuel quota obligation, and to propose a way of organising this

that does not put gas-powered ships at a disadvantage in terms of costs. The introduction of a biofuel quota obligation must not make maritime transport less attractive than transport by road or encourage more bunkering of ships outside Norway. The report is to be completed in 2019. It will be necessary to conduct an environmental impact assessment before a biofuel quota obligation for shipping can be introduced, and it must be considered in the context of biofuel use in road and air transport.

Environmental requirements in public procurement processes

Norway's public procurement legislation states that public agencies must carry out procurement processes in a way that reduces harmful environmental impacts and promotes climate-friendly solutions where relevant. The Government wishes the public sector to use its procurement practices to stimulate demand for products manufactured using low-emission technology.

On 10 April 2019, the Government submitted a white paper on public procurement, which discusses how contracting authorities can play a part in achieving environmental targets as efficiently as possible. The white paper also deals with innovation, including environmentally friendly innovation, and the action the Government is taking to promote innovation in public procurement processes. As announced in its policy platform, the Government will prepare an action plan to increase the proportion of green public procurement and green innovation processes, for example by improving advisory and capacity building services provided by the Agency for Public Management and eGovernment.

The Government will whenever feasible ensure the inclusion of requirements relating to zero-emission transport in public procurement processes. The Government will expand on how this can be done in the forthcoming action plan for green public procurement and green innovation.

The inclusion of requirements relating to zero-emission transport in public procurement processes will open up opportunities and provide incentives to develop and deploy zero-emission vehicles and vessels, for example battery- or hydrogen-electric cargo vessels. However, such requirements must not be designed in a way that weakens the competitive position of maritime transport relative to freight transport by road.

As mentioned in Chapter 3.1, the inclusion of environmental requirements in public procurement processes, combined with various grant schemes, has proved to be an effective way of promoting the development of zero- and low-emission ferries. The Government will take steps to ensure that requirements in public procurement processes combined with grant schemes can also be used as a means of realising emission-free solutions for public high-speed vessel services wherever feasible.

Innovative procurement

The public procurement legislation allows buyers and suppliers to cooperate on innovative procurement. This makes it possible to meet the needs of the public sector in new and better ways. Contracting authorities can encourage innovation by engaging in market dialogue and using open specifications describing functional requirements.

An innovation partnership is one of several types of procurement procedures that can be used to promote innovation and the development of new products and solutions that are not currently commercially available. In an innovation partnership, an innovative solution is developed through a public-private partnership. The contracting authority can then choose to purchase the solution that has been developed. Innovation Norway provides support for innovation in public procurement through its innovation contract scheme, which makes grants available to public-private development contracts such as innovation partnerships.

The National Programme for Supplier Development was set up to promote innovation in public procurement, and climate and transport are priority areas for the programme. It involves collaboration between the Confederation of Norwegian Enterprise, the Norwegian Association of Local and Regional Authorities, the Agency for Public Management and eGovernment, Innovation Norway and the Research Council of Norway.

5.2. Taxation

Pricing of emissions is one of the main instruments of Norway's climate policy. More than 80 % of Norwegian greenhouse gas emissions are currently subject to the carbon tax, included in the EU Emissions Trading System (EU ETS), or both. These instruments provide incentives to achieve emission cuts at the lowest possible cost to society.

However, carbon pricing will often not be sufficient to justify the costs of developing new environmental technology. Well-designed support schemes may be necessary to compensate for high costs and risk levels in a transitional period. Schemes to support the development of environmental technology must be limited to projects where there is a prospect that zero- and low-emission solutions will in time become competitive without support.

Stepwise increases in the carbon tax rate

Norway introduced a carbon tax in 1991, and was one of the first countries in the world to do so. The tax is a technology-neutral instrument that promotes cost-effective emission cuts. Measures that cost less than the carbon tax rate give a return on the investment, although there may in some cases be other barriers that prevent measures from being implemented.

The standard carbon tax rate applies to shipping. In 2019, the normal tax rate for mineral oil is NOK 1.35 per litre, which corresponds to NOK 508 per tonne CO₂-eq. From 1 January 2018, the standard carbon tax rate has also applied to liquefied natural gas (LNG) and liquefied petroleum gas (LPG) for domestic shipping. The tax rates in 2019 are NOK 1.02 per Sm³ for LNG and NOK 1.52 per Sm³ for LPG, corresponding to NOK 508 per tonne CO₂-eq for LNG and NOK 507 per tonne CO₂-eq for LPG. A reduced carbon tax rate applies to mineral oil used in fisheries less than 250 nautical miles from the coast and the use of LNG and LPG in these fisheries is exempt from the carbon tax. The reduced tax rate for mineral oil is NOK 0.29 per litre, which corresponds to NOK 109 per tonne CO₂-eq.

The Government will increase the standard carbon tax rate by 5 % per year up to 2025 for all sectors. The revenue will be used to reduce taxation of groups affected by the increases to ease the transition. Rates of other relevant taxes, for example on HFCs and PFCs, will be increased correspondingly. Predictable stepwise increases in the carbon tax will make it easier for shipowners to take future carbon prices into account when making investment decisions. The Government will now consider how to follow up the recommendations of the committee appointed to consider measures to reduce emissions from the fisheries. These include a higher carbon tax rate for the industry combined with compensatory measures.

Electricity tax for commercial shipping

From 1 January 2017, a reduced electricity tax rate was introduced for commercial shipping. In 2019, the reduced tax rate is NOK 0.005 per kWh (the standard rate is NOK 0.1558 per kWh). The reduced rate is determined by the minimum level of taxation set out in the EU Energy Taxation Directive. The reduced rate provides an incentive for commercial shipping to use onshore power and electric means of propulsion.

5.3. Funding agencies

Enova

Enova's primary objective is to contribute to reductions in greenhouse gas emissions, improved security of energy supply, and the development of technology that will bring about reductions in greenhouse gas emissions in the longer term. Enova provides funding for investments in climate and energy projects in all sectors, and was allocated more than NOK 3 billion in the 2019 budget.

The Ministry of Climate and Environment owns Enova, and it is largely managed through rolling four-year agreements. The current agreement is for the period 2017–2020. From 2017, Enova's focus has been shifted more towards climate-related activities and innovation. This has meant a greater emphasis on reducing emissions from the transport sector and other non-ETS emissions, and on innovative solutions adapted to a low-emission society. The management model gives Enova enough flexibility to adapt its funding instruments on the basis of information on the development of

specific technologies and markets. The rules on state aid determine which types of projects can be supported and how.

Enova is expected to give priority to projects that will play a part in reducing and eliminating barriers to new technologies and promoting permanent market change. In a low-emission society, energy-efficient and climate-friendly solutions should in the longer term be able to succeed in the market without government support. Enova provides support to help technology initiatives to make the transition from the pilot phase to market introduction, and also runs programmes to boost demand for energy and climate technology. Both approaches are intended to promote permanent market change.

About one third of Enova's budget is used for transport projects, and maritime activities account for the largest share of this. Norway is in a strong position given its world-leading maritime sector and related industry clusters. Technological developments in the maritime transport sector are also providing good opportunities for value creation in Norway. Electrification is making rapid progress, particularly for shorter routes and vessels that have a dynamic positioning system. Enova will take a long-term approach to stimulating the market, through both technology development and market introduction, in order to accelerate and widen the scope of restructuring in the Norwegian shipping sector and in the next instance international shipping.

Enova is running programmes both for onshore power in Norwegian ports and for the infrastructure element of public transport services. Enova's funding instruments for new technology support the further development, testing and optimisation of zero-emission solutions. They can also be used to support new solutions to reduce the volume of transport, for example through digitalisation and the use of autonomous technology. Enova has also provided investment support for vessels to reduce technological risk and make it a commercially attractive proposition to invest in energy and climate-related measures for ships.

Since 2015, Enova has allocated more than NOK 1.6 billion to projects for different kinds of vessels. Of this, NOK 1.5 billion was for projects concerning vessels fitted with batteries or charging facilities for low- or zero-emission vessels using battery technology. Enova has provided support for vessels and projects in most segments of maritime transport. In addition, Enova has in the same period provided around NOK 500 million towards the development of shore power in Norwegian ports following competitive calls for proposals. The overall support for vessels and infrastructure is strengthening the value chain for battery technology, which will be important in the transition to a low-emission society.

For 2019, allocations to Enova via the Green Fund for Climate, Renewable Energy and Energy Efficiency Measures have been increased by NOK 485 million. The Government intends to enter into a supplementary agreement

with Enova for the new funding to be used to increase support for projects to reduce emissions from commercial transport. The new scheme will include investment grants for both commercial vehicles and commercial vessels, and the plan is to implement it at an early date.

Innovation Norway

Innovation Norway's activities are intended to advance restructuring of Norwegian business and industry, with a strong focus on sustainable solutions and innovation in areas relevant to major social challenges that can boost Norway's future competitiveness. Innovation projects dealing with green shipping may be eligible for a number of Innovation Norway's financial, profiling and expertise-building services.

Innovation Norway's environmental technology scheme provides risk reduction for companies that are developing and testing new technology, and provides support for projects that are expected to boost value creation in Norway. The maritime industry is the second largest recipient of funding, receiving an estimated NOK 73 million in 2017. Grants have been provided for a wide variety of projects, for example on charging and mooring systems for electric ferries, smart charging, heating and energy management systems, and systems for hydrogen bunkering.

Another of Innovation Norway's largest funding instruments is the innovation contract scheme. This is designed for small and medium-sized enterprises that are seeking to develop new, innovative products, services and technologies in close cooperation with pilot customers. The scheme is open to all sectors. The maritime sector receives an estimated NOK 25 million per year through the scheme. Many of the maritime projects have a green profile.

Innovation loans and low-risk loans are also attractive forms of financial risk reduction for innovation projects on green shipping. Loans from Innovation Norway can form part of an overall financial solution together with grants from Innovation Norway, loan financing from private banks and equity.

In 2018, a grant scheme for pilot and demonstration projects in the marine and maritime sectors was established in Innovation Norway, with NOK 30 million in funding available. The scheme supports pilot and demonstration projects for new technology, systems and processes in the marine and maritime sector. Innovation Norway is continuing to promote Norway as an ocean nation in 2019, as it did in 2018.

'The Explorer' is a digital showcase that is designed to strengthen Norway's green international profile and function as a channel to international markets. It is being developed as an important arena for the promotion of green Norwegian innovations. It will be further developed as a matching service between Norwegian solutions and international needs, investors and cooperation partners.

The Research Council of Norway

'Seas and oceans' and 'climate, environment and clean energy' are two of the five long-term priorities set out in the Government's long-term plan for research and higher education, which was published in October 2018.²⁸

The MAROFF programme is the Research Council's most important research programme for maritime research and innovation. Funding for maritime research is intended to stimulate investment in research and innovation projects that will make the maritime industry more competitive and adaptable and strengthen cooperation between research groups and the industry. Research projects in fields such as autonomous technology and digitalisation, green shipping and new opportunities in the ocean industries are being given high priority.

In 2017, the Ministry of Trade, Industry and Fisheries allocated NOK 169.3 million to the MAROFF programme. After budget negotiations were completed, the allocation to the programme was increased by NOK 25 million. In addition, the Research Council received a further NOK 17 million earmarked for maritime technology development and maritime innovation.

The SkatteFUNN tax incentive scheme provides tax deductions for business expenses for research and development. In 2017, companies in the maritime sector received tax deductions totalling NOK 480 million under the scheme. Small and medium-sized enterprises can claim 20 % of project costs as tax deductions, and larger firms can claim 18 %. The scheme is rights-based and has a statutory basis, and applies to all branches of industry and all companies, regardless of size.

Projects that have received EU funding

In September 2018, the Port of Kristiansand opened Europe's largest onshore power facility, which can provide even the largest cruise ships with enough electricity to meet their needs. The project was co-funded by the EU's Horizon 2020 programme. The EU's target is for all the largest ports to have onshore power facilities from 2025.

In January 2018, it was announced that a project to develop a fully-electric high-speed vessel had been awarded EUR 12 million from the Horizon 2020 research programme. Rogaland county authority is the project coordinator, and Norwegian partners include the NCE Maritime CleanTech industry cluster and a number of its members. The vessel is to be demonstrated on the route Stavanger-Hommersåk by 2022.

The PILOT-E and PILOT-T schemes

The PILOT-E scheme was launched by Innovation Norway, the Research Council of Norway and ENOVA in 2016. Its aim is to speed up the development and deployment of novel products and services in the

²⁸ Meld. St. 4 (2018–2019) *Long-term plan for research and higher education 2019–2028*

field of environment-friendly energy technology so that emissions are reduced both in Norway and internationally. Through close coordination between funding agencies, PILOT-E can assist companies through the entire technology development pathway from concept to market.

Calls for proposals under the PILOT-E scheme in both 2016 and 2018 focused on solutions for zero-emission maritime transport. The zero-emission vessel *Future of the Fjords* is the first PILOT-E project that has reached the commercialisation stage. This is the world's first all-electric sightseeing vessel constructed using carbon-fibre composite materials. The shipbuilding company Brødrene Aa received a grant of NOK 10 million through the PILOT-E scheme to develop the vessel. Enova provided support for the shipowning company The Fjords in the form of a grant of NOK 17.8 million towards the purchase of an emission-free vessel and a grant of about NOK 7 million for the charging facility PowerDock. The Fjords has more recently announced the construction of a new zero-emission sightseeing vessel for use in the Oslofjord.

The Pilot-T scheme is part of the Government's innovation initiative, which was announced in the white paper *Norwegian National Transport Plan 2018–2029* (Meld. St. 33 (2016–2017)). The scheme involves cooperation between the Research Council and Innovation Norway, and offers Norwegian companies opportunities to take part in the development of new technology and new solutions for the transport sector. The Research Council has issued calls for proposals for projects in the research stage, with up to NOK 40 million in funding available, and Innovation Norway has allocated up to NOK 25 million to development and demonstration projects. The Pilot-T scheme is being continued in 2019.



***Future of the Fjords* is an all-electric sightseeing vessel that can carry 400 passengers.**
Photo: Helge Sunde / SamPhoto / NTB scanpix

Maritime clusters and test facilities

Norwegian Innovation Clusters is a programme run by Innovation Norway, Siva and the Research Council of Norway. It is intended to enhance innovation and collaboration within regional innovation clusters by expanding cooperation between businesses, knowledge institutions and public development agencies.

The programme provides support for clusters on three levels. *Arena* is for immature clusters in an early phase of organised collaboration. *Norwegian Centres of Expertise (NCE)* includes mature clusters with an established organisation, systematic collaboration and that have already achieved results through cooperation projects. *Global Centres of Expertise (GCE)* are mature clusters that are engaged in systematic collaboration in strategic areas, both within the cluster and internationally with R&D institutes and other relevant partners. The companies in a GCE cluster must be part of a global value chain, and there must be considerable potential for growth in national and international markets.

The programme has been funding cluster development since 2002, and maritime clusters have always been a major element of the programme.

Several clusters that members previously had a market for their goods and services in the oil and gas sector are now looking at new maritime opportunities, particularly opportunities for supplying green solutions. Several mature clusters are changing their strategies, and new clusters that have emerged are focusing on areas such as renewable solutions and offshore wind power.

NCE Maritime Cleantech focuses on clean maritime transport solutions. The Ocean Hyway Cluster achieved *Arena* status in 2018, and its ambition is to become a cluster for the entire value chain for hydrogen technology.

The mature maritime clusters, such as CGE Blue Maritime, are world leaders in their areas. In 2017, several of them were involved in a project to provide input on what measures different industries need to secure Norwegian exports, what can be done to make Norway a more attractive country for investors and businesses, and how the Brand Norway concept can be further developed and adapted for the maritime sector. The mature clusters are also ready to carry out national priority programmes.

The Government will continue to promote clusters as drivers of innovation. The cluster programme was evaluated in 2017, and the recommendations that were made are being assessed in connection with further development of the programme.

Private-sector cooperation forums

The Maritime Battery Forum was established in 2014 to promote collaboration between individuals and organisations established in Norway who are interested in battery-propelled ships. It functions as an arena for the exchange of information and cooperation between the industry, authorities and research groups. The Norwegian Forum for Autonomous Ships was established in 2016 as a cooperation forum for stakeholders working on autonomous shipping. Its members represent large parts of the maritime industry in Norway, and include the Norwegian Coastal Administration, the Norwegian Maritime Directorate and employees' and employers' organisations.

The Norwegian Catapult

The Government is supporting the development of test facilities for the development and deployment of new technology in all branches of industry. The Norwegian Catapult Programme was established in 2017, and supports the establishment of national centres that offer facilities and expertise for testing and simulation of new technologies and new solutions. Their purpose is to help companies accelerate the process from concept to market launch of their products and to do so effectively and at lower cost. The main target group is small and medium-sized enterprises, but larger companies and research and educational institutions can also use the catapult centres. Three new catapult centres, all of which focus on the ocean industries, were established in 2018. The Ocean Innovation Catapult Centre is based in Bergen and focuses on the development of new solutions for growth and green restructuring in the ocean industries. The Sustainable Energy Catapult Centre on Stord is a test facility for maritime and decentralised energy systems (batteries, fuel cells and hybrid systems) for the ocean industries and related industries. The main focus areas for the DigitCat Catapult Centre in Ålesund are simulation, digital twins and virtual prototyping. Although its main target group is the ocean industries, its work is relevant to all parts of the Norwegian production industry.

The Norwegian Export Credit Guarantee Agency (GIEK) and Export Credit Norway

Companies in all sectors can apply for GIEK's export guarantees and export financing from Export Credit Norway. Over a prolonged period, a large proportion of these guarantees and export financing has gone to companies associated with the oil and gas industry, mainly supporting deliveries of ships from Norwegian yards and shipbuilding abroad using Norwegian equipment.

Ships and related equipment made up about 85 % of Export Credit Norway's lending balance and about 75 % of GIEK's outstanding guarantee liabilities from 2015 to 2018. Of the lending balance for ships and related equipment in Export Credit Norway in this period, only 5–6 % was outside the oil and gas sector. For GIEK, the percentage outside the oil and gas

sector rose during the period, from 6 % in 2015 to 22 % in 2018. GIEK and Export Credit Norway often cooperate, but do not necessarily finance the same contracts. Norwegian shipyards and the maritime sector generally have restructured in the past few years, shifting away from oil and gas to other sectors. Over time, this may have more effect on Export Credit Norway and GIEK's portfolios, with an increase in sectors such as shipping, fisheries and cruise vessels.

The 2018 budget established a scheme making it possible for GIEK and Export Credit Norway and GIEK to finance vessels built at shipyards in Norway for use in Norway. Guarantees and loans can be provided for fishing vessels, ferries, wellboats, high-speed vessels and short sea vessels. This is a temporary three-year scheme, and will be evaluated. The scheme became operational in GIEK in January 2018 and in Export Credit Norway at the end of June 2018. So far, GIEK has only provided one guarantee under the scheme, for nine electric ferries, and Export Credit Norway has concluded a loan agreement for the building of a stern trawler.

GIEK's building loan guarantee scheme provides guarantees during the building period or during modification of ships and offshore installations. The purpose of the scheme is to ensure that Norwegian shipyards, offshore yards and other relevant companies can obtain loans by reducing the risk for private banks, and thus to increase the level of activity. The scheme is intended to make Norwegian shipyards more competitive by giving them easier access to financing and by increasing capacity in the Norwegian financial market.

5.4. The NOx agreement and the NOx Fund

Norway introduced a tax on NOx emissions in 2007. This applies to all ships with propulsion machinery with a total installed capacity of over 750 kW. Exemptions from the tax can be given for emissions covered by the environmental agreement between the Norwegian state and business organisations on measures to reduce NOx emissions. In 2017, a new environmental agreement for the period 2018–2025 was concluded between the Ministry of Climate and Environment and 15 business organisations.

The business organisations that are parties to the environmental agreement have established the NOx Fund. Its purpose is to encourage companies in Norway to carry out measures to reduce NOx emissions. Enterprises that come within the scope of the NOx tax and adhere to the agreement undertake to make payments to the Fund per unit of their NOx emissions. The NOx Fund provides support for enterprises that carry out measures to reduce their NOx emissions.

Most of the support granted by the NOx Fund has been for projects in the maritime sector, and projects in this sector also account for about 60 % of the emission reductions that have been achieved.²⁹ Measures to reduce NOx emissions by reducing fuel consumption or switching to other forms of energy also result in lower CO₂ emissions. It is estimated that projects supported by the NOx Fund, and projects that have been granted support but not yet carried out, may have reduced annual CO₂ emissions by about 400 000 tonnes CO₂-eq.

5.5. Cooperation between the authorities and the business sector

The Government's green shipping policy has been developed in close cooperation with the business sector. It will be vital to build on this constructive cooperation to speed up the pace of change in the maritime sector in the period up to 2030.

Shortsea Promotion Centre Norway

The Shortsea Promotion Centre Norway was established in 2003.

It is a centre of expertise for short sea shipping and part of a European network of similar centres. Its purpose is to obtain and communicate knowledge and act as a forum for information and contact between stakeholders in the transport market, in cooperation with relevant stakeholders in the maritime transport sector. The Centre may play a role in encouraging cooperation between companies to strengthen short sea transport services.

The project is being run by the Ministry of Trade, Industry and Fisheries and the Ministry of Transport. The Maritime Forum is hosting the project in the period 2018–2023. The maritime transport industry and logistics organisations are included in the steering group for the Centre.

The Green Shipping Programme

The Green Shipping Programme is a private-public partnership that was established in 2015 on DNV GL's initiative. The vision for the programme is to establish the world's most efficient and environmentally friendly coastal shipping fleet. The programme's studies and pilot projects are helping to identify and develop zero- and low-emission solutions that can be put into practice rapidly.

Work under the Green Shipping Programme has been divided into four phases. In the first phase, which started in 2015, the potential for battery and gas-based maritime transport in Norway was assessed. During this phase, two studies were carried out and five pilot projects were established to assess the prospects of environmentally friendly operation of ships. The projects focused mainly on technical solutions.

²⁹ https://www.nho.no/siteassets/nox-fondet/rapporter/2018/nox-fondet-arsrapport-2017_oppslag.pdf (In Norwegian only.)

In phase two, which started in spring 2016, business cases were developed. The programme has defined possible regulatory and financial incentives and instruments. It has also analysed economic and commercial consequences of various measures and reviewed how key barriers and challenges can be overcome. Five pilot projects were established during this phase.

The third phase of the programme started in 2018, and is focusing on eliminating barriers to zero- and low-emission solutions in shipping. In addition, detailed implementation plans will be developed.

In the fourth phase of the programme, up to 2030, its stakeholders will seek to scale up the solutions that have been developed through pilot projects. In this phase it will be vital that there are smoothly functioning markets for green technologies, so that low- and zero-emission solutions can be put into practice in all shipping segments. It will be important to maintain the dialogue between the authorities and stakeholders in various parts of the value chains so that it can play a part in eliminating barriers to green, cost-effective solutions.

NOK 7 million was allocated to the Green Shipping Programme in the 2019 budget.

The Government will:

- Maintain Enova's position as an important funding agency for the transition to zero- and low-emission technology
- In the forthcoming action plan for green public procurement and green innovation, consider how requirements relating to zero-emission transport can be included in public procurement processes whenever feasible
- Consider the introduction of a biofuel quota obligation for advanced biodiesel and biogas for shipping
- Increase the carbon tax rate by 5 % per year from 2020 to 2025
- Continue to support the Green Shipping Programme and maintain close dialogue with business and industry in order to create green, competitive employment within Norway's maritime clusters



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