CHARTING A COURSE FOR GREEN COASTAL SHIPPING

Input to the Norwegian government’s commission on green competitiveness from the Green Coastal Shipping Programme
The road map described in this document is input to the Norwegian government’s commission on green competitiveness.

It is a proposal for a broad, cohesive and well-rooted strategy for stimulating the green shift in the maritime industry. This will offer great reductions in greenhouse gas emissions, and lead to sustainable growth and added value and an increased level of international competitiveness for the maritime industry. The document has been developed by the Green Coastal Shipping Programme.

The Green Coastal Shipping Programme is a collaborative project between government authorities and the private sector with the objective of encouraging more widespread adoption of environmentally friendly solutions for shipping. The goal of the programme is for Norway to be a world leader in environmentally friendly and efficient shipping.

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THIS WILL OFFER GREAT REDUCTIONS IN GREENHOUSE GAS EMISSIONS, AND LEAD TO SUSTAINABLE GROWTH AND ADDED VALUE AND AN INCREASED LEVEL OF INTERNATIONAL COMPETITIVENESS FOR THE MARITIME INDUSTRY
CONTRIBUTORS
The maritime industry is big in Norway and is one of the few Norwegian industries which is also big on an international scale. Norwegian ships and sailors sail on all seas, Norwegian producers deliver components and equipment to ships under construction throughout the world and Norwegian service providers offer their skills to customers in all maritime markets.
Key actors in the industry are shipowners and ship operators, as well as shipyards and equipment suppliers. Other actors include fuel suppliers, ports and service providers of many kinds, including financial, insurance, classification and consultancy services and research and educational institutions. Cargo owners, logistics companies, buyers of transport services and government authorities are premise providers to the industry. All of these actors make up a complete cluster, with significant value creation and employment. Table 1 provides an overview of value creation and jobs in the maritime industry from 2004 to 2013.

One of the key challenges that the maritime industry will have to tackle in coming years is the reduction of greenhouse gas emissions. Such emissions must be reduced, despite an increased need for maritime transport. At a time when emissions reductions are high up on the political agenda this is to be anticipated, and the shipping industry will be expected to think innovatively and look into new solutions such as electrification, hybrids, LNG and hydrogen. COP21, the Paris Agreement and Norway’s commitments to reducing emissions set strict guidelines for shipping emissions, especially as the sector is a large source of non-tradable carbon emissions. Despite the fact that ships are the most environmentally friendly means of transportation, they still lead to significant greenhouse gas emissions. Norwegian domestic shipping represents some nine per cent of total CO2 emissions in Norway.¹ In other words, there is a real potential within shipping to reduce emissions in the Norwegian climate balance. Ships also emit significant amounts of gases such as NOx and SOx, and therefore contribute to poor air quality, something which constitutes a significant threat to health the world over – including in parts of Norway. Nevertheless, we do not tackle this directly in this document as it lies outside of the expert commission’s mandate. However, many measures for combating CO2 emissions will also significantly reduce emissions of gases which pose a threat to the environment and health alike.

Along with the rest of the maritime cluster, Norwegian shipping holds a unique position in the world. The industry is characterised by a capacity for innovation and value creation, which has led to Norway becoming one of the most advanced maritime nations in the world today. The Norwegian maritime cluster is at the forefront of the development and use of technology and concepts that help to reduce emissions and improve the environment.

Over the coming decades, society and the shipping industry must undertake wide-ranging, fundamental upheavals in order to meet the environmental challenges of the future. This will present a challenge, but it will also present us with the opportunity to develop and innovate with new environmentally friendly technologies that can offer cost-effective emissions reductions in shipping, whilst also providing big ripple effects in the form of increased export possibilities, value creation and jobs within the maritime industry.²

Such upheavals do not happen on their own. They demand further input from the industry itself; however, it is also a prerequisite that government authorities invest in and lay the groundwork for them. The steps that must be taken are fundamental, and can be compared to those that have been made in Norwegian electric vehicle policy, which has shown that Norwegian authorities can provide effective incentives for environmentally friendly choices. The corresponding subsidy schemes for shipping will lead to significant reductions in the emissions of greenhouse gases and to improvements in local air quality, with better cost efficiency and a considerably greater effect on business. Norway has naturally good prospects for developing the environmentally friendly and sustainable transport solutions of the future, based on short sea shipping. In addition, we have a maritime industry that has a long history of tackling demanding transport and logistics tasks internationally. It should be possible for our long coastline to serve as an incubator for technological solutions that can then be exported and have a ripple effect globally.

The choices we make today will determine our emissions in 2050. This document describes the industry’s own outlook on the steps that must be taken, and its structure consists of three principal parts:

- The current situation: emissions, the industry, opportunities
- Vision for 2050
- Steps that must be taken to realise this vision

Table 1: Value creation and employment in the maritime industry, 2004–2013³.

<table>
<thead>
<tr>
<th>VALUE CREATION, BILLION NOK</th>
<th>EMPLOYMENT</th>
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<tr>
<td></td>
<td>2004</td>
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<td>Shipowners</td>
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<td>Services</td>
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<tr>
<td>Shipyards</td>
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<tr>
<td>Total</td>
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</tbody>
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Table 1: Value creation and employment in the maritime industry, 2004–2013³.

THE CURRENT SITUATION:
EMISSIONS, THE INDUSTRY AND OPPORTUNITIES

GREENHOUSE GAS EMISSIONS FROM NORWEGIAN DOMESTIC SHIPPING

Compared with other sectors, some aspects of the greenhouse gas emissions from the shipping industry make it stand out. Firstly, the source of the emissions – that is to say the ship – is extremely mobile. Norwegian domestic emissions can originate from ships that are heading for foreign trade. Secondly, there are many – in some cases small – actors, and the type of activity that these actors’ ships are conducting varies greatly. In addition, there are big differences in business models – in, among other things, customer-supplier relationships, contractual relationships and pricing structures. Checks are performed on shipping in different ways, including through flagging and ownership. This can limit the impact that Norwegian authorities can have. Finally, ships have a very long lifespan (30 years), which makes the frequency of replacement low and the pace of change slow. This means that the choices and investments that we make today will determine the composition of, and emissions produced by, the Norwegian fleet in 2030 and 2050.

Calculations based on the ships’ activities show that domestic Norwegian shipping makes up 9% of all Norwegian greenhouse gas emissions.4 Fuel consumption and CO2 emissions from domestic traffic are dominated by three types of ship: passenger ships, offshore ships and fishing vessels (see figure 1). In addition, cargo ships as a whole make up a significant proportion of emissions. It is the smaller ships in these categories which constitute the most domestic traffic. In 2013, there were a total of 6,700 different vessels servicing Norwegian waters and contributing to overall CO2 emissions. The contributions to domestic emissions tend to come from a relatively small number of ships which spend a lot of time in Norwegian waters. Ships flying under the Norwegian flag make up almost 70% of emissions from domestic traffic, whereas the Bahamas, Malta and Panama are the other main contributors, making up less than four per cent each.

DIFFERENT SHIPS PRESENT DIFFERENT CHALLENGES

Different types of shipping and sea transportation are associated with different types of features and challenges, and there are many differences between the four main ship types. Note that considerable quantities of emissions are linked not directly to transportation (i.e. the conveyance of goods or people) but to the fulfilment of different types of services, such as fishing and anchor handing. These aspects are important for:

- understanding what technologies and solutions can be used;
- understanding how government authorities can potentially affect emissions; and
- understanding how the Norwegian maritime industry stands to benefit from establishing domestic Norwegian shipping as an international spearhead.

OTHER EMISSIONS IN NORWEGIAN WATERS

This road map is primarily aimed at reducing domestic emissions, i.e. emissions from traffic between Norwegian ports or between ports and offshore installations. These emissions form part of Norway’s international commitments and as such are of particular significance. All emissions in Norwegian waters are, however, twice the size of those of domestic emissions alone, and the effects on the environment are just as significant. There is a good market potential for Norwegian service providers and suppliers to deliver solutions to reduce emissions. It is important that the steps taken to reduce domestic emissions also encompass other emissions to as great an extent as possible.

4 DNV GL (2014)
Cargo ships
Cargo ships comprise the traditional coastal fleet transporting goods along the Norwegian coast. This fleet features many old ships and is in real need of renewal. It is these ships that must carry out transportation in order to meet the objective of transferring cargo transportation from the roads to the sea. The shipowners’ customers tend to be shipping agents and cargo owners – primarily private operators – and the ships also tend to be privately owned. Cargo ships are built and designed to a lesser degree in Norway, but they often carry Norwegian equipment and a Norwegian class. The international fleet of cargo ships is extremely large, something that means there is a real potential to export green solutions.

Passenger ships
The combined emissions of domestic passenger ships, including ferries, high speed craft, cruise ships and others, are also high. State and county municipalities often purchase ferry services; something which gives government authorities the opportunity to have a direct influence. The ships are privately owned and are built both in Norway and abroad. There is also considerable potential here to export green solutions.

Offshore vessels
The supply ship fleet is modern, and given the large amount that these ships contribute to overall emissions, this is an important segment. The customers are oil companies conducting operations and/or exploratory activities on the continental shelf, and the ships are privately owned. Note that the offshore vessels constitute only one element of the total transportation used by the oil companies on the continental shelf. In total, this transportation constitutes approximately two per cent of the total Norwegian climate balance, featuring input from oil tankers; gas, chemical and product tankers; vessels for construction, maintenance and preparedness; and other service ships and base-to-base transportation. Norwegian offshore vessels are often built in Norway and tend to be designed in Norway and equipped by Norwegian suppliers. There is considerable potential for the export of green solutions.

Fishing vessels
Fishing boats are the last large segment, representing a large part of domestic emissions. Many Norwegian fishing boats are built abroad, but they have often been designed in Norway and are equipped by Norwegian suppliers. On an international level, there are a great many fishing vessels, meaning there is a real potential to export green solutions.

MEASURES AVAILABLE FOR REDUCING CO₂ EMISSIONS
Common to all aspects of domestic shipping is the huge potential for cost-effective emission reductions. A wide range of measures are available to reduce ships’ greenhouse gas emissions. Such measures can be divided into three main categories:

- **Technological measures.** These include the optimisation of hull design, propellers, propulsion engines, battery hybridisation, onshore power and charging. These also encompass measures that reduce the amount of energy used on board for purposes like lighting, heating and powering cranes and pumps.
- **Operational measures.** These include all of the ways in which a ship’s emissions can be reduced without having to make physical changes to the ship. Examples may be speed adjustments, better and more frequent hull cleaning, optimalised draught and more.
Fuel measures. These cover all alternatives to the current favoured choices, which are variants of fossil diesel. Examples of alternative fuels include full electric power through the use of batteries, natural gas (LNG), biogas, biofuels and hydrogen.

A few selected examples of the measures available are shown in the boxes. A more comprehensive overview is available on the International Maritime Organisation’s (IMO) website, among other places.⁵

Some measures, including the majority of operational measures, can be implemented on both new and existing ships. Others, including many technological and fuel measures, are best implemented on ships which are being newly built. In many cases, however, measures which are best suited for ships currently under construction can also be used on existing ships, but at a higher cost. Many of the technologies will incur additional costs, with heavy investment during the initial phase. Nevertheless, to some extent we have seen that once the technologies get a foothold they can generate considerable savings. Many of the solutions that are beneficial for the environment are also useful for combatting harmful emissions, such as NOx and SOx. Fuel measures also require a market and infrastructure that can deliver different types of energy carriers. Norway is in a particularly good position to build a cost-effective infrastructure that can deliver power to rechargeable battery hybrid ships.

In addition to the categories of measures mentioned, shipping can make a significant contribution to reducing society’s emissions of greenhouse gases by moving goods deliveries from roads to the sea. A report by DNV GL for the Norwegian Shipowners’ Association⁶ shows that intermodal transport systems can consume considerably less energy and emit considerably less greenhouse gases than car-based systems. Scenarios involving both domestic and inter-European transportation were analysed, and it has been shown that CO₂ emissions could be reduced by 54–80%. When converted to an identified transfer potential of five million tonnes of cargo from road to sea, this gives a national reduction in CO₂ emissions of 300,000 tonnes per year, which corresponds to 300,000 long hauls via lorry or the environmental effect of 150,000 electric cars.

POTENTIAL TO REDUCE GREENHOUSE GAS EMISSIONS FROM DOMESTIC SHIPPING

A study conducted by DNV GL and commissioned by the Ministry of Climate and Environment⁷ has analysed the extent to which the measures available can reduce emissions by 2040. Without sweeping national measures, the study suggests that CO₂ emissions from Norwegian domestic shipping can be expected to increase by almost 40 per cent by 2040. This assumes a fleet growth that does not use environmentally friendly fuels or new technologies beyond those needed to adhere to the Energy Efficiency Design Index (EEDI) requirements, see figure 2.

However, the study also shows that technological and operational measures can help to limit the growth of emissions considerably, but that this is not enough to reduce future emissions down to the desired level. Even if all 17 operational measures included in DNV GL’s model are implemented on all ships for which this is deemed to be technically possible – both new and old – emissions in 2040 are estimated to be some 11% higher than they are today.

Examples of measures

Electric ships

Ships powered by batteries charged using onshore power will eliminate all emissions from the ship – including CO₂ emissions. The investment costs are often high, but fewer running costs are incurred.

The technology is new, but it is undergoing rapid growth. One main challenge is the limited current range of such ships and the basic charging station infrastructure available onshore. Hybrid electric vessels that are powered to a significant extent by onshore power will often be a good and reasonable alternative for cases in which the operating situation makes it difficult to be exclusively battery-driven.
Figure 2: CO₂ emissions from Norwegian domestic shipping towards 2040.

Significant reductions to the current emissions levels are considered to be achievable only with an extensive use of alternative fuels with low carbon emissions. DNV GL (2016a) describes a scenario which will enable large cuts to emissions to take place in a cost-efficient manner. The scenario – which describes one of many possible ways forward – involves the use of biofuels on traditional cargo ships and fishing vessels, LNG on offshore vessels and an electrically powered ferry fleet. In this scenario, 2,750 ships – 28% of the sea fleet – must run on alternative fuels by 2040. This scenario offers a reduction in CO₂ emissions of 40% when compared to today’s levels. The list of measures included in this study is not exhaustive. In other words, there are additional measures that are expected to be available for shipping over the coming years.

NECESSITY OF BEING PREPARED FOR GREAT CHANGE

As such, large cost-effective cuts to emissions are deemed to be possible. However, this will require big steps to be taken so that existing solutions can actually be put to use, and it will also require new solutions to be developed. The scenario described can hardly be described as anything other than a fundamental upheaval to the fleet, and it will involve extensive changes to thousands of ships.

LNG

The use of liquefied natural gas eliminates almost all emissions that are harmful to health and the environment, and can reduce greenhouse gas emissions by approximately 20%. In the short term, LNG is the only realistic alternative to diesel for transportation over larger distances.

The technology has considerable added investment costs, but in many cases these pay themselves off over the ship’s lifespan. Access to bunkering infrastructure is a challenge. The technologies utilised on LNG-powered ships are the same as those utilised when running on liquefied biogas.

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8Cost-efficient = The life cycle costs of the measure are less than zero.
VISION FOR 2050

Our vision is for Norway to establish the world’s most efficient and environmentally friendly coastal shipping, powered partly or entirely by batteries and other environmentally friendly fuels. By 2030, greenhouse gas emissions from domestic shipping shall be cut by 40% compared to current levels, and we shall have zero emissions by 2050.

THIS MEANS THAT BY 2050 WE WILL HAVE:

- a fleet of safe, highly productive, energy-efficient ships with zero or low emissions.
- a complete, developed infrastructure for environmentally friendly fuels, in which energy carriers like gas, biofuels, hydrogen and electricity are available along the entire coast at competitive prices. This infrastructure will be co-ordinated with that of foreign ports to ensure the ships’ regional and global mobility.
- effective ports and coastal terminals for shipping along the coastline, enabling frequent maritime transport chains along the coast which can compete with road transportation.

This will transform Norwegian coastal shipping into a showcase to the world, an incubator and a platform for the Norwegian export of environmental technologies and green transport services, making a considerable contribution to reducing global shipping emissions.
We do not believe that this vision can be achieved with today’s measures. This is despite the fact that:

- the technological solutions are available and we have supplier and shipyard industries that have indicated that they are in a position to deliver
- subsidy schemes for the development and implementation of technological solutions are in place
- the green shift is expected to be able to offer operational savings to shipping, even if there are increased investment costs and a need for financial impetus in the introductory phase

EVERYONE MUST CONTRIBUTE

The shipowners are willing to invest in new solutions, but this presupposes an assurance that the market is willing to pay for green ships and services. Among purchasers of transport services there is currently a reluctance to pay, and shipowners therefore feel that not investing presents the least risk to them.

As heavy investment into new, green ships does not lead to an increase in income when compared with older, conventional ships, one cannot expect investments to be made. We need concrete, effective steps that will make the market for green solutions work.

An important prerequisite is that cargo owners, shipping agents and end users of transport services show a greater willingness to pay for green maritime services. At the same time, government authorities can also go a long way to creating a market for green shipping through incentives and regulations, and as a purchaser of maritime services. An example of steps that are expected to have a positive impact is the requirement for the use of zero- and low-emission technologies, currently seen in Norwegian invitations for ferry tenders. The effectiveness of such instruments is essential to reach the objectives for reduced greenhouse gas emissions by 2030 (40% reduction) and 2050 (100% reduction). This reorganisation will not happen by itself, and the rollout of new solutions will take time. Government authorities and the creators of policy instruments must also take on board how little time there actually is if the national objectives are to be met.

TIME FOR ACTION

We need concrete, effective steps that will make the market for green solutions work. This road map presents the following five steps which we believe Norway must successfully implement to achieve the goal of efficient shipping with a significant reduction in emissions. We must:

1. increase co-operation between industry actors throughout the value chain
2. create markets for green technology
3. reinforce shipowners’ financial capacity
4. establish a CO₂ fund for the transport sector
5. establish an adequate fuel infrastructure – production, distribution and bunkering
01 INCREASE CO-OPERATION BETWEEN INDUSTRY ACTORS THROUGHOUT THE VALUE CHAIN

Much of the driving power behind a renewal of the industry must come through steps introduced by government authorities, as a form of market failure hinders effective change. Similarly, it is clear that industry actors all have a responsibility to implement such steps, as well as having a commercial, sustainable opportunity to do much themselves.

The Norwegian maritime industry has already invested considerable sums into new, energy-efficient and environmentally friendly technologies, from the “simple” transition to more energy-efficient equipment and lighting to extensive conversions to new and innovative propulsion and energy-use solutions, alternative fuels and zero-emissions technology. The industry can already refer to:

- Several hundred projects involving energy optimisation through conversion to new, energy-saving propulsion technologies, hull optimisation or a transition to the use of low-energy equipment on board.
- Over 50 LNG-powered ships in Norwegian waters, as well as several on order. Development is following suit internationally, with 25 LNG-powered ships in operation and over 80 ships on order.
- One fully electric vessel and 10 hybrid electric vessels are in operation, and a further 20 to 30 concrete projects are being implemented or planned involving battery-powered technology – a number of which are growing rapidly as a result of the requirements for zero- and low-emission technologies in the ferry sector.
- 40 to 50 projects involving the establishment or expansion of onshore power opportunities for ships.

Considerable investment has been put into these initiatives by the sector. If one takes, for example, the projects supported by the NOx Fund, the shipowners themselves stand to cover over half of an additional investment of NOK eight to nine billion, compared with conventional solutions. However, the industry must also take on board how little time we have and use the opportunity to take a market position and make profitable emissions cuts:

- Innovative power throughout the maritime industry must be harnessed – the right solutions might well be found in the interfaces between different actors. In particular, cargo owners and purchasers of transport services must be involved as it is these parties, together with government authorities, who can make the decisions that will have the greatest impact and trigger the green shift.
- Cargo owners, shipping agents, shipowners, port authorities, shipyards and suppliers of equipment, gas, power and services, as well as other actors within the field of safety and environmental approvals must invest in reorganisation, training, new technologies and marketing for the export of environmental technologies and green transport services to the international market.
- Shipowners and suppliers must actively investigate and make use of the subsidy and funding schemes available.
- The industry must review its contract forms so as to make use of contracts which reward instead of hindering green choices with regard to transport, and give sufficient room for testing and implementing new green technology.
- Together with other industry actors, cargo owners must find out how the transportation of goods can be differentiated between what must be conveyed rapidly and what can take slightly longer, so that the advantages of the different forms of transport can be exploited to the greatest extent possible.
- Studies must be conducted of the key segments, in which obstacles are identified, possible solutions outlined and clear recommendations given to bring about change and the green shift. These should correspond to the study carried out for the report Realisering av null- og lavutsippsløsninger for ferjesamband (“the realisation of zero- and low-emission solutions in the tender process for ferry links”). Initially, such a study will be useful for the transportation of goods, offshore-related transport, fishing and aquaculture.
- The Green Coastal Shipping Programme is a partnership programme between the public and private sectors. The programme shall be an effective policy instrument for the initiation of the Government’s maritime strategy and port strategy and is a good tool for the implementation of the expert commission’s recommendations.
We are already seeing a gradual increase in demand for green solutions in the maritime sector as a result of the overall context of rules, incentives and an increased environmental awareness in society. The problem is that this is moving too slowly if we are to avoid the dramatic consequences of climate change. It is, however, possible for government authorities to contribute more actively to increasing demand for existing solutions for energy-efficient ships with low or no greenhouse gas emissions, as was the case with the electric car scheme. For the dominant types of traffic in Norway, the following concrete steps could be important:

**PASSENGER SHIPS, INCLUDING FERRIES AND HIGH SPEED CRAFT**
- Implement the recommendations from barrier and solution studies conducted in the ferry sector. ⁹
- Expand and reinforce the Storting’s requirements regarding zero and low emissions when inviting tenders for ferries and high speed craft in such a way as to 1. primarily encourage the replacement of the oldest and most polluting elements of the ferry fleet, and 2. help to create an effective tender market in which infrastructure limitations or tender requirements do not hinder the introduction of new, environmentally friendly vessels in future invitations to tender.
- Introduce more ambitious environmental requirements in the announcement of the contract for the Bergen–Kirkenes Coastal Route (formerly the Hurtigruten agreement).

**FISHING AND AQUACULTURE**
- Use the allocation of quotas and licences to drive green change so that fishing takes place with limited emissions.
- Give authorised operators within aquaculture responsibility for emissions in a greater share of the value chain (including maritime transportation and services).

**OFFSHORE VESSELS**
- Use the allocation of licences (permits for exploration and extraction) to demand that maritime activity (different types of offshore ships) shall be conducted with limited emissions.
- Give licence holders responsibility for emissions in a greater share of the value chain (including maritime transportation and services).
- Use the state’s power of ownership of the continental shelf to set demands for green transport in procurements. This can also be effective in existing fields.

**CARGO SHIPS**
- Introduce provisional subsidy schemes which benefit goods owners that choose ships with zero- and low-emission technologies. There will be a need for this in a start-up phase to establish a transport system of both volume and regularity.
- To increase the desire to invest, we must increase the volumes of goods – move cargo from land to sea. Cargo transported by sea must in the long term be treated the same way as cargo transported by land – such is not currently the case.
- National authorities should take overarching responsibility for the infrastructure within sea transportation, in the same manner as for air, rail and road transportation. The ports must be more closely integrated into a national logistics system.
- Establish a National Transport Plan to ensure that the terminals and logistics solutions are appropriate for effective sea transportation.
- Through land planning, the authorities can make arrangements for logistics terminals and warehouses to be established near ports.
- Introduce a comprehensive and national system for environmental differentiation in port charges, compensation and other charges.
- Support investment into measures to reduce the time and costs associated with the handling of cargo in ports, including loading and unloading and the cargo’s route through the port to and from warehouses, goods terminals or other forms of transportation.
- Use the allocation of licences to oil companies to set strict requirements on energy usage and emissions from the transportation of petroleum products and transportation between land bases.
- Set requirements for environmental friendliness to be a characteristic of transportation in all public procurements.

⁹DNV GL (2016b)
Even if the market for green ships should provide favourable conditions for good income in the long run, there is a danger that investments in new, green ships will fail to materialise. Many shipowners are struggling with their financial capacity and have a limited ability to invest in expensive fleet renewal programmes. New technology can bring with it greater risks than traditional technologies linked to the second-hand value of the ship, and this is something banks bear in mind when lending. The capital situation has, for example, been highlighted as an important obstacle in relation to meeting zero- and low-emission requirements in new tenders for routes in the ferry sector, despite the fact that a good number of other aspects appear to be laying the groundwork for technological restructuring, including the funding of additional costs through subsidy schemes. We recommend the following:

- Establish state guarantee schemes and/or favourable loan schemes for environmentally friendly ships based on models similar to those of state House Bank loans.
- Ensure that the Norwegian Guarantee Institute for Export Credits (GIEK) and Export Credit Norway gain a clearer mandate to prioritise green solutions.

Regardless of how much they may want to renew their fleets, some shipowner segments do not get commercial loans – for example, within goods transportation, where the typical shipowner can have one or two vessels that are 30 years old or older. This move is primarily about the ability to invest in new ships, not the added costs of environmental technologies in themselves. However, it is often the case that a number of environmental solutions in practice presuppose new builds, so these are interrelated. The additional costs of the technology in itself are financed through subsidy schemes.
Several of the technological solutions the industry must convert to in order to achieve the zero- and low-emission targets result in increased investment costs, especially in the introductory phase for new technology. For some solutions, this could be so considerable that they are not chosen, even if both the ability to invest in new ships and the demand for environmental technologies are present.

Today, there are different support schemes which are intended to cover the additional costs for technologies that increase energy efficiency and reduce emissions, but these are not sufficiently targeted. We recommend:

- Establishing an environmental agreement with an associated CO₂ fund for the transport sector.

Environmental agreements between the authorities and the business sector have proven to be very effective policy instruments, among other things as a result of the flexibility a private fund has to shape and allocate support, as compared with that received from a state enterprise such as Enova. The environmental agreements regarding NOx (the NOx Fund) and the SO₂ agreements for process industries are good examples of this, wherein the business sector commits to achieving certain given emissions reductions through payments to an environmental fund, and these are then fed back to industry actors as investment support for additional costs incurred in enacting measures to reduce emissions. These environmental agreements have gained much positive attention well outside of Norway’s borders. An environmental agreement with an associated CO₂ fund for transportation, which NHO has advocated for, could help to overcome the obstacles to new environmentally friendly technologies being put into use. A CO₂ fund should encompass as much as possible of the business sector’s transportation; that is to say trucks, buses, vans, agricultural and construction machinery, ferries, local shipping and flights. Just as with the NOx Fund, the structure will also lead to international vessels involved in Norwegian shipping having to contribute to the fund. A “Business Sector CO₂ Fund” and existing schemes such as those by Enova will be able to supplement one another well and contribute in different ways to the technological restructuring necessary to meet emissions targets. A CO₂ agreement between business sector transportation and the authorities will also be able to feature the ambition to develop and pilot new technology. In such a way, the business sector itself can take greater responsibility for filling in “holes” in the R&D subsidy schemes and giving the environmentally friendly technologies the most secure route to market possible.

As part of establishing a CO₂ fund, it would be appropriate to set national goals for reducing emissions within the segments encompassed by the fund. We also recommend that national goals be set to reduce emissions within the remaining key segments of coastal shipping which may perhaps not be covered by the fund.
Even with a strong market demand and good funding and subsidy schemes for environmentally friendly maritime services, the essential restructuring may be hindered by a classic case of the “chicken and the egg” problem with regard to the fuel infrastructure. We know that business must make great changes to realise its vision and goals. We also know that it takes a very long time to replace the ship fleet. As this transition must take place quickly there will not always be time to wait and see which technologies and solutions will be “winners” in the markets. This is especially true of the choice of infrastructure, where determining the type of fuel provided in Norwegian ports often lies far outside of the individual actors’ sphere of influence. Society must make infrastructure choices, because the possibility of selecting many technologies is dependent on the infrastructure being in place. In this context, it also becomes important to connect to infrastructure decisions in our region, especially in the EU.

Electricity will be one of the important fuels in the fulfilment of the sea chart’s vision. Today, fully electric and chargeable battery hybrid solutions are limited by the infrastructure available and the large degree of special adaptations for the operational profile. Chargeable hybrid solutions based on gas and batteries, for example, will be able to give individual operators real flexibility with regard to being able to move ships around as and where needed (capacity, repair dockings, etc.), and will be a key part of the solution.

In order to accommodate the use of onshore power, rechargeable hybrids and fully electric ships, we should:

- Make available – and make it a requirement to use – onshore power for all relevant ship types in all ports with substantial emissions. We must, for example, avoid situations in which cruise ships docks close to city centres without onshore power.
- Gradually expand and step up the infrastructure to encompass charging infrastructure for rechargeable hybrids and fully electric ships (not only ferries).
- Adapt the pricing of tariffs and fees for onshore power and charging so that the power supply is competitive for rechargeable hybrid ships. Through this competitive power pricing, we expect an explosive market penetration for this type of ship which will give shipowners operational savings together with reduced emissions of gases that are harmful to health and the environment.
- Take account of the need for an increased provision of power to shipping through Statnett’s network development plans.

Other existing environmentally friendly fuels must be made available to a sufficient extent. In particular this requires a national infrastructure for the production, distribution and bunkering of:

- LNG and sustainable biogas.
- Sustainable liquid biofuels.
- Sustainable hydrogen.

The transport and bunkering infrastructures for LNG and biogas overlap and must be expanded. In addition, the production capacity for biogas must be expanded considerably – for example, through the introduction of green certificates. The transportation and bunkering of liquid biofuels will be able to make use of the existing infrastructure for fossil diesel. The availability of sufficient volumes of sustainable biofuels must also increase.
The steps we have proposed above will bring us a long way towards realising our vision. However, this presupposes the practical implementation of the steps being made sufficiently comprehensively and powerfully. In addition, work with international regulations and research and development (R&D) must continue and be reinforced. Further, one must assume that taxation and duties policies are arranged in the most effective way possible to bring about the desired solutions.

Even if a good deal can be achieved nationally, we are also dependent on our international partners in the IMO and EU to be able to reduce emissions sufficiently. Shared international requirements through the IMO are essential to all actors being able to compete on a level playing field. Unilateral Norwegian requirements will be potentially detrimental to the competitiveness of Norwegian actors: both shipowners and goods owners. Norway must continue to have a leading role internationally, whilst we must also take the essential national steps to see the desired – and needed – change.

Continued investment into R&D and the development of new and better solutions are also essential. We are here referring to the Maritime 21 process, which results in a range of good recommendations for the prioritisation of research and development, and which supplements this sea chart in a good way. We nevertheless bring up the need to initiate studies that identify the concrete barriers to the green shift and green competitiveness.

There should also be dedicated investment into piloting autonomous zero-emission cargo ships in coastal shipping. Here, Norway has good prospects as well as the potential to show the world the first full-scale demonstration, in which we take a unique position – as Google has done with their driverless cars. Such a project will demand strong state support, as a result of the scale and complexity of the project.

With the implementation of the proposed measures, it will be possible to achieve a fleet with zero emissions by 2050.

OTHER RECOMMENDATIONS

10Maritime 21’s recommendations are available on this website: http://www.maritim21.no/prognoss-Maritim21/Forside/125406265186
The Norwegian maritime industry is global and competence-based, with a strong position in markets throughout the world. It is often a leader when it comes to the development and use of green technologies, and with more than 110,000 employees in Norway, it is also one of the country’s biggest and most important industries. After oil and gas, the industry is by far the biggest export industry we have, with one-third of Norway’s total exports once petroleum products are discounted.

A restructuring to zero- and low-emissions technology can have a considerable impact in the form of increased turnover for Norwegian shipyards and service and equipment suppliers. If the industry is to be able to retain high productivity in relation to other industries, the effects will also be positive from a socio-economic perspective, which will reduce the overall costs of the transition. In the process of transition, key competence from the oil and gas industry can be put to use to great advantage within the maritime industry. For example, world-class competence within gas, combustion and explosions analysis and risk management could successfully be used to expand a secure and effective infrastructure for gas, as well as for gas- and battery-powered ships.

Increased demand domestically will give the Norwegian supplier industry a head start. We can already see an example of this through the NOx Fund, which, by awarding the support of some billion NOK, has made a considerable contribution to Norwegian suppliers experiencing an increase in turnover and becoming experienced leaders within environmental technologies such as batteries, LNG and catalysts for ships. A marked increase in demand for such solutions is expected internationally, as a result of increasingly strict emissions requirements under the direction of the IMO and increased environmental awareness more generally. For example, over a rather short space of time, the situation of LNG-powered ships has gone from their being a relatively Norwegian phenomenon to roughly 90% of the ships currently on order destined for outside of Norway.

Zero- and low-emissions requirements which are now being set for new ferry contracts are another such example. This will increase the activity of the highly competent Norwegian shipyard and supplier industry, which is otherwise experiencing reduced access to contracts.

This roadmap will have the following commercial effects:

- Profitable emissions cuts, with a significant potential for scaling based on the strong international position the Norwegian maritime industry occupies in the world.
- Green jobs. The maritime industry can become an important green growth industry with thousands of new jobs.
- Increased competitiveness through being the first to demonstrate successful demo projects in different market segments.
- A leading position internationally. Norwegian coastal shipping can become a showcase to the world, an incubator and a platform for the Norwegian export of environmental technologies and green transport services.

The maritime industry can become an important green growth industry with thousands of new jobs.
**MILESTONES ON THE WAY TOWARDS THIS VISION**

**2016**
Authorities and business see the opportunities presented by, and the need for, extraordinary steps.
New ferries and high speed craft ordered with requirements that presuppose zero- and low-emission technology.

**2017**
Goals for reduced emissions established in the key segments by domestic shipping.
The NOx Fund is continued.
A comprehensive national plan for fuel infrastructure (alternative fuels) is in place – the prospects of access to alternative fuels shall not constitute any obstacle.
A state guarantee scheme and favourable loan schemes for environmentally friendly ships are set up.

**2018**
A provisional (five-year) grant scheme is established to transfer goods from land to sea – to establish volumes on the new transport network.
Environmentally differentiated port charges introduced nationally. This offers incentives for both domestic and international traffic.
The business sector’s CO2 fund for the transport sector is established.

**2019**
A committee of large cargo owners and shipping agents agrees to establish select dedicated and highly frequent sea transportation routes.
A considerable share of base-to-base transport for the oil companies is transferred from road to sea.

**2020**
Requirements are set for zero- and low-emission solutions for maritime services in all new oil and gas licences.
The first full-scale pilot for autonomous zero-emission ships is implemented.
Requirements are set for zero- and low-emission solutions for maritime services in the fishing and aquaculture industry through all new allocations of quotas and licences.

**2025**

**2030**

**COMPETITIVE PRICING OF POWER SUPPLY THROUGH TARIFFS AND VAT EXEMPTIONS**

**2018**
Competitive pricing of power supply through tariffs and VAT exemptions, where applicable, contribute to the market for onshore power, rechargeable hybrid ships and fully electric ships being realised.
Shipping competes on the same terms as road transport. The authorities take overarching responsibility for infrastructure for sea transportation by setting up Havinor. A comprehensive national strategy for port infrastructure is in place.
Strict requirements are set for environmentally friendly transport in all public procurements (with more stringent requirements year on year).

**2019**
A committee of large cargo owners and shipping agents agrees to establish select dedicated and highly frequent sea transportation routes.
A considerable share of base-to-base transport for the oil companies is transferred from road to sea.

**2020**
Requirements are set for zero- and low-emission solutions for maritime services in all new oil and gas licences.
The first full-scale pilot for autonomous zero-emission ships is implemented.
Requirements are set for zero- and low-emission solutions for maritime services in the fishing and aquaculture industry through all new allocations of quotas and licences.
The authorities have made arrangements to accommodate a more efficient terminal structure and logistics solutions that promote sea transportation. The sea route to Europe can compete with the land route in key segments.

2025
The sea route is completely competitive with road transport. Cargo owners start using the sea route in earnest. The transfer potential is on its way to being fulfilled.
EU follows Norway and sets corresponding requirements. The Norwegian export of solutions takes off. Among new offshore vessels, fishing vessels and cargo ships, vessels with zero- and low-emission technology dominate.

2028
National infrastructure for the provision of alternative fuels, including charging, is fully developed.
The rest of the world, through the IMO, sets strict requirements for low and zero emissions. This offers additional export possibilities.

2030
National infrastructure for the provision of alternative fuels, including charging, is fully developed.
All existing ships make substantial use of environmentally friendly fuels.
All new ships along the coast are delivered with low- and zero-emission technology.
The uptake of technology and fuel-mixing has reached a point where emissions are 40% lower than they currently are.

2035 2040 2045 2050

2050
The world’s most efficient and environmentally friendly coastal shipping, powered partly or entirely with batteries and other environmentally friendly fuels, is established, with zero greenhouse gas emissions.
REFERENCES


WORK ON THE ROAD MAP

The road map has been developed by a working group from DNV GL through the summer and autumn of 2016. The work has been carried out with the active participation of a reference group consisting of members of the Green Coastal Shipping Programme. Other members in the programme have contributed throughout the process.

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THE CHOICES WE MAKE TODAY WILL DETERMINE OUR EMISSIONS IN 2050