

The Norwegian Maritime Authority's view on fuels for the future

Kolbjørn Berge

Project Manager – New energy carriers and alternative fuels





Topics

- Climate targets and actions taken
- Potential for reduction of climate gasses
- Fuels for the future
- Is the international regulatory framework ready?
- Results from projects
- Summary
- Questions

Climate Targets

The Norwegian Parliament's climate targets are at least a 40 % reduction of greenhouse gas by 2030 compared to 1990 levels.

They put out 5 focus areas, where environmental sound shipping is one focus area.

Domestic shipping in Norway contributes with 9 % of the total CO2 emission in Norway, and the ships constructed today, will still be around in 2040 – 2050.

Therefore we need to implement solutions to reduce the emission of climate gasses on ships constructed today



Government.no

Topics ▾ Documents ▾ What's new ▾ Ministries ▾ The Gove

You are here: [Home](#) • [What's new](#) • [News](#) • [Norway's climate target for 2030](#)

Norway's climate target for 2030

At least 40% reduction of greenhouse gas emissions by 2030, compared to 1990 levels

News story | Date: 2015-03-27

Today, Norway submitted its 2030 climate target to the UN Framework Convention on Climate Change. In December this year, a new global climate agreement is to be concluded at the UN Climate Conference in Paris. All countries are invited to submit their intended nationally determined contributions, containing emissions reductions targets, well in advance of Paris and by March 2015 for those ready to do so. Norway is the third country to submit its intended contribution, after Switzerland and the EU. Norway is committed to a target of an at least 40% reduction of greenhouse gas emissions by 2030 compared to 1990 levels.



Norwegian Public Roads Administration

- Due to actions taken by the public road administration, only in a few years carbon dioxide emissions from the ferries are reduced with 140 000 tons. About the same as emissions from 70 000 cars.
 - Total CO2 emission for 2016: 600.000 tons
 - Estimated for 2021: 400.000 tons
 - 2030: 200.000 tons
- Resolution No. 873, 13 June 2016:
 - The Government is requested by the Parliament to consider development contract for hydrogen ferries
 - The Norwegian Public Roads Administration should establish a development contract for a hydrogen-electric ferry, sailing 2021

Source: Norwegian Public Roads Administration



Development contract: Hydrogen-electric ferry

- Objectives
 - Technical possibility for zero emission for routes not suited for all-electric operation
 - Development of hydrogen technology for marine use
 - Development of rules and regulations for maritime use of -and for onshore handling and storage of -hydrogen
 - Further development of charging and hybrid operation
 - Development of supplier industries for hydrogen

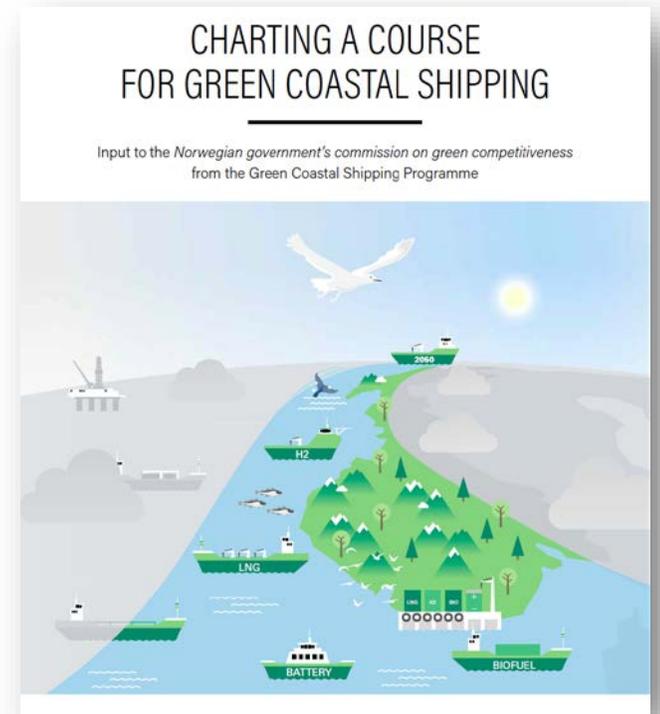


Source: Norwegian Public Roads Administration



Potential for reduction of climate gasses

- The Norwegian consortium, Green Coastal Shipping Programme, published “Charting a course for green coastal shipping” as input to the *Norwegian government's commission on green competitiveness*
- The report covers possible technical- , operational- and fuel measures to reduce CO2 emissions
- It also covers the potential to reduce greenhouse gas emissions from domestic shipping





Potential to reduce greenhouse gas emissions from domestic shipping

- We need to look into other energy carriers and fuels than what's used today if we are going to reduce the emission of greenhouse gasses significantly

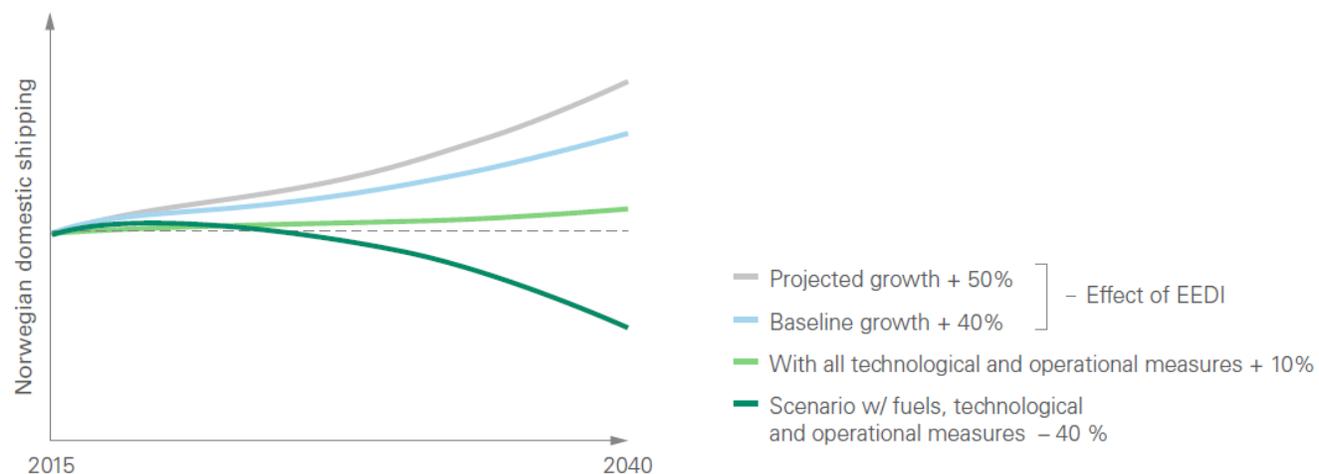
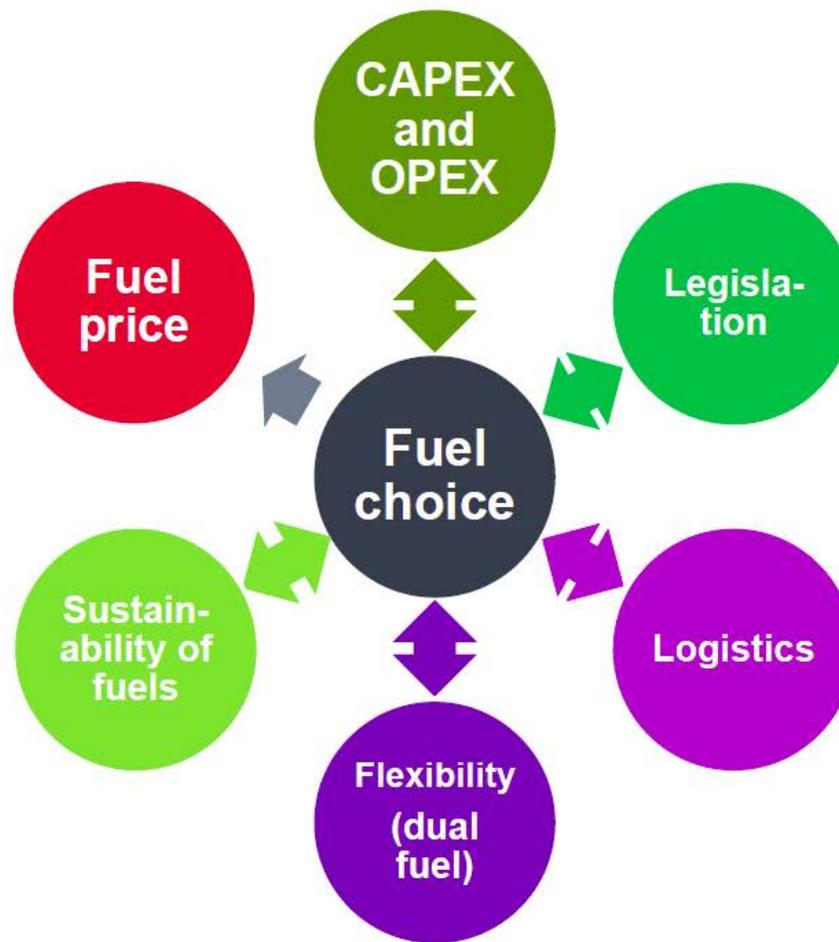


Figure 2: CO₂ emissions from Norwegian domestic shipping towards 2040.



Fuel Choice for the Future





Fuels for the future

- The fuel mix of the future will be much more complex than today, and the fuel could differ to each vessel and its trade area.
- The Norwegian Maritime Authority can't predict what the next and future fuel will be, but we aim to be a partner to find good and safe solutions together with the industry for the future fuels
 - HFO engines w/scrubbers and EGR
 - Marine diesel engines w/SCR and EGR
 - Low sulphur diesel oil
 - Ammonia gas dual fuel engines
 - LNG/gas engines single/dual fuel
 - Methanol dual fuel engines
 - LNG/gas generators and electrical propulsion
 - Electrical propulsion – battery only
 - Biodiesel/gas or LNG battery hybrids
 - LNG/gas electrical propulsion with H2 fuel cells and battery
 - Hydrogen fuel cells and battery hybrids



Use of LNG and Methane slip

- The methane slip of LNG engines have been improved over the last few year and now the methane slip is minimal
 - The emission factor of CH₄ is based on measurements on ships in operation and testbed data from engine suppliers representing gas fuelled ships. Load cycle is an average of ISO E2 and E3

	CH ₄ (2010)	CH ₄ (2017)
Engine type	g/kWh	g/kWh
Emission factor - Lean Burn Spark Ignition (LBSI)	8,5	4,1
Emission factor - Low Pressure Dual Fuel (LPDF)	15,6	6,9

Source: SINTEF Ocean

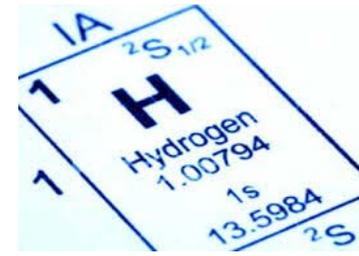


Methane slip – new technology reduces Methane slip

- Further ongoing development
 - LPSI engines ~ 2,5% Methane slip
 - LPDF engines ~ 3.0 – 3,5 % Methane slip
 - HPDF engines ~ Zero Methane slip

Source: SINTEF Ocean

Hydrogen as fuel



- We see increased interest in using hydrogen as fuel.
 - In Norway there are a number of projects looking into hydrogen solutions, and as the public road administration have a development contract for hydrogen fuelled road ferry that are scheduled to be delivered in 2021, we will see even more projects.
- Use of hydrogen
 - Hydrogen have some properties that differ from natural gas, such as explosion potential, ignition energy, density and if liquid, lower temperatures.
 - There are no fuel systems that are adopted for marine use
 - Every aspect of the use of hydrogen on board needs to be assessed, to ensure that the vessel is as safe as a conventional vessel



Is the international regulatory framework ready?

- The emission targets would be challenging to reach without looking towards new fuels, and most of them having low flash point.
- From the 1.1.2017 the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code) regulates the use of fuels with flash point below 60°C.
- The code currently only have detailed requirements for using natural gas
- Alternative design for other fuels

Alternative Design

The alternative design follows the guideline for alternatives as a

This process has no restrictions as long as the alternative is as safe as a conventional vessel

Project where risk based assessment is used

- 2.3.1 This Code contains functional requirements for all appliances and arrangements related to the usage of low-flashpoint fuels.
- 2.3.2 Fuels, appliances and arrangements of low-flashpoint fuel systems may either
 - 1 deviate from those set out in this Code, or
 - 2 be designed for use of a fuel not specifically addressed in this Code.

Such fuels, appliances and arrangements can be used provided that these meet the intent of the goal and functional requirements concerned and provide an equivalent level of safety of the relevant chapters.

2.3.3 Equivalence of the alternative design
The equivalence of the alternative design shall be demonstrated as specified in SOLAS regulation II-1/55 and approved by the Administration. However, the Administration shall not allow operational methods or procedures to be applied as an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof which is prescribed by this Code.
MSC.1/Circ.1455 - Guidelines for the approval of alternatives and equivalents

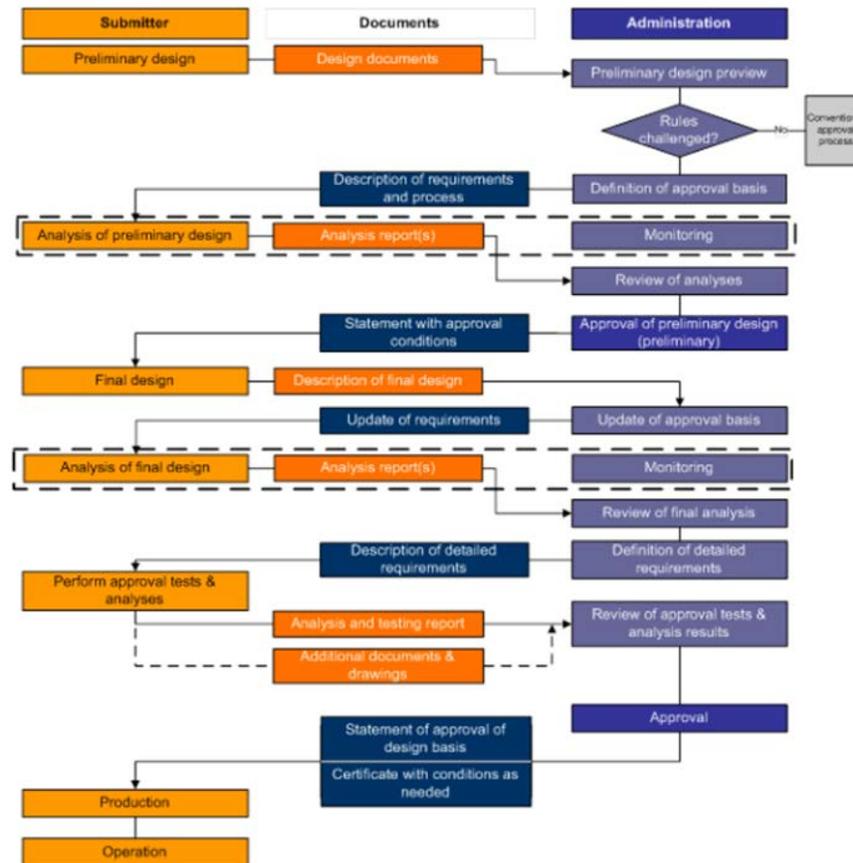
3.2.1 The safety, reliability and dependability of the systems shall be equivalent to that achieved with new and comparable conventional oil-fuelled main and auxiliary machinery.

17 additional functional requirements follow, which shall be fulfilled through the ship design.

It is emphasized that operational procedures shall not replace safety barriers through the ship design. (ref. 2.3.3)



MSC.1/Circ.1455 Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments





Results from projects

- Will in short summarize the results from the some projects:
 - Eidesvik Shipping – LNG PSV with battery
 - Grieg Shipping – Hybride Cranes
 - Norled – Ampere





Eidesvik Shipping – LNG PSV with battery

- Installed a battery pack for peak shaving, start and stop function and as spinning reserve
- Data from the first year shows the following fuel savings:
 - 3 % peak shaving during transit
 - 20 % start/stop in harbour / standby
 - 32 % in DP operation
 - 15 - 16 % overall savings
 - In addition lower running hours

Source: Eidesvik





Grieg Shipping – Hybrid Crane bulk carrier

- A small battery pack installed for peak shaving during crane operations.
- Reasonably low cost of investment due to small battery pack, only 67 kWh needed.
- Following reduction in emission:
 - CO2 equivalent to 100 cars
 - NOx equivalent to 5000 cars
 - PM equivalent to 7000 cars
 - In addition, reduction in running hours

Source: Grenland Energy





Ampere

- The ferry is equipped with 1092 kWh of lithium-ion batteries.
- To reduce energy consumption the ferry is built as a aluminium catamaran.
- The designers have really worked hard to reduce energy consumption, from led lightning to propels.
- The total emission was reduced with 88 %* for carbon dioxide, 100% of NOX and energy consumption by 57 %



*Based on CO2 values for the Nordic power grid



Summary

- We don't know what the future fuels are, but we are ready for the challenge together with the industry to find good and safe solutions
- What we learn and experience thru these project, we will implement in our work with international regulations
- For projects with new energy carrier or alternative fuels, start the discussion with us as early as possible.

Any questions?

Kolbjørn Berge

Project Manager – New energy carriers and alternative fuels

E-mail: kobe@sdir.no

Phone: + 47 99 16 12 77

