WHEN TRUST MATTERS

From sea to sky

What Norway’s aviation industry can learn from maritime's decarbonisation journey

December 2025

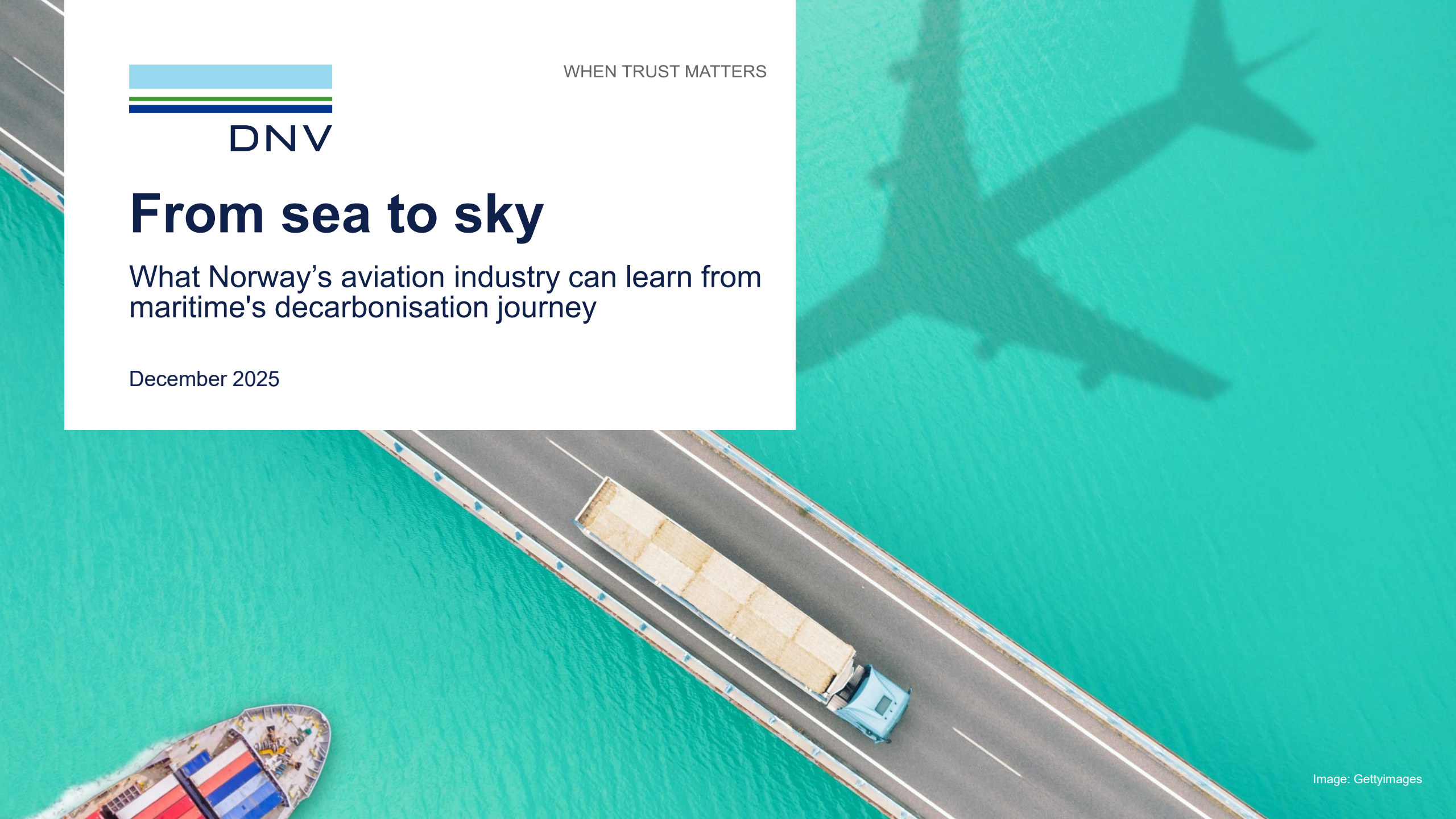


Image: Gettyimages

About this report

This report emerged from a series of discussions between DNV, Avinor, and stakeholders in the Norwegian aviation sector following the publication of DNV's 2024 memo, *Navigating Barriers to Next-Generation SAF Production in Norway*. That memo identified several key challenges in scaling up production of sustainable aviation fuels (SAF), particularly next-generation pathways such as e-SAF and advanced biofuels.

Despite Norway's strong potential – including a renewable electricity grid, availability of forestry residues, and early leadership in SAF blending –the memo highlighted several systemic barriers:

- **High production costs:** Next-generation SAF technologies are more capital-intensive than conventional fuels, requiring significant upfront investment.
- **Funding gaps:** Early-stage funding exists but is limited compared to other transport sectors. Support for mid- and late-stage project development is lacking, which is important for de-risking investments and attracting private capital.
- **Lack of clear and aligned national strategy:** Unlike other transport sectors, the Norwegian aviation sector lacks a public decarbonisation roadmap.
- **Feedstock and infrastructure challenges:** There is no national strategy for feedstock prioritisation, and critical enablers like carbon capture and utilisation (CCU) remain underdeveloped.

During stakeholder dialogues, an observation emerged: while emission reductions in domestic aviation have been slow, maritime decarbonisation appears to be gaining momentum, supported by targeted public funding, clear national strategies, and mature public-private collaboration. This raised several questions:

- Is maritime decarbonisation receiving more attention and support than aviation in Norway?
- If so, why? Are there systemic differences in technology readiness, economic importance, or industrial presence that justify prioritising one over the other?
- Are there lessons from maritime decarbonisation that could be applied to aviation?
- Could synergies between the sectors – such as shared fuel production infrastructure – help accelerate progress?

This report was commissioned to explore these questions. It aims to compare the decarbonisation pathways of the two sectors, identify lessons that may be transferable, and provide insights for stakeholders. While the report addresses decarbonisation broadly, it places particular focus on how these insights can accelerate domestic use and supply of next-generation SAF. Its purpose is to clarify the challenges and opportunities for aviation decarbonisation and to guide informed dialogue on how to accelerate progress.

Image: Gettyimages

Report details

Project name	**From sea to sky: What Norway's aviation industry can learn from maritime's decarbonisation journey**		DNV AS Veritasveien 1 1341 Høvik Norway http://www.dnv.com
For	Avinor AS		
Client reference	Arvid Løken Arvid.Loken@avinor.no		
Date of issue	17-12-2025	Project number	10546609
Report number	2025-0405	Organizational unit	Advisory – Markets and Risk
Contract number	00173588	Subject group	Energy, Markets and Strategy

Prepared by	Maja Frost, Antonio Seijas, Mathilde Gagné, Frida Berglund	Contact name	Maja Frost
Verified by	Magnus Killingland	Contact email	
Approved by	Frida Berglund	Contact phone	

X	Open	Key words	SAF, eSAF, decarbonisation, aviation, maritime, Norway
	Internal use only		
	Commercial in confidence		
	Confidential	Service Area	Energy Systems
	Secret	Market Segment	Energy Markets & Strategy

Important notice and disclaimer

This report presents findings and conclusions based on technical services performed by DNV AS (“DNV”).

The work addressed herein has been performed according to the authors’ knowledge, information and belief based on information provided to DNV, in accordance with commonly accepted procedures consistent with applicable standards of practice. The report and the work addressed herein is not, nor does it constitute, a guaranty or warranty, either express or implied. DNV EXPRESSLY DISCLAIMS ANY WARRANTY OR GUARANTY, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

The scope of use of the information presented herein is limited to the facts as presented and examined, as outlined in this document. No additional representations are made as to matters not specifically addressed within this report. Any additional facts or circumstances in existence but not described or considered within this report may change the analysis, outcomes and representations made in this report. The analysis and conclusions provided in this report are for the sole use and benefit of the party contracting with DNV to produce this report (the “Client”). No information or representations contained herein are for the use or benefit of any party, person, or entity, other than the Client. ANY USE OF OR RELIANCE ON THIS REFERENCE MATERIAL BY ANY PARTY, WHETHER INDIVIDUAL OR ENTITY, SHALL BE AT THE SOLE RISK OF SUCH PARTY. IN NO EVENT WILL DNV OR ANY OF ITS PARENT OR AFFILIATE COMPANIES, OR ANY OF ITS OR THEIR RESPECTIVE DIRECTORS, OFFICERS, SHAREHOLDERS, EMPLOYEES, REPRESENTATIVES AND/OR AGENTS (“DNV GROUP”) BE LIABLE TO ANY OTHER PARTY REGARDING OR AS A RESULT OF ANY OF THE STATEMENTS, RECOMMENDATIONS AND/OR OPINIONS CONTAINED IN THIS REPORT, AND/OR FOR THE USE OF, RELIANCE ON, AND/OR ACCURACY OR ADEQUACY OF SAME.

DNV Group shall have no liability to Client except as otherwise expressly provided by the relevant contract between DNV and Client.

Table of Content

Acronyms

Acronym	Description
AFIF	Alternative Fuels Infrastructure Facility
AFIR	Alternative Fuels Infrastructure Regulation
AtJ	Alcohol-to-Jet
CEF	Connecting Europe Facility
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilisation
EEA	European Economic Area
ETS	Emission Trading System
FID	Final Investment Decision
FT	Fischer-Tropsch
GBER	General Block Exemption Regulation
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GSP	Green Shipping programme
HEFA	Hydroprocessed Esters and Fatty Acids
HVO	Hydrotreatet Vegetable Oil

Acronym	Description
LNG	Liquified Natural Gas
ICAO	International Civil Aviation Organization
IMO	International Maritime Organisation
MtJ	Methanol-to-Jet
PSO	Public Service Obligation
RED	Renewable Energy Directive
RFNBO	Renewable Fuel of Non-Biological Origin
RLCF	Renewable and Low-Carbon Fuel
SAF	Sustainable Aviation Fuel
TCTF	Temporary Crisis and Transition Framework
TEN-T	Trans-European Transport Network

Executive Summary

A tale of two sectors: Comparing maritime and aviation decarbonisation in Norway

As Norway advances toward its climate targets, decarbonising hard-to-abate sectors such as maritime and aviation is becoming increasingly urgent. While both industries are under pressure to reduce emissions, they have followed different pathways, reflecting contrasts in policy support, industrial structure, and technological maturity.

This report compares the decarbonisation trajectories of Norway's maritime and aviation sectors, examining national and international frameworks, technical readiness, funding instruments, and collaboration models. The goal is to identify lessons from maritime that can accelerate aviation's transition, with a particular focus on next-generation sustainable aviation fuel (SAF).

A tale of two sectors

Both maritime and aviation are essential for connectivity, trade, and economic growth, but their operational profiles and technology options differ:

- **Maritime progress** has been notable, particularly for short-range vessels and ferries where electrification is feasible. Strong public procurement, targeted funding, and public-private collaboration have driven success. Enova has recently expanded support across the full value chain for alternative fuels, covering vessels, bunkering infrastructure, and local production of hydrogen and ammonia. These measures have driven investment decisions and positioned Norway as a frontrunner in maritime decarbonisation. For deep-sea shipping, however, zero- and low-emission solutions remain nascent, requiring significant investment and international coordination.

- **Aviation**, by contrast, face stricter safety and weight constraints that make electrification challenging, though early short-haul pilots demonstrate technical feasibility. SAF represents the most viable decarbonisation option, particularly for longer routes, as it is compatible with existing aircraft and infrastructure. Norway has been a frontrunner in implementing bio-based SAF blending mandates, which are set to increase next year, although most SAF is imported. The ReFuelEU Aviation regulation broadens the range of eligible SAF pathways, including e-fuels and advanced biofuels, and introduces sub-mandates for e-fuels. However, scaling these pathways remains a major challenge, as they are significantly more costly than conventional fuels and face both technical and commercial barriers.

Policy and funding gaps

Maritime decarbonisation benefits from clear, government-backed roadmaps, targeted funding, and strong collaboration platforms. Enova alone allocated nearly NOK 2.9 billion to maritime initiatives in 2024, supporting vessels, infrastructure, and fuel production. Aviation lacks a comparable strategy and dedicated funding schemes, with limited and fragmented support provided. While ReFuelEU Aviation sets clear SAF blending targets, scaling supply remains difficult without mechanisms to de-risk investments. Targeting support for domestic production of next-generation SAF could reduce investment risk and import dependency while unlocking industrial opportunities.

Industrial base and emission profiles

Domestic maritime transport accounts for over 8% of Norway's emissions and supports a large industrial ecosystem, aligning with national goals for green industrial growth and exports. Aviation contributes just over 2% of emissions and has a smaller domestic industrial footprint, which may explain its lower policy priority. However, aviation's strategic importance for trade, tourism, and regional connectivity underscores the need for action.

Strategic recommendations to accelerate the transition

To close the gap and accelerate aviation's transition, stakeholders should consider the following strategic actions:

- **Develop a government-backed roadmap for aviation decarbonisation** outlining long-term goals and short-term milestones. This could include SAF blending milestones aligned with RefuelEU Aviation mandates, timelines and quantified targets for zero-emission aircraft deployment, and (if applicable) targets for domestic SAF production.
- **Consider next-generation SAF as an industrial opportunity** to create regional industry growth and reduce reliance on imports, leveraging Norway's renewable energy resources, forestry residues, and emerging hydrogen value chains. This should be a government-led initiative.
- **Evaluate dedicated funding schemes –** such as for zero- and low-emission infrastructure and novel, next-generation SAF technologies – as experience shows that targeted funding helps accelerate decarbonisation initiatives. Further, coordinating funding instruments across sectors could help unlock greater potential for aviation to contribute to Norway's overall decarbonisation goals.
- **Explore cross-sector synergies in fuel infrastructure and supply security.** Several next-generation fuel pathways produce shares or slates of both aviation and maritime fuels. Coordinated development of shared fuel infrastructure could reduce duplication, pool feedstock demand, unlock economies of scale, and enable regional energy hubs serving multiple sectors. Ensuring security of fuel supply is also an important argument for these measures.
- **Strengthen collaboration platforms.** The Green Shipping Programme has been instrumental in shaping maritime policy and unlocking funding through strong public-private coordination. Formalising a similar partnership for aviation, with broad participation across the value chain, could support coordinated action. This could include launching full value chain pilots, such as zero-emission demonstrations or green corridors incorporating domestic SAF production.

By adapting lessons from maritime decarbonisation to aviation's specific context, Norway can accelerate aviation's transition, reduce reliance on imports, and maintain its leadership in sustainable transport – from sea to sky.

1. The backdrop to our report

1.1 Context, scope and purpose: Comparing the two sectors

Norway's transport sector is undergoing major transformations to support the country's national and international climate targets. Among the most challenging segments to decarbonise are maritime and aviation: both critical to connectivity and economic activity, yet reliant on high-cost, complex solutions.

Recent dialogues within the aviation sector, including those following DNV's 2024 memo *Navigating Barriers to Next-Generation SAF Production in Norway*, have raised a growing concern: while maritime decarbonisation appears to be gaining momentum through targeted support and strategic alignment, the aviation sector seems to progress more slowly.

This report was commissioned to explore whether this perceived gap is real, and if so, what stakeholders in Norway's aviation industry can learn from maritime's journey. While the report covers the topic of decarbonisation more broadly, a particular area of interest is how these insights can help accelerate domestic use and supply of next-generation sustainable aviation fuels (SAF).

Purpose and intended use

This report is intended for stakeholders in the Norwegian aviation sector – industry leaders, policymakers, and funding bodies – working to accelerate aviation's decarbonisation trajectory. It aims to:

- Compare national maritime and aviation decarbonisation efforts.
- Identify main technical differences and potential synergies in decarbonisation pathways.
- Highlight any gaps in national policy, funding, and public-private coordination.
- Extract lessons from maritime that could accelerate aviation's transition domestically.

Scope and approach

The report provides a high-level comparison of the two sectors, with a focus on domestic decarbonisation. It does not aim to catalogue all technologies or initiatives, but rather to highlight strategic insights and actionable recommendations for the Norwegian aviation sector. While it covers decarbonisation options broadly, it places a specific focus on alternative fuels to inform stakeholders working to scale next-generation SAF production in Norway.

Report structure

This report is organised as follows:

- **Chapter 2: Technical differences and synergies:** Compares the technological maturity, fuel pathways, and infrastructure needs of the two sectors, and explores opportunities for cross-sector collaboration.
- **Chapter 3: The macro perspective:** Briefly outlines the relevant global and European regulatory landscape shaping decarbonisation in both sectors.
- **Chapter 4: The Norwegian context:** Examines national decarbonisation efforts, policies, funding mechanisms, and industrial dynamics that influence the pace of decarbonisation.
- **Appendix:** Provides supporting data and references.

1.2 Navigating barriers to next-generation SAF production in Norway: A short extract

This summary is based on findings from the DNV memo, *Navigating barriers to next-generation SAF production in Norway.*

While the memo focuses specifically on next-generation SAF production, its findings are relevant to broader discussions on the decarbonisation of transport – particularly the disparity in policy support and funding between the aviation and other transport sectors. The memo identifies structural gaps in financing, regulatory clarity, and strategic prioritisation that have left aviation lagging behind maritime and road transport in Norway's green transition.

Extract of the report

Norway is well-positioned to lead in next-generation SAF production, with access to renewable energy, forestry resources, and industrial waste. However, despite these advantages, the country faces significant barriers that hinder the scaling of SAF technologies beyond the conventional HEFA (Hydroprocessed Esters and Fatty Acids) pathway.

The memo identifies three primary challenges:

1. **High production costs and funding gaps:** Next generation SAF pathways require significant capital compared to conventional jet fuels and HEFA. Norway lacks funding mechanisms that support SAF projects through all development stages. While early-stage funding exists (e.g., Enova, Innovation Norway), there is a critical gap in mid-to-late-stage financing – particularly for FEED (Front-End Engineering Design) and EPC (Engineering, Procurement, and Construction) phases – making it difficult for projects to reach commercial maturity. In contrast, countries like the UK and US offer full-lifecycle funding and tax incentives that de-risk investment.

2. **Lack of clear governmental strategy:** Norway has not implemented a national, public strategy for decarbonising aviation, nor whether (and if so, how) to scale up domestic production of next-generation SAF. Meanwhile, Norway continues to prioritise decarbonisation in the maritime and road transport sectors, which benefit from clearer strategies and more targeted funding across the value chain.

3. **Feedstock and infrastructure challenges:** Securing a stable, scalable supply of diverse feedstocks is important for next generation SAF production. There is no strategy in place to secure feedstock for SAF, nor sufficient support for enabling technologies like Carbon Capture and Utilisation (CCU), which is essential for e-fuel pathways. While CCS has received substantial funding (e.g., Longship), CCU remains underdeveloped and underfunded.

Key insight on sectoral disparity: The Norwegian government has established robust decarbonisation strategies for maritime and road transport, resulting in significant funding and clearer policy direction. In contrast, aviation lacks a comparable strategic framework, leaving the sector with limited targeted support.

To unlock the potential of next-generation SAF, Norway should bridge funding gaps, align with EU regulations*, and develop a clear, national strategy for aviation decarbonisation. Drawing on international best practices – particularly from the UK, US, and Germany – can help Norway build a competitive SAF industry and contribute meaningfully to domestic and global aviation decarbonisation.

** Update: Norway is now in the process of implementing both RED II and ReFuelEU Aviation. This reduces regulatory uncertainty, provide clearer market signals for the aviation sector, and improves the competitive position against EU counterparts.*

2. The technical lens

2.1 The technical lens: Introduction and key take-aways

Decarbonising transport relies on a variety of technological pathways, supported by policy levers. For both maritime and aviation, four main levers are typically used:

- **Electrification**, where technically and economically feasible
- **Support for drop-in zero- or low-emission fuels** compatible with existing infrastructure
- **Investment in new** or repurposed infrastructure for alternative fuels and propulsion systems
- **Stimulation of market uptake** through subsidies, regulation, and procurement mandates

While electrification is the most energy efficient option, it is only viable for specific use cases – particularly short-distance routes with sufficient turnaround time for recharging. In most other cases, a broader portfolio of solutions is required, including energy-efficiency measures and alternative fuels.

While some pathways for producing alternative fuels are commercially available, many of them are at early stages of commercial deployment and depend on both further technology developments, infrastructure availability, and the alignment of national and international regulations.

In this chapter, we outline the main differences in terms of technological maturity, feasibility, and infrastructure requirements of key decarbonisation pathways across the two sectors, followed by a discussion around potential cross-sector synergies. We dive further into domestic considerations and use of policy levers in Chapter 4.

Key take-aways

- **The feasibility and impact of each option varies significantly** between maritime and aviation due to differences in fuselage and hull design, energy requirements, operational patterns, safety standards, and infrastructure availability. These differences not only determine which technologies are viable, but also how quickly and cost-effectively each sector can decarbonise.
- **Electrification is sector-specific:** Battery-electric solutions are viable for short-sea shipping but currently remain limited to pilot projects in aviation.
- **Maritime has a wide range of options but depends on new infrastructure:** Maritime benefits from greater fuel flexibility but require bespoke vessels and infrastructure for most decarbonisation pathways.
- **Aviation relies on drop-in solutions:** Due to strict safety and performance requirements, aviation relies heavily on drop-in fuels like SAF which does not require changes to aircrafts and supporting infrastructure. While conventional pathways are commercially viable, next-generation SAF is not, being significantly more expensive and currently lacking domestic production capacity.
- **Shared fuel pathways offer synergy:** Several fuel production pathways can yield both light and heavy fractions suitable for aviation and maritime, respectively. This could enable co-investment and infrastructure sharing across sectors, reducing costs and accelerating production of alternative fuels.

2.2 Comparing key differences in possible pathways

Although both sectors rely on fossil fuels today and are pursuing alternative fuels as the main route to decarbonisation, the technological maturity, infrastructure complexity, and fuel performance requirements differ significantly.

Fuel dependency and commercial readiness

- **Aviation:** Highly dependent on SAF as the main viable decarbonisation option. SAF can be blended with fossil jet fuel and used in existing engines and infrastructure, but production pathways differ in maturity and costs.
- **Maritime:** Exploring a broader range of fuels (LNG, methanol, ammonia, hydrogen) and dual-fuel operations, alongside operational measures and battery-electric propulsion for short-haul routes. While some of the fuels can be used as drop-in, others require extensive retrofits or new vessel design. Only a few of these are commercially available today, with others in early development.

Infrastructure needs and complexity

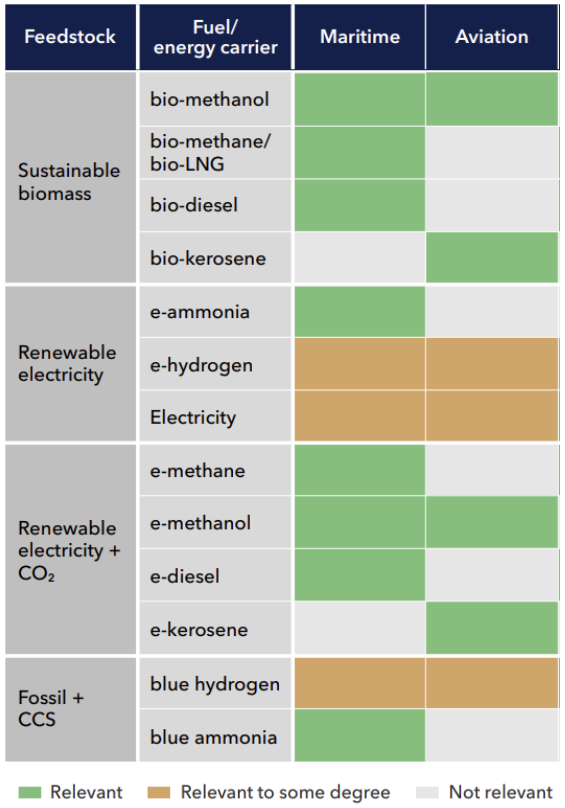
- **Aviation:** Benefits from SAF's compatibility with existing infrastructure but all domestic demand relies on imports as no domestic production or blending facilities exist – a topic further explored in DNV's report *The SAF Product Journey.* Infrastructure for electric or hydrogen aircraft is limited to pilot installations.
- **Maritime:** Requires more diverse bunkering solutions, often tailored to individual fuels. Ports may need to host multiple fuel systems simultaneously, increasing complexity and cost. Maritime benefits from ongoing public investments in shore power and hydrogen value chains, including domestic production of fuels.

Fuel properties and technical stringency

- **Aviation fuels** (used in jet engines operating on the Brayton cycle) require high gravimetric energy density, low viscosity, clean combustion characteristics, and thermal stability at high altitudes and temperatures.
- **Maritime fuels** (diesel engines) are more tolerant to variations in fuel quality and can accept denser or lower-grade fuels, offering more flexibility in alternative fuel development.

These requirements restrict the number of fuels that are technically viable in aviation, whereas maritime can accommodate a broader spectrum, as seen in Figure 1.

Figure 1: Possible pathways for alternative fuels
Source: "Maritime Forecast 2050" (DNV, 2024)



Note: Methanol is not directly used in aviation; its relevance is as a precursor for the methanol-to-jet (MtJ) process.

2.2 Comparing key differences in possible pathways

Table 1 provides a high-level comparison of the technological maturity and decarbonisation challenges facing the maritime and aviation sectors. While both sectors face significant hurdles, aviation is subject to stricter fuel requirements that limit available options. Still, both sectors must navigate technical and commercial constraints in scaling up the upstream supply chain for production and distribution of alternative fuels.

Cost and market uptake

Alternative fuels are significantly more expensive than conventional fossil fuels in both sectors. ZERO estimates costs to be 2–4 times higher[1], while other estimates show SAF costs may be 3–10 times those of jet fuel (see Table 2). However, with the help of targeted support schemes and heavy penalties imposed by ReFuelEU Aviation for non-compliance with blending mandates, the price difference is likely to be reduced.[2,3] However, the cost of producing alternative fuels will remain high, with the added costs likely distributed amongst ticketed passengers. Dialogue with airlines shows this is challenging in practice due to fierce competition on ticket prices.

Table 2: Average fuel prices as of March 2025

Fuel Type	Average Price (€/tonne)	Price Difference	Source
Conventional Jet Fuel	€734–€800	Baseline	[5,6,7]
SAF (Biofuels)	€2,085–€2,768	~3× higher than jet fuel	[4,7]
Synthetic SAF (eSAF)	€7,500–€7,695	~10× higher than jet fuel	[5,7]

Table 1: Technology maturity and challenges for decarbonisation for aviation and maritime industries.
Source: Adapted from “Transport in Transition” (DNV, 2023)

Value chain			Technology maturity and challenges		
Supply/ demand	**Value chain step**		**Electrification**	**Drop-in fuels re-using existing infrastructure**	**New fuels and new or retrofit infrastructure**
Supply infrastructure and fuel	Feedstock (sources)				
	Production				
	Logistics/refuelling/charging				
Demand	Maritime	Coastal/near-shore domestic			
		Regional short-sea			
		Deep-sea			
	Aviation	Short haul			
		Medium haul			
		Long haul			

Existing technology or infrastructure · Medium challenge · High challenge · Substantial challenge · “Impossible” (no known technology)

Sources: 1) ZERO, “Barriereanalyse: Produktsjon av fornybare drivstoff”; 2) SAF Investor, "EU announces reference SAF prices for penalties" (March, 2025); 3) Rains, T. et. al, "Biofuel and commercial aviation: will consumers pay more for it?" (2017) ; 4) BCG, "The Real Cost of Decarbonizing in the Shipping Industry" (March, 2024); 5) IBA, "What’s the Cost of Aviation’s Sustainability Drive in 2025?" (February, 2025); 6) Green Air News, "EASA releases 2024 reference prices for ReFuelEU aviation fuels ahead of major report (April, 2025) ; 7) Green Air News, "EASA releases status report on Europe’s SAF production and readiness to meet blending targets" (December, 2024)

2.3 Potential cross-sector synergies

Despite structural and technical differences, there are several promising opportunities for cross-sector collaboration – especially for fuel production and infrastructure. Shared fuel pathways, common feedstocks, and co-located production facilities can unlock economies of scale and reduce overall transition costs.

Several pathways for producing synthetic hydrocarbon fuels can yield both light and heavy fractions suitable for aviation and maritime, respectively. For example, Fischer-Tropsch (FT) and Alcohol-to-Jet (AtJ) processes typically produce outputs that can be split with output rations around 80/20 or 20/80 on light vs. heavy fractions. This enables the development of dual-use refineries that can serve both sectors from the same input stream, improving utilisation and reducing per-unit costs. Similarly, some partially refined chemicals or intermediate fuels produced for maritime use can be further upgraded to meet aviation fuel standards. Some relevant examples are shown in Table 3.

In the Norwegian context, DNV has identified three promising synergy pathways:

1. **HEFA + FT Pathways:** Using forestry residues and fish oil waste to produce Hydrotreated Vegetable Oil (HVO) for ships and SAF aircrafts in shared biorefineries.
2. **Green methanol:** Leveraging a renewable grid for producing methanol for maritime offtake from green hydrogen combined with captured CO_2, and potentially upgraded to SAF once Methanol –to-Jet (MtJ) becomes an approved pathway.
3. **Lignin valorisation:** Converting lignin from pulp and paper mills into SAF and marine diesel blends.

These examples illustrate how smart coordination can reduce duplication of effort and unlock efficiencies. Collaboration between stakeholders in both sectors – including project developers, regulators, and end-users – will be essential to realise the full potential of these synergies.

Table 3: Alternative fuel pathways where synergies between maritime and aviation are possible.

Pathway	Feedstock	Shared process step	Aviation fuel	Maritime fuel	Synergy source
HEFA	Waste oils, fats, algae	Hydroprocessing	SAF (C8–C16)	HVO (C15–C18)	HVO is an intermediate; further hydroprocessing refines it into SAF.
Fischer-Tropsch (FT)	Biomass, CO_2 + H_2	Syngas synthesis	FT-SPK (C8–C16)	FT diesel (C10–C20)	Adjusting hydrocarbon chain length during distillation splits output for sectors.
Alcohol-to-Jet (AtJ)	Sugars, lignocellulose	Alcohol production (ethanol/butanol)	SAF (C8–C16)	Bio-alcohols (C2–C4)	Alcohols can be diverted for maritime use or upgraded to SAF.
Pyrolysis Oil Upgrading	Biomass residues	Deoxygenation	Upgraded SAF	Marine bio-oil	Raw pyrolysis oil is upgraded to SAF or maritime fuels.
Co-Processing	Bio-oils + fossil crude	Refinery integration	Co-processed SAF	Low-sulfur marine fuel	Bio-oils blended into refinery streams yield fractions for both sectors.
Lignin Conversion	Lignin (forestry waste)	Hydro-deoxygenation	Cycloalkanes (SAF)	Marine diesel blends	Lignin-derived hydrocarbons split into SAF and heavier maritime fuels.
Power-to-Liquid (PtL)	CO_2 + green H_2	Methanol synthesis	eSAF (C8–C16)	Synthetic diesel (C10–C20)	Methanol intermediates are converted to SAF or maritime fuels.

3. Global frameworks

3.1 Introduction and key take-aways

3.2 Regulatory framework: IMO, ICAO and the EU

3.3 Public funding: EU-level support schemes

3.1 Global frameworks: Introduction and key take-aways

Decarbonisation in maritime and aviation is shaped not only by national strategies, but also by international and European frameworks that set the direction, pace, and incentives for change. These frameworks define emissions targets, regulatory obligations, and funding mechanisms that influence investment decisions and technology development across both sectors.

While both maritime and aviation are subject to global climate commitments, the strength and enforceability of these frameworks differ. This chapter briefly introduces the macro-level conditions that shape decarbonisation efforts, focusing on international regulatory drivers (IMO and ICAO), EU climate instruments (EU ETS, FuelEU Maritime, ReFuelEU Aviation), and EU-level funding mechanisms and industrial alliances.

Key take-aways

- **Both the maritime and aviation sector sees increasing global pressure** through strengthened global frameworks. While IMO aims for binding targets and upcoming pricing mechanisms to create clearer incentives for decarbonisation of international shipping, ICAO has implemented a market-based mechanism with emission caps.
- **EU is increasing regulatory push** through adopting the FuelEU Maritime and ReFuelEU Aviation regulations. Both are planned implemented into the EEA Agreement and Norwegian law.
- **Funding from EU-level support schemes is a critical enabler** for large-scale decarbonisation projects, such as production of next-generation SAF. While Norwegian players are eligible to apply for funding, and several SAF-projects have been successful, competition is fierce.
- While EU-level funding mechanisms are generally sector-agnostic, recent developments indicate a **push for both maritime and aviation alternative fuels**.

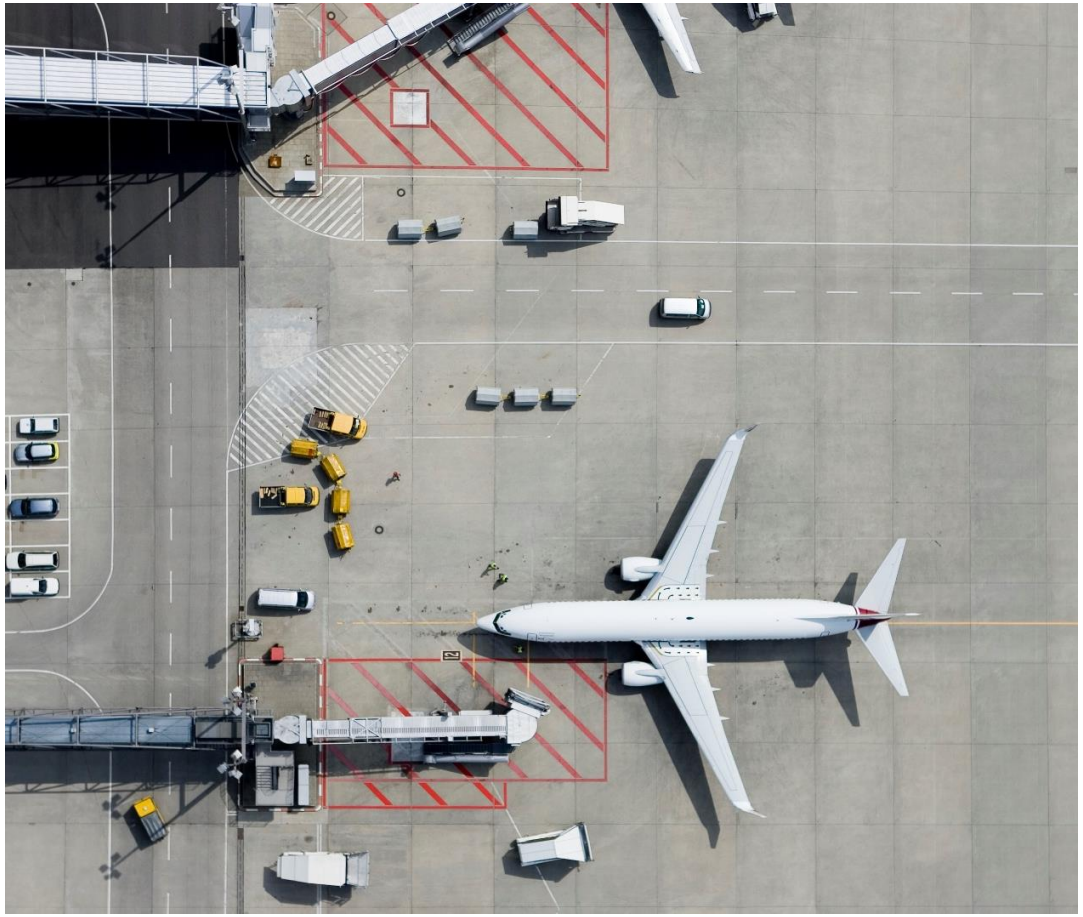


Image: Getty/fStop Images - Stephan Zirwes

3.2 Regulatory framework: IMO, ICAO and the EU define overarching mechanisms

Both the maritime and aviation sectors are subject to international regulatory frameworks that define overarching decarbonisation goals and mechanisms. However, the degree of enforceability and the impact on domestic operations differ significantly across the two sectors.

Global regulatory drivers: IMO and ICAO as framework setters

The International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO) are the key global bodies shaping climate policy in their respective sectors.

Maritime: The IMO has adopted binding targets to reduce well-to-wake greenhouse gas (GHG) emissions from international shipping by 20% by 2030 (relative to 2008), with a long-term ambition of reaching net-zero by 2050.[1] Although only 3.6% of the 2030 goal had been achieved by 2023, these targets are already influencing investment decisions and technology development in the shipping industry. In addition, the IMO is strengthening its regulatory framework with new legally binding GHG emission limits and a global GHG pricing mechanism. These will apply to all ocean-going vessels above 5,000 gross tonnage and are expected to be formally adopted end of 2026 following a one-year postponement of discussions, entering into force in 2027.[2,3]

Aviation: ICAO governs international aviation emissions, notably through the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). This market-based mechanism aims to cap net emissions from international aviation at 85% of 2019-emissions from 2024.[4] Participation remains voluntary until 2027, when it becomes mandatory. To date, 129 of 193 countries are expected to join, including Norway through the EU Emissions Trading System (ETS). In 2022, ICAO adopted an aspirational goal of net-zero CO_2 emissions by 2050.[5] This target is non-binding and allows countries to tailor implementation to national circumstances. In 2023, through the CAAF/3 conference, a global framework for SAF was agreed, including an aspirational goal of reducing CO_2 emissions by 5% by 2030 through increased use of SAF. The ambition will be reviewed in 2028.[6]

EU regulation: EU ETS, FuelEU Maritime and ReFuelEU Aviation

While international frameworks are essential for driving progress on global emissions, it is the EU regulatory regime in the context of the European Economic Area (EEA) Agreement that has a more immediate impact domestically. Through the EEA Agreement, Norway participates in key EU climate instruments, which play a central role in shaping decarbonisation efforts for both sectors.

EU ETS

The EU ETS is a cornerstone policy to EU-wide decarbonisation, applying a cap-and-trade approach to reducing GHG emissions. The cap is gradually reduced over time, tightening emission allowances and raising the price signal, and set to bring emissions down by 62% by 2030 compared to 2005 levels.[7]

- **Aviation:** Emissions from intra EU/EEA flights and certain routes between the EEA and third countries are covered by the EU ETS, setting a cap on emissions from aircraft operators. Free allocation will be phased out from 2026.[7] Domestic aviation is fully covered, alongside a national CO_2 tax which is proposed removed from 2026.[8] Flights out of and into EU/EEA are governed by CORSIA, which is being implemented in the EU via EU ETS. Its effectiveness will be assessed by the Commission in 2026, and based on the results, they may decide to bring more flights under the EU ETS.[9]
- **Maritime:** From 2024, segments of the maritime sector were brought under the EU ETS, with full implementation expanding over time. Norway is implementing these changes through the EEA Agreement.[10]

Sources: 1) DNV, "IMO regulations" ; 2) IMO, "IMO approves net-zero regulations for global shipping" (April, 2025); 3) IMO, "IMO net-zero shipping talks to resume in 2026" (Oct, 2025); 4) ICAO, "Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)"; 5) ICAO, "Long term global aspirational goal (LTAG) for international aviation"; 6) European Commission, "Commission welcomes new UN Aviation Agency global target for sustainable aviation fuels", (November, 2023); 7) European Commission, "EU ETS emissions cap"; 8) Klima- og miljødepartementet, Regjeringens klimastatus og –plan for 2026; 9) European Commission, "Reducing emissions from aviation"; 10) Miljødirektoratet, "Klimakvoter: Skipsfart i EU ETS og MRV"

3.2 Regulatory framework: IMO, ICAO and the EU define overarching mechanisms

In addition to the EU ETS, the EU has introduced two major regulatory packages that further strengthen decarbonisation initiatives: FuelEU Maritime and ReFuelEU Aviation. These regulations will be incorporated into Norwegian law via the EEA Agreement, which is critical for maintaining a level playing field between Norwegian and other EU stakeholders.

FuelEU Maritime

This regulation imposes maximum limits for the annual average GHG intensity of energy used by ships above 5,000 gross tonnage calling at EU ports, regardless of flag. It takes a well-to-wake approach and covers not only CO_2 emissions but also methane and nitrous oxide. The targets start with a 2% reduction by 2025, increasing to 80% by 2050.[1]

To further reduce port emissions, passenger and container ships must use on-shore power supply (OPS) or equivalent zero-emission technologies while at berth:

- From 1 January 2030 in ports covered under Article 9 of the Alternative Fuels Infrastructure Regulation (AFIR).
- From 1 January 2035 in all EU ports that develop OPS capacity.

FuelEU Maritime is technology-neutral, allowing shipowners to choose fuels and technologies based on ship-specific and operational profiles. It includes flexibility mechanisms, supporting existing fleets and rewarding early movers.

In October 2024, the Norwegian Maritime Authority completed the consultation on the incorporation of the regulations into Norwegian law through the EEA Agreement.[2]

ReFuelEU Aviation

This regulation introduces binding mandates to accelerate the use of SAF in Europe. Fuel suppliers must deliver a SAF blend starting at 2% in 2025, rising to 6% by 2030 and 70% by 2050, including sub-targets for synthetic fuels from 2030. Eligible SAF types are defined by the Renewable Energy Directive (RED) II. A flexibility period until 2035 allows blending targets to be met on average across Union airports*; after that, targets apply per airport.[3]

The regulation places obligations on Union Airport Managing Bodies to ensure SAF access at Union airports from 2035. Aircraft operators must uplift 90% of annual fuel needs at Union airports to prevent tinkering.[4] Penalties apply to both fuel suppliers and airlines for non-compliance.

The ReFuelEU Aviation regulation will be incorporated into the EEA Agreement and Norwegian law no later than 2027, with implementation as soon as practically possible.[5] While the decision has been made in principle, the adaptation to national law is currently under consultation. In the meantime, the national blending mandate will increase to 2% from 1 January 2026 in line with the regulation.[6]

**Union airports are all EU airports with more than 800 000 passengers per year or freight traffic of more than 100 000 tonnes per year and are expected to cover around 95% of all EU aviation traffic.*[6]

Sources: 1) European Commission, "Decarbonising maritime transport – FuelEU Maritime"; 2) Meld. St. 25 (2024–2025), Klimamelding 2035 – på vei mot lavutslippssamfunnet 3) European Commissions, "Report from the Commission to the European Parliament and the Council: The ReFuelEU Aviation SAF flexibility mechanism" (Feb, 2025); 4) European Commission, "ReFuelEU Aviation"; 5) Regjeringen, "Vil redusere utslippene fra luftfarten" (May, 2025); 6) Klima- og miljødepartementet, Regjeringens klimastatus og –plan for 2026

3.3 Public funding: EU-level support schemes key to realizing commercial projects

The EU offers a range of funding instruments to support decarbonisation in both maritime and aviation. These mechanisms are accessible to Norway through the EEA Agreement and play a critical role in enabling large-scale, capital-intensive projects – particularly relevant for high-cost alternative fuels, such as next-generation SAF.

While these schemes offer substantial support levels, they are significantly more competitive than national-level programmes. The most relevant EU instruments include:

- **Infrastructure funding** via the Alternative Fuels Infrastructure Facility (AFIF)
- **Project-based grants** via the Innovation Fund, including the European Hydrogen Bank
- **Nationally managed support schemes** approved under EU State Aid frameworks
- **Pipeline-building initiatives** such as the Renewable and Low-Carbon Fuels Value Chain Alliance

The Alternative Fuels Infrastructure Facility (AFIF)

AFIF is part of the Connecting Europe Facility (CEF) and provides grants for the roll-out of alternative fuels infrastructure for road, maritime, inland waterways and air transport along the trans-European transport network (TEN-T). The instrument supports implementation of the Alternative Fuels Infrastructure Regulation (AFIR), along with ReFuelEU Aviation and FuelEU Maritime. In November 2025, 70 projects received a total of EUR 600 million in grants across 24 countries, including electrification of ground handling services at airports as well as charging infrastructure and alternative fuels bunkering at ports.[1]

While AFIF supports hydrogen and electricity supply at airports, **it does not currently support SAF supply infrastructure**. This creates a funding gap for the aviation sector, especially for next-generation SAF solutions.

Projects located in Norway are eligible for AFIF if they form part of the TEN-T. However, competitiveness may be reduced unless there is a clear link to EU-wide transport connectivity.

The EU Innovation Fund

The EU Innovation Fund is EU's flagship programme for large-scale decarbonisation projects, financed through EU ETS revenues. It focuses on highly innovative technologies and flagship projects aimed at significantly reducing emissions, with awards granted through regular calls and competitive bidding procedures[3]. The Innovation Fund portfolio now consist of over 270 projects, with EUR 15.6 billion committed, and three new calls for 2025 have recently been launched with a total budget of EUR 5.2 billion.[4] Enova acts as the national contact point, providing guidance to project developers.

In the 2024 call, EUR 2.9 billion was awarded (invited to grant agreement preparation) across 61 net-zero projects, of which five for the production of SAF. This includes two large-scale plants and a pilot in France, one large-scale plant in Denmark, and a Norwegian pilot aimed at producing SAF from ethanol.[5] In the 2023 call, the Norwegian company Nordic Electrofuel received EUR 40 million – the maximum amount available – for its e-SAF project.

Within the Innovation Fund, the European Hydrogen Bank (EHB) was launched under the Fit for 55 package to accelerate hydrogen deployment.[6] The programme is run as a competitive auction, with two rounds finalised and a third recently launched. In the second auction, a part of the budget (EUR 200 million) was earmarked for maritime offtake, of which EUR 100 million was allocated to three Norwegian projects.[7] The third auction has a total budget of EUR 1.3 billion, of which EUR 300 million is earmarked for projects with offtakers in the maritime **and aviation** sector.[8]

Sources: 1) European Commission, "EU awards over €600 million to alternative fuel projects to boost zero-emission mobility" (Nov 2025) ; 3) European Commissions, "What is the Innovation Fund?"; 4) European Commission, "€5.2 billion of EU Emissions Trading revenues earmarked for clean transition technologies under the Innovation Fund" (Dec, 2025) ; 5) European Commission, "Innovation Fund projects"; 6) Competitive bidding - European Commission; 7) Norsk Hydrogenforum, "Milliardstøtte fra EU til GreenH, Gen2 Energy og Norwegian Hydrogen" (May, 2025) 8) Hydrogen Europe, "EU makes €6 billion available to hydrogen sector with launch of 3rd Hydrogen Bank auction and Innovation Fund call" (Dec 2025);

3.3 Public funding: EU-level support schemes key to realizing commercial projects

Project pipeline facilitation: RLCF industrial alliance

Beyond direct funding, the Renewable and Low-Carbon Fuels Value Chain (RLCF) Industrial Alliance aims to strengthen collaboration across the fuel value chain. While it does not offer financial support, it promotes matchmaking and knowledge exchange between fuel producers, technology providers, offtakers, and investors. A current call for projects invites stakeholders to submit initiatives that align with defined project archetypes for maritime and aviation fuels. This pipeline-building approach is expected to play a growing role in de-risking early-stage projects.[1]

EU-approved State Aid schemes

Under EU State Aid rules, Member States and EEA countries can set up national support schemes, subject to approval by the European Commission. These schemes are grounded in overarching EU frameworks – such as the General Block Exemption Regulation (GBER) and Temporary Crisis and Transition Framework (TCTF) – and complement EU-level programmes. Some relevant examples for alternative fuels include:

- Enova's support for hydrogen production in the maritime sector. This is based on the GBER framework, which covers the full hydrogen value chain and includes provisions for CO_2 capture and transport – aspects that would be especially relevant for e-SAF production support. For more details, see Appendix A.3.
- Germany and Spain have announced national top-up finds to the third auction of the EHB via the Auction-as-a-Service mechanism, totalling EUR 1.7 billion.[2]
- A joint German-Dutch scheme with a financial volume of EUR 3 billion aims to support the production of Renewable Fuels of Non-Biological Origin (RFNBOs), including renewable hydrogen, throughout the world.[3]
- A Danish scheme of EUR 1.7 billion aims to support the production of upgraded biogas and e-methane to be injected into the Danish grid.[4]

Such schemes allow countries to tailor incentives to national priorities, creating opportunities for national companies to access co-funding beyond EU central programmes.

Increased recognition of CCU: Key to unlocking next-generation SAF supply

The EU is increasingly recognising CO_2 utilisation (CCU) as a key enabler for net zero. Under the Net Zero Industry Act, CCU is classified as a "net-zero technology", allowing for public funding provided sustainability criteria are met. Further, CCU is listed as a key focus area under the EU Innovation Fund.

A recent example is the Horizon Europe call "CCU for the production of fuels"under Cluster 5, offering up to EUR 7 million per project to advance CO_2-based fuel technologies to TRL 6–7. While not SAF-specific, SAF projects were eligible to apply, and the call was open to Norwegian participants. By contrast, Norwegian national funding schemes for CCU remain limited, despite the importance of this technology for e-fuel production. This creates a risk that Norway may fall behind in developing fully domestic SAF value chains.[5]

Sources: 1) European Commission, "Call for projects to be included in the Alliance Project Pipeline is open!"; 2) Hydrogen Europe, "EU makes €6 billion available to hydrogen sector with launch of 3rd Hydrogen Bank auction and Innovation Fund call" (Dec 2025); 3) European Commission, "Commission approves €3 billion German-Dutch State aid scheme to support the production of renewable fuels of non-biological origin" (Dec, 2024); 4) European Commission, "Commission approves €1.7 billion Danish State aid scheme to support the production of renewable gas" (Dec, 2024) ; 5) Avinor, "Framework conditions for SAF in Norway"

4. The Norwegian context

4.1 The Norwegian context: Introduction and key take-aways

While international and EU-level frameworks set the direction for maritime and aviation decarbonisation, it is the national context that ultimately determines the pace and shape of implementation domestically. In Norway, the maritime sector has emerged as a frontrunner, benefiting from targeted funding, clear policy signals, and strong public-private collaboration. Aviation, by contrast, has made slower progress, despite early leadership in SAF blending mandates.

By comparing emissions, economic impact, policy levers, funding mechanisms, and collaboration models, this chapter explores whether there are structural or strategic factors that impact the pace of sector decarbonisation in Norway, and what aviation stakeholders can leverage to accelerate the sector's transition.

In this chapter, we:

- Compare the emissions profiles and economic roles of the maritime and aviation sectors in Norway (4.2).
- Examine the decarbonisation pathways available to each sector and national efforts so far (4.3).
- Analyse national policy instruments – such as CO_2 pricing and blending mandates, procurement rules, and sectoral targets – and how they differ across sectors (4.4).
- Assess the scale and structure of public funding, with a focus on Enova's role (4.5).
- Explore how public-private collaboration platforms have shaped progress (4.6).

Key take-aways

- **Maritime benefits from national prioritisation:** Clear policy targets and dedicated funding position maritime to decarbonise faster going forward, partly due to its larger emissions share, economic footprint, and industrial base. Aviation, while essential for connectivity, has lower domestic emissions and a smaller value chain presence, limiting the scope for decarbonisation through domestic innovation or export growth.
- **Operational realities shape pathways:** Maritime's fixed routes enable early adoption of battery-electric and hydrogen solutions. Aviation faces stricter safety and energy constraints and short turnaround times, making it largely reliant on drop-in fuels like SAF – challenged by high costs and supply barriers.
- **Funding and policy support are uneven:** Enova and other public instruments have prioritised maritime with targeted schemes and higher funding. Aviation support remains fragmented, with few projects funded and no clear national decarbonisation roadmap.
- **Enova's mandate explains part of the gap:** SAF is a drop-in fuel without the need for retrofits, already traded globally and regulated by increasing blending mandates. According to Enova, this reduces the need for targeted, cross-value-chain support schemes. However, Enova highlights that support for novel technologies, such as next-generation pathways, is possible, as seen with Biozin and Silva Green Fuels.
- **Collaboration models matter:** The Green Shipping Programme has successfully aligned public and private actors to shape strategy and unlock funding in the maritime sector. Aviation's "Grønn Luftfart" programme is still in early stages but could play a similar role if scaled and formalised.

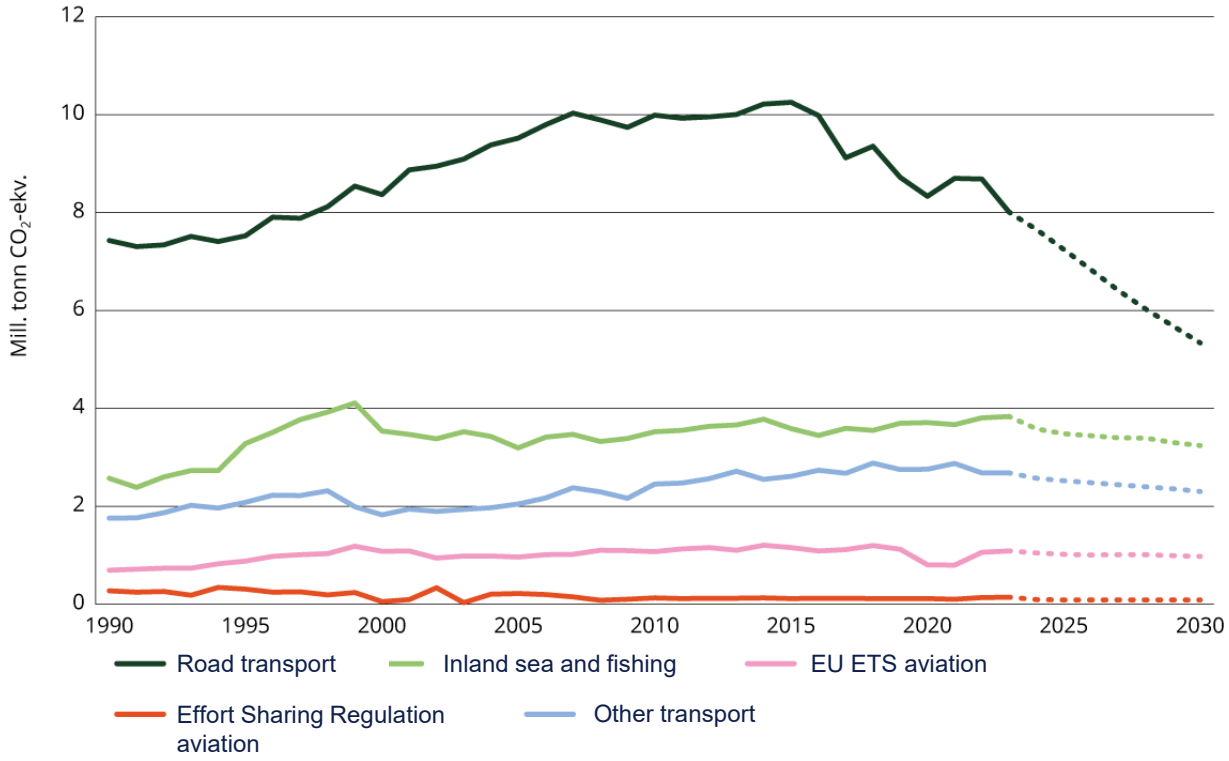
4.2 Setting the scene: Emission reductions are progressing slowly in both sectors

Norway's climate targets of halving transport emissions by 2030 compared to 2005 levels require deep cuts across all transport sectors, but maritime and aviation present unique challenges.[1] Both are hard-to-abate, capital-intensive, and essential for national connectivity. Yet their emissions profiles differ – shaping how they are prioritised in policy and funding.

Domestic aviation accounts for just over 2% of Norway's emissions, or around 1 million tonnes of CO_2 annually.[2] Meanwhile, domestic shipping and fishing are responsible for roughly 8.4%, making it a significantly larger source of emissions. On top of this comes international shipping and aviation, not counted within Norway's national emission budget.

Despite ambitious targets, both sectors have seen limited progress. While road transport has made significant progress due to electrification, maritime and aviation remain in the early stages of their transition, as seen in Figure 2. Government projections suggest steeper future reductions for maritime, reflecting stronger policy and funding support.

Figure 2: Historical and projected emissions from transport in Norway
Source: The Government climate status and plan[1]



Sources: 1) Særskilt vedlegg til Prop. 1 S (2024–2025), Regjeringens klimastatus og plan; 2) Meld. St. 10 (2022-2023), Bærekraftig og sikker luftfart: Nasjonal luftfartsstrategi

4.2 Setting the scene: The maritime sector has a large economic and industrial significance

Maritime: A strong industrial presence

The maritime sector is an industrial pillar in Norway: in 2023, the industry employed nearly 90,000 people and generated over NOK 200 billion in value, representing around 4.1% of national Gross Domestic Product (GDP).[1] More broadly, the wider ocean economy influenced by maritime activities accounts for around 30% of national GDP, underlining its strategic importance.[2] Norway also has world-leading expertise across the maritime value chain, from vessel design and propulsion systems to infrastructure development.

This large economic footprint and deep industrial presence makes maritime a natural candidate for targeted decarbonisation support. It also aligns with Norway's broader goals of green industrial growth and exports.

Aviation: Essential infrastructure, but smaller industrial footprint

Aviation plays a different but equally crucial role, connecting remote communities and supporting tourism and trade. Most short-haul routes are supported through public service obligations (PSOs), underscoring the sector's function as a critical public infrastructure rather than a purely commercial service.

In 2023, the sector directly employed around 60,000 people and contributed approximately NOK 65 billion, or 1.3% of GDP, to the Norwegian economy.[3] When accounting for indirect effects (such as tourism and logistics), its total contribution rises to NOK 233 billion, or 4.6% of GDP – a figure comparable to maritime's direct value creation.

However, aviation has a weaker domestic industrial footprint. Norway is largely a technology taker, with aircraft and fuel systems developed internationally. This limits the scope for policy to drive decarbonisation through domestic innovation or export growth. Even so, the country possesses strong resource conditions for next-generation SAF production, offering potential for industrial development and export opportunities within the aviation value chain.

Sources: 1) Menon Economics, "Maritim verdiskapingsrapport 2024"; 2) Nærings- og fiskeridepartementet, "Regjeringens satsing på hav og havnæringer" (June, 2021); 3) IATA, "The value of air transport to Norway" (2025)

Image: Stock Adobe

4.3 Decarbonisation pathways: Shaped by operational realities

The technologies available to decarbonise the sectors are shaped by operational realities. Route length, turnaround time, safety requirements, and infrastructure compatibility all influence which solutions are viable, and how quickly they can scale.

Maritime: Fixed coastal routes enable early zero-emission adoption

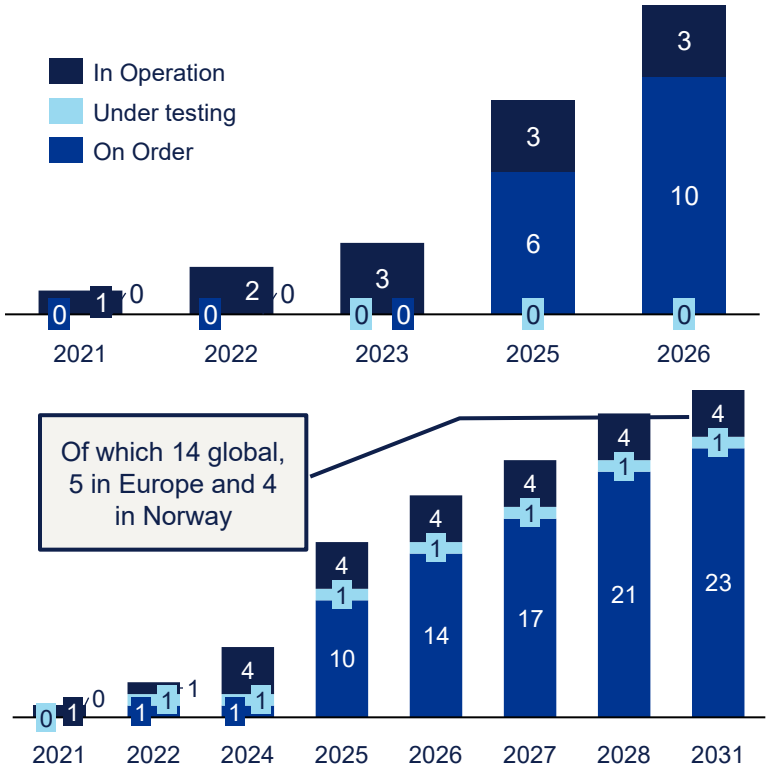
Norway's maritime sector covers a wide range of vessel types, route lengths, and operational profiles. Many vessels operate along fixed coastal routes with predictable sailing and docking schedules, providing favourable conditions for electrification – particularly in the short sea segment. This has positioned Norway as a global frontrunner in deploying electric and hybrid ferries, driven by procurement mandates and supported by public funding. Today, over 80 electric and hybrid ferries are operational, covering almost 40% of the global battery-electric fleet.[1]

Hydrogen is also gaining traction, although still in the early stages. MF Hydra – the world's first hydrogen ferry – has been operational since 2022, and several hydrogen-driven vessels are entering the order books (see Figure 3). This development is largely driven by Enova-funded projects: Enova has granted NOK 777 million to five production facilities targeting maritime offtake, all of which have taken final investment decision (FID), as well as NOK 763 million to six hydrogen- or ammonia-powered ships.[2,3]

Beyond these short-haul routes, the decarbonisation of the broader domestic fleet remains a challenge. The sector is exploring a wide range of alternative fuels, including liquefied natural gas (LNG)*, methanol, ammonia, and both liquid and gaseous hydrogen. Most of these options require purpose-built or retrofitted vessels and corresponding bunkering infrastructure, and only a few technologies – such as battery-electric systems, LNG, and methanol – are currently commercially available**.

In addition to alternative fuels, maritime decarbonisation can be supported by a wider toolkit of operational measures, including route optimisation, slower sailing speeds, onboard carbon capture, and wind-assisted propulsion. The diversity of options provides flexibility but increases the complexity of implementation and coordination across the value chain.

Figure 3: Order book for hydrogen ICE ships (top) and fuel cell ships (bottom)
Source: DNV Alternative Fuels Insights (data extracted: 14.05.25)



Note that the LNG climate impact is not zero and is therefore not a definite solution to decarbonisation.

***Two-stroke dual-fuel methanol engines are close to commercial maturity, while four-stroke engines are rapidly progressing. There is currently no commercial technology for ammonia-fuelled vessels, however, the first dual-fuel engines have been ordered, and the first ocean-going vessel completed testing in May 2024.*

Sources: 1) DNV Alternative Fuels Insights; 2) Enova, "Fem hydrogenanlegg klare for byggestart: – Et stort steg mot utslippsfri sjøfart" (Nov, 2025); 3) Enova, "Viktige steg mot utslippsfrie skip" (June, 2025)

4.3 Decarbonisation pathways: Shaped by operational realities

Aviation: Structural barriers result in dependency on drop-in fuels

Similar to the maritime sector, Norway's domestic aviation network includes a wide range of travel distances, with a mix of 15-30 minutes regional hops and longer multi-hour routes. However, the aviation sector faces some structural barriers to zero-emission solutions. Most aircrafts operate at high altitude and speeds, demanding fuels with higher energy density, and limited turnaround time on the ground restricts options for recharging. From a technical and industrial perspective, the sector is also highly dependent on international supply chains, with aircrafts, engines, and fuel systems predominantly developed abroad and subject to stringent safety regulations and long approval cycles. This leads to slower uptake of new technologies and longer lead times for innovation, with conventional aircrafts likely to remain in use beyond 2050.[1]

As a result, aviation decarbonisation efforts are largely dependent on drop-in fuels – specifically, SAF – which can be blended into conventional jet fuel and used with existing aircraft and airport infrastructure. Norway was the first to introduce blending mandates on biofuels for its aviation industry, which has been steady at 0.5% since 2020. The mandate will increase to 2% from 2026 and continue to grow in line with ReFuelEU Aviation when the regulation is implemented into Norwegian law (latest 2027). The implementation will also ensure a broader range of SAF pathways, including e-SAF and advanced biofuels, can be used to fulfil the mandate.

SAF offers a more immediately deployable solution but comes with high production costs and supply challenges, especially considering the expected demand increase in coming decades. While there are initiatives to establish domestic production of next-generation SAF, commercialisation of these projects would require significant investment and political support.[2]

Electric and hydrogen-driven aircrafts are under development and may serve shorter routes in the future. Avinor is actively developing and planning for charging infrastructure at its airports. See Table 4 for some examples.

Table 4: Some milestones in the journey of aviation decarbonisation in Norway

Area	Progress	Quote
SAF aviation	Norway became the first country to operate Lockheed Martin's F-35 fighter jets using sustainable aviation fuel at Ørland Air Base. Oslo Airport was the first in the world to offer blended SAF.	*"Norway has become the first country to operate Lockheed Martin's F-35 fighter jets using sustainable aviation fuel (SAF). Defence Minister Bjørn Arild Gram called it a significant climate initiative that enhances military readiness."*[3]
Electric aviation	BETA ALIA CTOL electric cargo aircraft test flights between Stavanger and Bergen scheduled for Q3 2025. The aircraft has received FAA certification for visual, instrument, day and night flight.	*"The first test flights of the BETA ALIA conventional take off and landing (CTOL) cargo electric aircraft between Stavanger and Bergen in Norway are set for the third quarter of this year."* *"In the fall of 2025, an electric aircraft will fly between Stavanger and Bergen."*[4,5]
Electric aviation	Avinor has launched Norway's first tender competition for fast chargers for electric aircraft, to be installed at Stavanger and Bergen airports to support the 2025 electric flights.	*"Today, there are no chargers for aircraft at Avinor's airports. The use of batteries as an energy carrier in aircraft is still a new technology, but there are many electric aircraft under development."*[5]

Sources: 1) Meld. St. 10 (2022-2023), Bærekraftig og sikker luftfart, Nasjonal luftfartsstrategi 2) DNV, Navigating barriers to next-generation SAF production in Norway, 2024 ; 3) Monagas, D. "Norway first to operate F-35 jets on SAF" (Jan, 2025); 4) Butterworth-Hayes, P. "BETA ALIA CTOL cargo electric test flights between Stavanger and Bergen set for late 2025 – Avinor" (March, 2025); 5) Avinor, "Norway's first procurement of electric aircraft chargers" (Jan, 2025)

4.4 National policy levers: Divergence between the sectors

Norway employs a range of national policy instruments to support the decarbonisation of the maritime and aviation sectors. While both sectors are subject to CO_2 pricing and fuel blending mandates, the level of strategic clarity, coordination, and long-term commitment differs.

CO_2 pricing

Both domestic aviation and most of the maritime sector are subject to a national CO_2 tax and the EU ETS, although full implementation for maritime will not be completed until 2026. In *Meld. St. 10 (2022–2023)*, the government identified these two instruments as the most important for reducing aviation emissions.[1] The CO_2 tax for quota-obligated aviation is proposed removed in the 2026 national budget, pending approval.[2]

Fuel blending mandates

- **Aviation:** Norway introduced a national SAF blending mandate in 2020, currently set at 0.5%. The ReFuelEU Aviation regulation will be incorporated into the EEA Agreement and Norwegian by 2027 at the latest. This will establish a higher and gradually increasing mandate, recognise alternative fuels beyond biofuels, and introduce sub-mandates for synthetic fuels. While awaiting full implementation, the national mandate will be increase to 2% from 1 January 2026, contingent on Norwegian aviation operators having competitive conditions equivalent to their European counterparts, particularly access to EU support schemes.[2]
- **Maritime:** A biofuel blending mandate for maritime fuels was introduced in Q4 2023, requiring 6% biofuel content. This will increase to 7% in 2026 and 8% in 2027, with further gradual increases signalled by the government.[2] Ships may also use biogas to meet upcoming regulatory requirements in specific contexts, such as operations in protected fjords.[3]

Sectoral targets and climate strategy

- **Aviation:** The national aviation strategy is framed as an ambition to accelerate the uptake of zero- and low-emission technologies rather than quantified targets.[1] The government has reiterated its ambition to introduce such aircraft as soon as possible, but without a concrete timeline or numerical goals.[2]
- **Maritime:** The National Climate Plan and National Transport Plan include quantified targets for reducing emissions from domestic shipping and fisheries by 50% by 2030 (relative to 2005). Zero-emission requirements will apply from 2026 to all cruise ships and ferries under 10,000 gross tonnage operating in World Heritage fjords; for larger vessels, these rules take effect in 2032.[2]

Public procurement and market shaping:

- **Aviation:** Public procurement is limited to Public Service Obligation (PSO) routes, identified as the most viable entry point for zero- and low-emission aircraft due to short distances and lower passenger volumes. The government aims to introduce such aircraft through a pilot contract on a suitable route and begin phasing them in on PSO routes by 2028/29 when new contracts are due, subject to technology availability.[1] NOK 1 billion has been allocated under the National Transport Plan (2025–2036) to support early deployment.[4]
- **Maritime:** The public sector plays a major role in shaping the maritime market. As of 2025, zero-emission requirements apply to all publicly procured ferry services, building on a decade of earlier deployment. While a planned requirement for fast ferries from 2025 was postponed due to cost uncertainties, the government still aims to introduce it later and has expanded the Fast Ferry Programme by NOK 240 million to fund pilot routes through competitive applications. Climate requirements for service vessels in aquaculture and offshore petroleum sectors are also under consultation.[2]

Sources: 1) Meld. St. 10 (2022-2023), Bærekraftig og sikker luftfart, Nasjonal luftfartsstrategi; 2) Klima- og miljødepartementet, Regjeringens klimastatus og –plan for 2026; 3) Meld. St. 25 (2024–2025), Klimamelding 2035 – på vei mot lavutslippssamfunnet; 4) Meld. St. 14 (2023–2024), Nasjonal Transportplan 2025–2036

4.5 Public funding: Enova supports transport decarbonisation

Public funding plays a key role in maturing low- and zero-emission technologies, scaling infrastructure, and de-risking first-of-a-kind projects. However, the level of funding received in each sector differs significantly.

In Norway, the development of green technology and infrastructure is primarily supported through Enova, Innovation Norway, the Research Council of Norway, and the NOx fund. Among these, Enova plays a central role and is the focus of this chapter.

Enova: A key instrument for transport decarbonisation

Enova, through the Climate and Energy Fund, aims to support Norway's climate commitments and accelerate the transition to a low-emission society. Its focus is on late-stage technology development and early market introduction, with the objective of triggering lasting market shifts so that, over time, sustainable solutions can succeed without public support[1]

From 2021 to 2024, Enova's Zero Emissions Fund – open to all commercial transport sectors – allocated most of its support to maritime and land-based projects (see Figure 4). Enova also provides funding for infrastructure based on projected emission reductions. This support has so far been limited to electricity, biogas, and hydrogen, mainly targeting land and maritime applications (see Figure 5).

According to the government, this emphasis reflects the more advanced technological maturity in road and maritime transport. Aviation has historically received limited support.[1]

Figure 4: Enova's Zero Emissions Fund 2021-2024

Source: Data from Enova

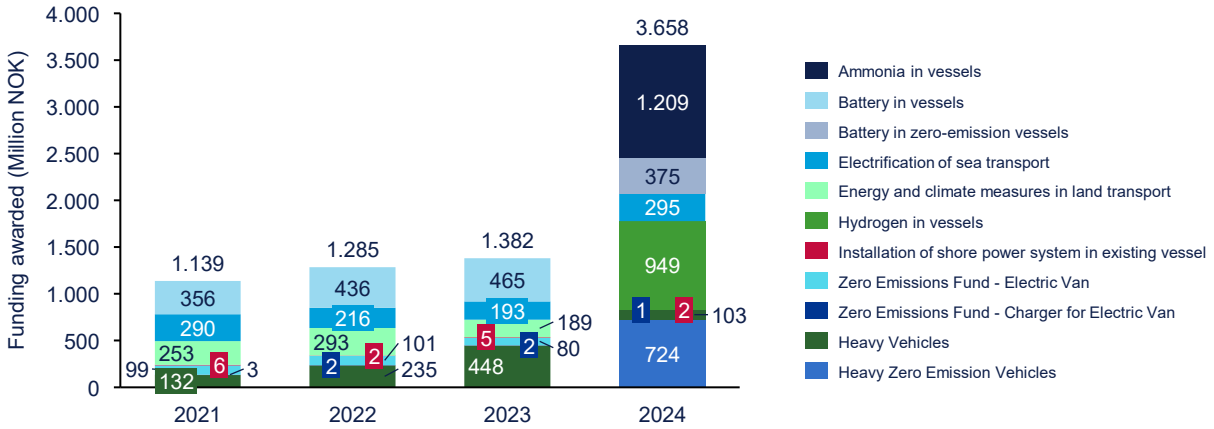
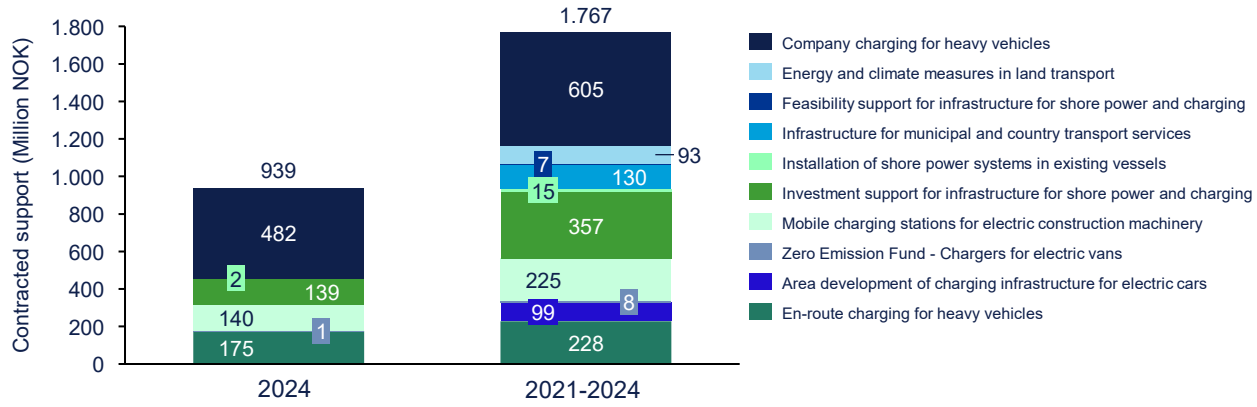


Figure 5: Enova's zero-emission fuel infrastructure funding 2021-2024

Source: Data from Enova



Sources: 1) Meld. St. 10 (2022-2023), Bærekraftig og sikker luftfart, Nasjonal luftfartsstrategi

4.5 Public funding: Maritime decarbonisation has been a focus area

Maritime benefits from targeted schemes for both battery-electric and alternative fuels

The Norwegian government has made maritime decarbonisation a strategic priority through Enova, with broad and targeted support instruments for zero-emission solutions across vessels and supporting infrastructure – for both battery-electric and liquid fuels.

- **Battery-electric vessels** have been supported since 2015, helping to establish a strong national value chain for maritime battery systems. In 2024, Enova restructured this programme to focus exclusively on zero-emission vessels, accelerating decarbonisation and promoting sector-wide energy efficiency.[1]
- **Shore power:** Since 2016, Enova has allocated over NOK 1 billion to 125 shore power projects, including NOK 143 million in the most recent round.[1]
- **Hydrogen and ammonia vessels:** Since 2023, Enova has offered targeted calls for hydrogen and ammonia vessels. In 2024 alone, over NOK 2.1 billion was awarded to 24 maritime projects under Enova's *"Hydrogen and Ammonia Fuelled Vessels Programmes".* As of March 2025, 15 ammonia vessels and 14 hydrogen vessels have received support. Individual projects can receive up to 80% of investment costs, capped at NOK 300 million.
- **Hydrogen infrastructure:** In late 2024, Enova awarded NOK 777 million to five hydrogen hubs along the coast (10–20 MW scale), from Oslofjorden to Bodø. These hubs aim to establish the first functioning hydrogen value chains for shipping. All projects have taken FID, with commissioning expected in 2027/28.
- **Ammonia infrastructure:** In 2022, Enova supported Neptun Glomfjord's project to produce green ammonia for maritime use. The project reached investment decision in January 2024 and expects to start production in 2027. In 2025, 15 ammonia bunkering projects received funding to mature early-stage concepts along the Norwegian coast.

Between 2022 and 2024, total funding for maritime decarbonisation rose from NOK 1.7 billion to NOK 2.9 billion, largely driven by Enova's growing budget. Interestingly, while the number of projects receiving funding fell, average funding per project increased – reaching NOK 35 million in 2024, more than double that of other sectors. This points to a shift toward fewer but higher-impact projects. For more details and sources, see Appendix A.2.

Support for de-risking aviation decarbonisation remains fragmented

Public funding for aviation decarbonisation in Norway is primarily relevant for projects targeting zero- and low-emission technologies, including aircraft and related infrastructure, as well as next-generation SAF production. In contrast to the maritime sector, no dedicated support schemes are in place, and funding levels remain significantly lower and more fragmented.

The recent government allocation of NOK 1 billion under the National Transport Plan (2025-2036) to support early deployment of zero- and low-emission aviation signal a positive shift, though implementation depends on annual appropriations in the national budget.[2] As a start, the government allocated NOK 50 million to Avinor and the Civil Aviation Authority in 2025 for the establishment of Norway as an international test arena for zero- and low-emission aviation. The same amount is proposed allocated under the 2026 national budget.[3]

Funding through Enova has so far been limited to its general technology development programme, although few aviation-relevant projects have received support. Examples include a NOK 507 million grant to Biozin for a commercial demonstration plant for advanced biofuels (which also received funding from EU instruments) and a NOK 117 million grant to Silva Green Fuels, although offtake is not limited to the aviation sector.[4] Biozin is currently evaluating project feasibility alongside Equinor after Shell pulled out, while Silva Green Fuels is being wound down following Statkraft's decision to exit biofuels.[5,6]

Sources: 1) Meld. St. 25 (2024–2025), Klimamelding 2035 – på vei mot lavutslippssamfunnet; 2) Regjeringen, "NTP 2025-2036: En fremtidsrettet utvikling av norsk luftfart" (March, 2024); 3) Klima- og miljødepartementet, Regjeringens klimastatus og –plan for 2026; 4) Enova, "Første og største EU-støttete prosjekt" (2022); 5) Horntvedt, A. "Utreder gigantprosjekt i biodrivstoff – får med seg Equinor" (Apr, 2024) ; 6) Solem, L., "Milliardfabrikk lever på lånt tid: – Det blir en pekelek" (Sep, 2025);

4.5 Public funding: Reflections on the funding gap

Note: DNV's reflections, based on discussions with Enova and aviation stakeholders.

Why has public support been more targeted toward maritime decarbonisation in Norway, and are there cross-sector synergies that can be utilised?

In our understanding, Norway's targeting of maritime decarbonisation reflects a policy and industrial strategy focused on domestic emissions reduction and domestic value creation, coupled with the sector's technology-infrastructure dependencies that call for integrated support. In domestic transport, maritime emissions are higher than aviation, strengthening the case for focused abatement. Norway's maritime industrial ecosystem also enables economic spillovers and exportable capabilities, further reinforcing the case for targeted support.

A large share of domestic shipping follows defined routes and bunkers at recurring locations. Decarbonising these routes depends on synchronised investments across vessels, fuel/electricity supply, and bunkering/shore-side infrastructure. This makes domestic programme design both necessary and impactful. Our understanding is that when early hydrogen vessel projects stalled due to lack of fuel availability, Enova made a strategic exception to its typical avoidance of "dual support," co-funding local fuel production and bunkering alongside vessels. This integrated, cross-value-chain design aligns with the route-specific, domestic nature of Norway's coastal shipping.

By contrast, aviation's industrial value chain is mostly international, with fewer Norwegian actors. The sector's main decarbonisation solution (SAF) is drop-in and compatible with existing aircraft and airport infrastructure, although challenges related to certification of certain pathways exist.[1] Further, conventional SAF (primarily HEFA) is globally traded. In our interpretation of the discussions, these characteristics reduce the rationale for Norway-specific, end-to-end schemes for aviation, particularly where blending mandates can stimulate demand.

The funding gap for next-generation SAF

However, HEFA feedstock constraints limit the role of conventional SAF under increasing blending mandates from the ReFuelEU Aviation regulation. Most future demand will have to be met by next-generation SAF, including e-fuels and advanced pathways. While establishing local production is largely a market and policy choice (discussed further in our report on the *SAF Product Journey*), Norway's strong starting position – with favourable resource conditions and a few maturing projects – should not be overlooked.

Even so, a significant funding gap persists, especially for mid- and late-stage project development. Next-generation SAF pathways require substantial technical and commercial de-risking and have yet to reach large-scale deployment. While advanced biofuel projects such as Biozin and Silva have received support, e-fuels developers report that existing national funding mechanisms do not fully address the needs of emerging technologies. Furthermore, enabling technologies such as CCU – critical for e-fuel pathways – remain under-supported, despite growing recognition at the EU level. Addressing these gaps requires a coordinated approach to funding, policy, and industrial strategy.

Opportunities for cross-sector synergies and targeted support

While much of the support for maritime decarbonisation has targeted vessels, a substantial portion also supports hydrogen production and infrastructure. In principle, such funding could benefit aviation, especially for e-SAF where hydrogen is used as feedstock, provided schemes are not restricted to maritime offtake. Opening selected instruments to cross-sector eligibility where appropriate, as done in EU's third hydrogen bank auction round, could help reduce structural gaps. Both sectors face similar challenges in de-risking next-generation fuels, creating opportunities for joint pilots.

For short-haul decarbonisation pathways, such as hydrogen or battery-electric aircrafts, the system characteristics are similar to the maritime sector: they require simultaneous development of new aircraft, fuel/energy production, and supporting infrastructure. These solutions could, in principle, benefit from similar sector-targeted and cross-value-chain support mechanisms as those applied in maritime.

Sources: 1) DNV, The SAF Product Journey (Dec, 2025)

4.6 Public-private collaboration driving change

Decarbonising complex sectors like maritime and aviation requires more than technology development and funding: it demands coordination across the entire value chain. Public-private collaboration platforms play a critical role in aligning stakeholders, shaping policy, and unlocking investment.

Maritime: Established collaboration mechanisms

Public-private collaboration is deeply cemented in maritime, particularly through the Green Shipping Programme (GSP), which initiates studies, pilots, and full-scale projects while enabling dialogue between government and industry. For more information on the GSP, please see Appendix A.1. The government supports collaboration through GSP and regional clusters and signed a formal climate partnership with the maritime sector last year. This provides a platform for shaping regulations in line with Norway's climate commitments.

In addition, the state is strengthening spatial and regulatory support through new national planning guidelines for climate and energy, which instruct municipalities to reserve sufficient land for fuel stations, charging infrastructure, and shore power to support maritime energy transition.[1]

Aviation: Emerging collaborative structures

To support early deployment of zero- and low-emission aviation technologies, Avinor and the Civil Aviation Authority Norway have signed an agreement to establish Norway as an international test arena zero- and low-emission aircraft, supported by funding from the government.[2] The test arena will serve as a joint contact point, develop a common process for concept-to-demo flight, and support regulatory readiness. Additionally, a multi-stakeholder aviation transition forum led by the Ministry of Transport has been launched to ensure knowledge sharing and alignment.[1]Alongside these initiatives, the industry-led Green Aviation programme ("Grønn Luftfart") seeks to improve collaboration among aviation stakeholders.

Unlike the maritime sector, the aviation industry has yet to establish a formal climate partnership, a gap highlighted by employer and labour organisations (NHO and LO).[3] This formalisation could help provide a more structured platform for joint strategic action and regulatory engagement.

Lessons from the Green Shipping Programme (GSP)

Initially established as a platform for potential future funding and decarbonisation initiatives, the Green Aviation programme remains in early stages of development. The development and success of the GSP could offer valuable lessons in successfully engaging a broad range of project partners across the entire sector value chain in Norway. This inclusive model, combined with the large size of the domestic maritime sector and early adoption of green technologies, has contributed to the GSP's ability to scale and secure strong governmental backing.

In comparison, the Green Aviation programme is smaller in scale and still building momentum. Expanding its participation to include actors not currently operating within Norway could be an important step toward building a more representative collaboration platform. This could help align diverse stakeholders around common objectives and increase the programme's influence on policy and market development.

In addition, pilot projects covering the full value chain could help the industry collectively address barriers to transition, as demonstrated in the maritime sector. Although partly initiated through the agreement of establishing Norway as a test arena for zero- and low-emission aircraft, this could be expanded to next-generation SAF. For instance, developing a green corridor focused on production and upgrading of partially refined feedstock could facilitate scale and efficiency while being a first step in scaling domestic production and reducing import dependency. Given Norway's geography, a hub-and-spoke logistics model may be necessary to aggregate supply and achieve economies of scale. The challenges and opportunities related to SAF production and local supply chains in Norway are further explored in DNV's report *The SAF Product Journey.*

Sources: 1) Særskilt vedlegg til Prop. 1 S (2024–2025), Regjeringens klimastatus og plan; 2) Regjeringen, "Regjeringa vil etablere Noreg som testarena for null- og lågutsleppsluftfart" (Oct, 2024); 3) NHO, "LO og NHO: Norsk luftfart må bli utslippsfri" (Aug, 2023)

5. Strategic options to accelerate the transition

5.1 Strategic options for aviation stakeholders in accelerating the transition

To support aviation decarbonisation and align with national climate and industrial objectives, stakeholders could consider the following actions:

- **Develop a government-backed roadmap for aviation decarbonisation:** A national roadmap, jointly developed by government and industry, could outline long-term goals and short-term milestones areas such as:
  - SAF blending milestones aligned with RefuelEU Aviation mandates
  - Timelines and quantified targets for zero-emission aircraft deployment
  - (If applicable) targets for domestic SAF production
- **Assess SAF production as part of industrial strategy:** Domestic production of next-generation SAF may offer opportunities for regional industry development and export growth while reducing import dependencies. Norway's existing SAF integration, renewable energy resources, forestry residues, and emerging hydrogen value chain could support this. Including next-generation SAF production in Norway's industrial strategy on the government-level could facilitate broader policy and investment support.
- **Evaluate dedicated funding schemes for aviation decarbonisation:** Experience from maritime decarbonisation suggests that targeted funding can accelerate adoption of alternative fuels. A similar approach could be considered for aviation, particularly for zero-emission infrastructure or novel, next-generation SAF technologies.
- **Explore cross-sector synergies in fuel infrastructure and supply security:** Coordinated development of shared fuel infrastructure could reduce duplication, pool feedstock demand, unlock economies of scale, and enable regional energy hubs serving multiple sectors. This is also important for ensuring security of fuel supply. Policymakers and project developers may assess opportunities for joint investment.
- **Strengthen collaboration platforms:** Formalising a public-private climate partnership for aviation, with broad participation across the value chain, could support coordinated action as demonstrated in the maritime industry. This might include full value chain pilots, such as zero-emission demonstrations or green corridors incorporating domestic SAF production.

By adapting lessons from maritime decarbonisation to aviation's specific context, Norway can contribute to advancing low-emission transport across sectors.

Appendix

A.1 The Green Shipping Programme

The Norwegian Government's green shipping policy is significantly impacted by close cooperation with industry, which includes DNV's Green Shipping Programme (GSP). First developed back in 2015, the programme was founded to establish the world's most efficient and environmentally friendly coastal shipping fleet. The private-public partnership consists of both studies and pilot projects which can be categorised into four phases:[1]

1. Investigating the potential of battery and gas-based maritime transport in Norway with emphasis on technical solutions (2015)
2. Establishing business cases for green shipping through potential regulatory and financial incentives. This includes highlighting possible barriers and challenges to be tackled (2016).
3. How to tackle identified barriers for zero- and low- emissions shipping along with an implementation plan (2018)
4. Scaling up identified solutions identified in pilot project among stakeholders (up to 2030).

The programme has received significant governmental funding over the years. In 2019's budget for example, the programme received 7 million NOK. The programme has resulted in 53 pilot projects (as of spring 2024) where 19 have either been realised or are in the process of being realised.

The programme's work primarily focuses on achieving green competitiveness internationally while cutting industry emissions, with the following strategic focus[2]:

- **Carbon-neutral fuels need to be tested to enable zero emissions in the industry:** The programme has highlighted a number of key enablers that are crucial to establish zero emissions in the industry in the future, where carbon-neutral fuels is mandatory (e.g. hydrogen, methanol, ammonia and biogas). These fuels must be tested to gather experience so that costs for these solutions can decrease, improved efficiencies are realised and alternative fuels become more readily available.
- **Bringing together the entire maritime chain** increases the chances to quickly find achievable solutions for developing a low carbon maritime industry in Norway that is both innovative and competitive. This includes more than 100 partners from within the maritime chain including shipyards, shipping companies, research institutes, financial institutions, transport buyers and more.

The programme has now been running for a decade, and it highlights the importance of a transparent discussion within key stakeholders in the industry, to boost knowledge sharing and enable better decision-making in the energy transition journey.

The GSP works with pilot projects across the maritime value chain. This includes projects to enable green shipping corridors, which can fast-track the implementation of alternative fuels and meet zero emission targets within the industry[4]. Setting specific routes with increased collaboration between key players can help in tackling challenges when introducing new fuels and technologies in the industry. Some important pilot projects have included:

- *"The role and function of the port in a green transport corridor"*[5] encompassing the port authorities of Bodo, Harstad and Tromsø, to identify functions of affected ports, new port requirements and business opportunities, and identify challenges for the ports to facilitate these changes.
- *"Green transport corridor between North and South Norway"*[6] targeting green transport that combines sea, rail and road, identifying the needed actors, defining the role needed by authorities (as facilitators, supporters and regulators).

The GSP also has specific projects investigating ammonia and hydrogen infrastructure needed to meet future demand.

Sources: 1) The Government's action plan for green shipping; 2) The world's most efficient and environmentally friendly shipping - Green Shipping Programme; 3) GSP in a nutshell - Green Shipping Programme; 4) Key considerations for establishing a green shipping corridor; 5) The role and function of the port in a green transport corridor - Green Shipping Programme; 6) Green transport corridor between North and South Norway - Green Shipping Programme

A.2 Public funding targeting the maritime sector

Targeted support towards alternative fuelled-vessels

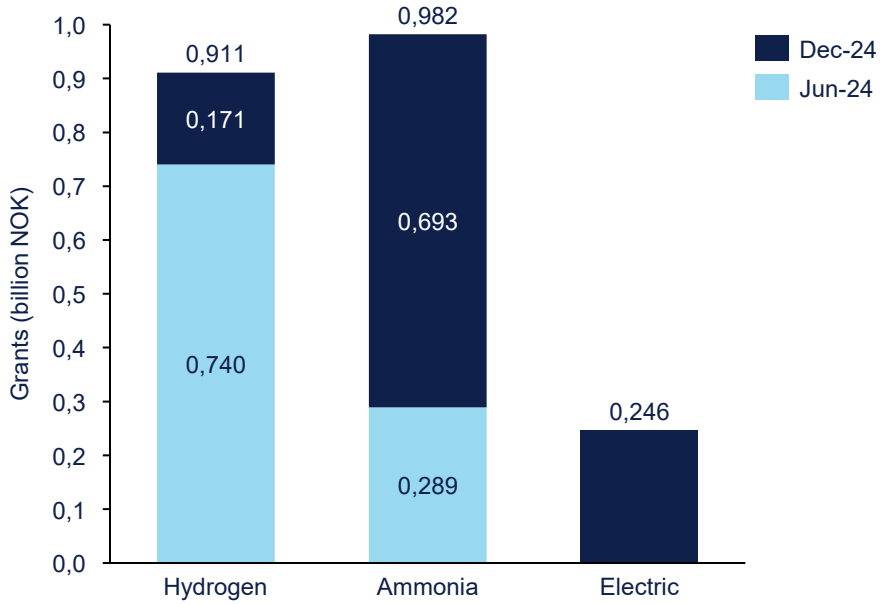
The largest funds available to Norwegian companies are managed by Enova, a state-owned organisation under the Ministry of Climate and the Environment. In December 2023, Enova introduced two major programmes targeting the maritime sector: the "**Hydrogen fuelled vessels programme**" and the "**Ammonia fuelled vessels programme**"[1]. These programmes provide grants to companies looking to either acquire new vessels or retrofit existing ones that run on hydrogen or ammonia (either partially or fully). Projects are selected based on cost-effectiveness (70%) and maturity (30%), and each project may receive up to 80% of the investment cost up to a maximum of 300 MNOK. The annual budget is up to 1500 MNOK per programme, with the programmes running until December 31st, 2026.

Within this framework, in 2024, Enova awarded over **NOK 2.1 billion** to **24 projects** in a two-staged process. First, in June 2024, Enova announced that it would support 15 projects with NOK 1.2 billion, including nine hydrogen vessels and six ammonia vessels. Then, in December 2024, 9 more projects were awarded grants: two hydrogen vessels and seven ammonia vessels[2]. This marks a significant scale-up from previous years and reflects an increasing focus on using alternative fuels to decarbonise the sector.

The next rounds are scheduled for March this year, with a total of two rounds in 2025 and another two rounds in 2026. A project that has been rejected can apply in a future round. In addition, a company can propose multiple projects as each ship is considered as a separate project. Enova also supports electric projects, where five electric vessels received USD 25 million in December 2024, and companies can still apply for the upcoming rounds[3].

Figure A1 shows the total Enova funding within hydrogen, ammonia and electric projects focused on the decarbonisation of vessels.

Figure A1: Enova-funding for vessels in 2024
Source: Data from Enova



Sources: 1) https://www.enova.no/bedrift/sjotransport/hydrogen-i-fartoy/; 2) https://www.hydrogen-worldexpo.com/industry-news/enova-agreed-fund-nine-hydrogen-vessels-six-ammonia-vessels; 3) https://maritime-executive.com/article/norway-awards-100-million-to-advance-ammonia-hydrogen-and-electric-ships;

A.2 Public funding targeting the maritime sector

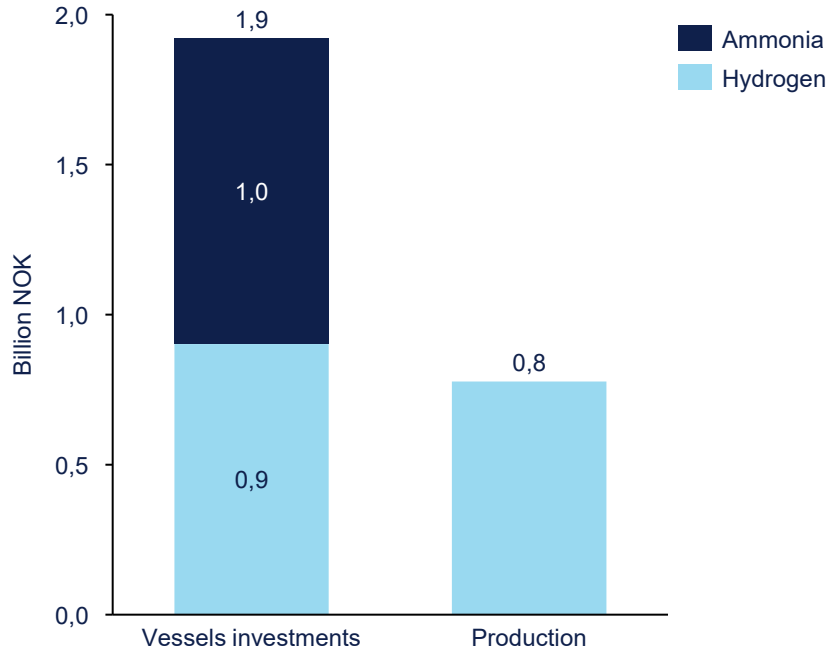
Building the full ecosystem: bunkering and production support

Enova's funding programmes extend beyond vessels to other parts of the value chain. For example, they provide funding for bunkering infrastructure through its "**Bunkering facilities for ammonia programme"**. In February 2025, they awarded grants to **15 projects** focused on exploring bunkering infrastructure for ammonia along the coast of Norway. The projects are given six months to mature their concepts and decide whether to apply for the larger-scale investment support offered by Enova. The selected projects could receive **up to 80% of their investment costs** in the form of a grant[1]. Although these projects are still in early stages, they are a crucial step toward building the necessary logistical backbone for future maritime fuels.

Finally, Enova supports the **production of alternative fuels** targeting the maritime sector under its **"Aid to hydrogen production for maritime transport 2027"** programme. With this programme, Enova aims to tackle two important challenges: the availability of hydrogen-based fuels along the coast and its price competitiveness. The scheme supports companies with an electrolysis capacity above 10MW, with construction plans for bunkering and fuelling facilities, and those which are located near maritime corridors[2]. So far, five hydrogen production projects have been supported with a total of **NOK 777 million**[3]. No further calls are planned.

As seen in Figure A2, the projects targeting vessels investments have received more funding compared to other projects in the value chain. However, the funding level per project is roughly double the amount for the production projects compared to the vessel investments. In terms of bunkering's funding, the projects are still at an early stage and the total subsidies amount to less than NOK 8 million.

Figure A2: 2024's Enova maritime fundings for fuel transition
Source: Data from Enova



Sources: 1) https://www.offshore-energy.biz/projects-exploring-ammonia-bunkering-in-norway-receive-enova-funding-boost; 2) https://www.enova.no/bedrift/industri-og-anlegg/hydrogenproduksjon-til-maritim-transport-2027/; 3) https://kommunikasjon.ntb.no/embedded/release/18309195/over-777-millioner-til-hydrogen-sikrer-forsyningen-langs-norskekysten?publisherId=17848299&lang=no

A.2 Public funding targeting the maritime sector

A funding model that prioritises impactful projects

Between 2022 and 2024, funding for maritime decarbonisation has increased significantly – from NOK 1.7 billion in 2022 to nearly NOK 2.9 billion in 2024. This can be explained by the increase in Enova's total budget in the same period, from NOK 5.4 to 11.6 billion. Although the number of supported maritime projects has declined (from 169+ in 2022 years to 84 in 2024)[1], the average funding per project has therefore risen sharply. This suggests a shift towards fewer, more impactful projects.

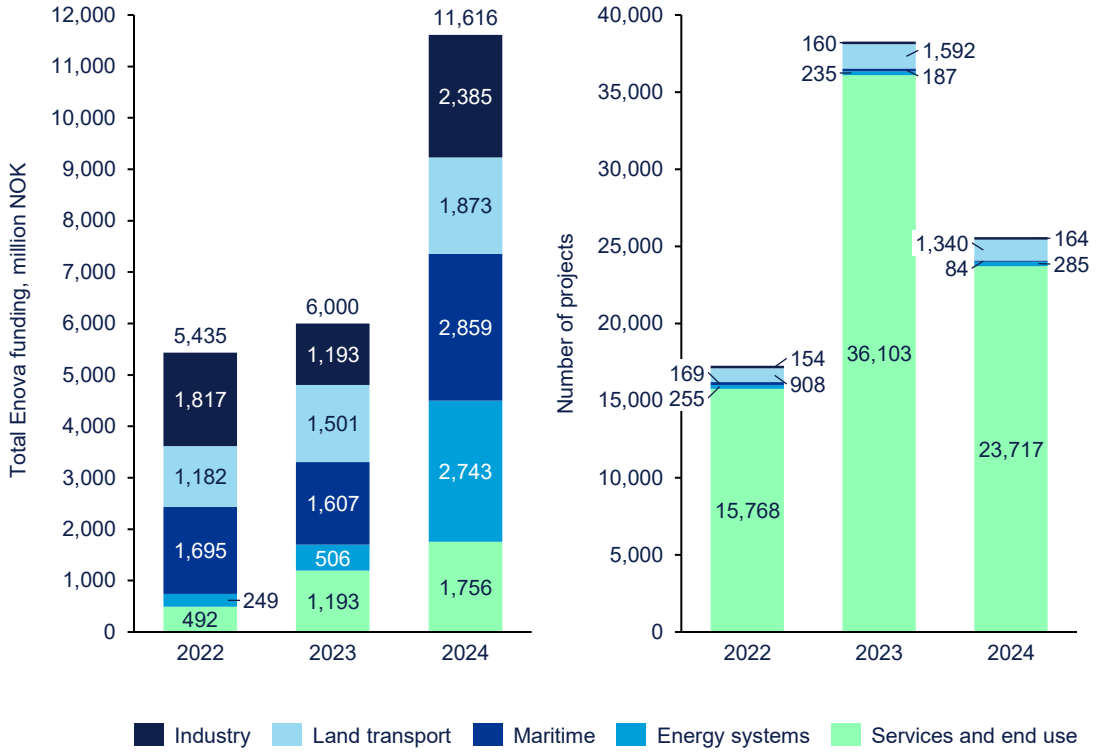
When compared with the other sectors, we see that the maritime industry receive more than double the average funding per project compared to the other sectors. This trend was especially evident in 2024, when the average funding per project rose to 35 MNOK (from around 8-10 MNOK in 2022 and 2023).

Additional lever: The NOx fund

On top of Enova, the maritime sector also benefits from the NOx fund – a technology-neutral, industry-led mechanism that reinvests proceeds from the Norwegian NOx tax into emissions-reducing projects. While both maritime and aviation are eligible, most of the money has gone to maritime initiatives. In one recent round, 49 MNOK was awarded to nine projects for battery, hydrogen, ammonia, and methanol-based retrofits and newbuilds[2]. The fund complements public instruments and enables maritime players to co-finance capital-intensive transitions. Aviation has yet to leverage the fund in a comparable way.

Figure A3: Total Enova funding awarded in 2022, 2023 and 2024 compared to number of projects per category / industry

Source: Data from Enova



Sources: 1) Data from Enova; 2) https://www.noxfondet.no/nyheter/nox-fondet-stotter-storstilt-utslippsreduksjon-i-maritim-sektor

A.3 EU regulatory frameworks enabling national support

There are three key EU frameworks that shape how Member States can support fuel production projects involving hydrogen and its derivatives – critical components for e-SAF production[1]:

1. **Guidelines on State Aid for Climate, Environmental Protection and Energy (CEEAG):** Aims to broaden the scope of green investments and technologies eligible for support to help achieve the EU Green Deal objectives. Hydrogen-related activities are extensively covered, including both production and use across the value chain.

2. **General Block Exemption Regulation (GBER)**: Allows Member States to grant certain types of aid without prior notification to the European Commission. It covers the full hydrogen value chain, including renewable hydrogen production and infrastructure. Notably, it also includes provisions for CO_2 capture and transport, provided these are part of a complete CCS and/or CCU chain. However, the aid must contribute to an overall reduction in emissions, not merely shift them between sectors. For CCS/CCU-related investments, aid intensity is capped at 30% of eligible costs[2]. That said, GBER does not explicitly mention e-fuels or SAF, but supports hydrogen production, thus indirectly enabling e-SAF. Enova's aid to hydrogen production for maritime transport in 2027 is in compliance with GBER rules[3], making them especially relevant for potential SAF production support.

3. **Temporary Crisis and Transition Framework (TCTF):** Provides a more flexible and targeted framework, allowing temporary support schemes or individual aid for the production and storage of renewable hydrogen and hydrogen-derived fuels, including electricity-based fuels (e-fuels) – making it directly relevant for e-SAF. Support under TCTF is subject to notification and approval by the European Commission, but it explicitly recognises e-fuels as eligible technologies when sustainability criteria are met.

Image: Taro Hama @ e-kamakura

Sources:1) State aid | European Hydrogen Observatory: 2) Regulation - 2023/1315 - EN - EUR-Lex; 3) Enova "Aid to hydrogen production for maritim transport 2027 (Hydrogenproduksjon til maritim transport 2027)", State aid Reference no.: GBER 42/2024/ENV

www.dnv.com