A COMPARATIVE GAP ANALYSIS

Navigating barriers to next-generation SAF production in Norway

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1 EXECUTIVE SUMMARY

This memo examines the next generation Sustainable Aviation Fuel (SAF) production market in Norway, identifying three main barriers hindering progress: financial challenges, regulatory uncertainty, and feedstock and infrastructure limitations. Despite having certain advantages to SAF production, such as access to renewable energy and forestry resources, gaps in strategic support and funding prevent effective scaling of SAF.

- **High production costs and funding gaps:** Next generation SAF technologies require significant capital compared to conventional jet fuels and traditional HEFA. While Norway primarily has mechanisms in place for early-stage funding, such as through Enova and Innovation Norway, there is a critical funding gap for later-stage project development. Specifically, projects find it difficult to secure the necessary capital to mature projects towards Front End Engineering Design (FEED), when the Final Investment Decision (FID) is made. This is required to reduce risks and attract private capital, further maturing the projects towards commercialisation. In contrast, countries like the UK and the US have established funding models that span project lifecycles, with next generation SAF projects receiving support.
- **Lack of clear governmental strategy and regulatory alignment:** Norway has yet to implement a clear strategy for next generation SAF and supportive infrastructure, unlike countries with a clear national roadmap such as the UK and Germany. A key concern for the Norwegian SAF industry is the current prioritisation of decarbonising other industries, notably the maritime and road transport sector where more targeted funding opportunities and governmental strategies exist for decarbonisation. Moreover, Norway is lagging on implementing relevant EU regulations like RED II and III, as well as the ReFuelEU Aviation package, which creates uncertainty for both producers and investors.
- **Feedstock and infrastructure challenges:** Securing a stable, scalable supply of diverse feedstocks is important for next generation SAF production. There is currently no clear national strategy to prioritize feedstock supply for SAF, with access to grid capacity being a key uncertainty. Additionally, carbon capture and utilization (CCU) – an important component for some SAF pathways – remains underdeveloped, with no clear policies in place to support its integration into SAF production. In contrast, countries like the US have targeted tax credits for CO_2 utilisation and incentives for farmers to produce crops for SAF feedstock.

Benchmarking Norway against the UK, US, and other leading countries show that robust funding models, ambitious SAF mandates, and clear national roadmaps have successfully addressed similar challenges elsewhere. To help build up the next generation SAF industry and support the global transition to low-emission aviation, Norway can draw inspiration from the initiatives ongoing in these countries.

2 INTRODUCTION

Sustainable Aviation Fuel (SAF) has emerged as a key component in the aviation industry's decarbonization strategy, being an effective way to achieve emission reductions without requiring major changes to existing aircraft and fuel infrastructure.

Currently, the majority of global SAF production (0.5 million tonnes in 2023) comes from the Hydroprocessed Esters and Fatty Acids (HEFA) pathway, which relies on feedstocks such as used cooking oils, animal fats and waste oils. However, limited availability of HEFA feedstocks presents a challenge to meeting the anticipated future demand post 2030: The ReFuelEU Aviation blending mandates alone translate to roughly 2.3 million tonnes of SAF being required by 2030[1]. As a result, the industry must transition to other SAF production pathways, known as next-generation SAF. These pathways utilize a wider range of technologies and feedstocks, including hydrogen and renewable electricity (for e-SAF), forestry and agricultural residues, household and industrial waste, and even captured CO_2.

Next-generation SAF technologies, though promising, face several hurdles. These technologies are less commercially developed than HEFA and come with higher costs, requiring significant upfront capital investment, longer lead times to achieve commercial scale, and often more complex supply chains for feedstock sourcing and processing. As such, there are significant investor risks involved, and securing financing remains a key challenge. Frameworks that help reduce these risks by facilitating demand, ensuring long-term regulatory certainty, managing technical risks and introducing mechanisms to share risk are crucial in securing financing for next generation SAF production[2].

While other countries are actively addressing these challenges through targeted policy frameworks and financial incentives, Norway's next generation SAF projects see several barriers. The industry highlights a lack of early-stage risk mitigation and uncertainty around implementation of EU regulations such as RED II, RED III and ReFuelEU Aviation as key factors preventing access to finance. Moreover, the SAF blending mandate in Norway remains at 0.5%, with no current plans to align with the more ambitious EU ReFuelEU Aviation targets. In contrast, other nations are seeing higher mandates to stimulate SAF production (see **Figure 1**). This is despite Norway being well-positioned to lead in next-generation SAF production – benefiting from access to renewable energy sources, forestry resources, and potentially significant volumes of industrial waste – and being a pioneer in integrating traditional SAF (HEFA) into its fuel infrastructure.

As the Ministry of Transport is now working to evaluate suitable measures to accelerate the transition towards fossil-free aviation, this memo can serve as a knowledge base. It aims to highlight the key barriers faced by producers of next generation SAF in Norway, map the frameworks available for SAF producers in Norway, and assess the gaps: where do the existing frameworks fall short, and can we build robust frameworks to boost next generation SAF production by learning from what is being done in other countries?

[1] Sustainable Aviation Fuels | EASA Eco (europa.eu)

[2] The requirements for sustainable aviation fuel (SAF) financing (ICF)

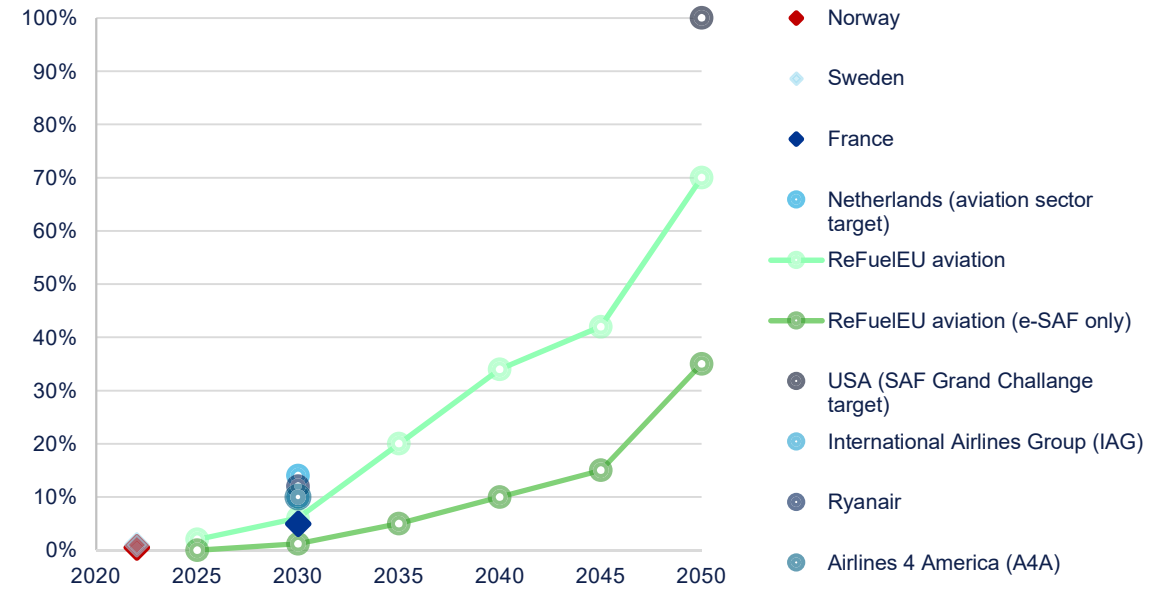

Figure 1: SAF blending mandates and ambitions for various countries, companies and organisations[3456].

[3] SAF policy actions | EASA Eco (europa.eu)

[4] ExxonMobil and Neste partner to supply SAF in line with new French blending mandate – GreenAir News

[5] Dutch Government Targets SAF Blending Mandate by 2023 | Aviation International News

[6] Sweden also has a mandate for greenhouse gas reduction that could impact SAF, where kerosene aviation fuel must reach 27% greenhouse gas reduction by 2030. (Greenhouse gas reduction mandate)

3 BARRIERS TO NEXT GENERATION SAF PRODUCTION IN NORWAY

The transition from HEFA-based SAF to next-generation SAF presents significant barriers that hinder the development and scaling of these technologies. In recent months, several SAF projects across Europe have either been cancelled or postponed, with major investors withdrawing due to concerns over commercial feasibility, high costs, and an immature market with low willingness to pay. Examples include the Swedish HySkies and SkyFuelH2 eSAF projects, the Green Fuels for Denmark project, several biofuel projects in the Netherlands and Germany, and Norway's own Biozin. Although Biozin has gained a new major investor in Equinor, the project is now targeting several potential offtake markets – not only SAF.

These challenges are underscored by a recent survey from the Air Transport Action Group (ATAG), which reveals that investors see uncertainty around technology maturity[7] as a key barrier, followed by lack of long-term regulatory certainty and inadequate risk sharing mechanisms. For emerging markets like next generation SAF, public financing is crucial to mitigate risks and facilitate market growth. As SAF markets develop and projects begin to yield returns, private financing can gradually play a larger role in meeting investment needs.

Although these challenges are seen on a global scale[8], there are a few barriers unique to the Norwegian context. Below, we categorise these into **financial**, **regulatory and market**, and **feedstock related** barriers, and highlight the identified gaps in existing frameworks in solving these barriers.

3.1 Financial barriers

Next-generation SAF technologies require substantial financial investment to move from pilot stages to commercial-scale production. Several barriers are identified that could hinder this process:

- **A need for public financing, but funding mechanisms largely prioritise other sectors:** Next generation SAF technologies are capital-intensive, with higher costs than traditional production[9] due to the need for advanced infrastructure, complexity of the technology and longer development timelines. Moreover, it takes time to develop a technology to commercial scale[10]. These factors increase financial risk, making it challenging to attract necessary capital from investors. As such, access to sufficient public funding is essential. However, **available funding mechanisms have largely prioritised decarbonising other sectors**, notably the maritime and road transport sector. While funding exists for hydrogen production which could in theory be used for SAF production, recent Enova tenders have been focused on hydrogen dedicated to the maritime industry, thereby excluding SAF projects. The past year, Enova provided a total of 1.22 billion NOK across 15 maritime projects (see more details in Appendix). It is also worth highlighting that Norway has released substantial funding in moments of crisis for prioritised sectors, with the oil and gas industry receiving by far the largest contribution during the Covid 19 pandemic of more than USD 11 billion[11].
- **Insufficient funding mechanisms for scale-up:** To mature a project through to commercialisation, it needs to go through several stages post innovation and demonstration phase: conceptual design, Pre-Front End Engineering Design (Pre-FEED) FEED, and Engineering, Procurement and Construction (EPC) – each with its unique set of tasks (some examples are shown in Figure 2). While the uncertainties decrease along the stages, the investment requirements and challenges typically multiply, highlighting the need for sufficient funding at all

[7] This included uncertainty around which technologies and producers can successfully construct projects and scale, securing sufficient feedstock supply and pricing, and the dominance of small companies with no track record in next generation SAF production. Source: ICF

[8] Globally, 60 e-kerosene projects are announced but only one has reached Final Investment Decision (FID). Source: E-fuels likely to remain scarce for a long time: PIK analysis paper — Potsdam Institute for Climate Impact Research (pik-potsdam.de)

[9] ICAO in the US estimated the capital cost to be from 0.9 up to 12.7 $/litre for pioneers depending on specific pathway and feedstock, while HEFA is currently ranging between 0.4 and 0.5 $/litre. Source: The European SAF policy landscape & ICAO SAF Rules of Thumb (icao.int)

[10] For example, advanced biofuel technologies typically require 10-20 years to progress from lab scale to FOAK status, plus 2-5 years for construction and commissioning. Source: The European SAF policy landscape & ICAO SAF Rules of Thumb (icao.int)

[11] The package included temporary ease of tax rules, reimbursements to cover part of losses, and support and restructure of oil and gas companies impacted by economic slowdown from decreased oil prices. Source: Norway - Energy Policy Tracker

stages to mature the project. **Existing funding mechanisms in Norway are primarily geared towards early-stage innovation and demonstration** (such as Enova and Innovation Norway), or commercial stages once risks are sufficiently reduced (such as Eksfin). There is a lack of funding for mid-phase project development, such as FEED and EPC, which limits the projects' ability to progress from pilot projects to commercial-scale production. A promising development is the newly established Green industrial financing mechanism from Innovation Norway, aimed at providing loans to large-scale industrial projects looking to scale.

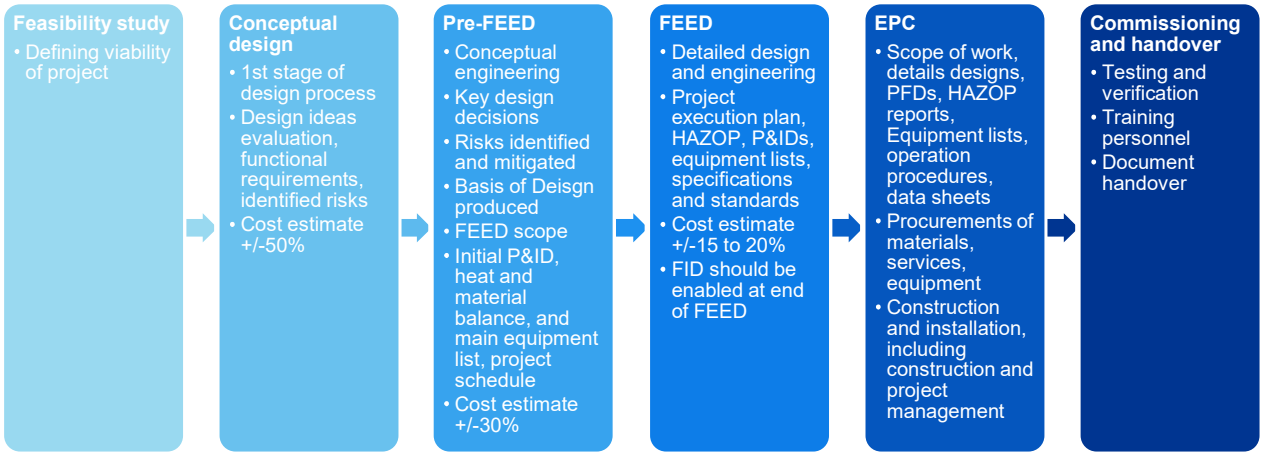

Figure 2. Project stages from conceptual design to construction[12]

In short, the total amount of funding available for SAF production is limited, especially for later project stages, with larger sums prioritised for other sectors. This results in SAF projects being required to secure funds outside of Norway such as through the EU Innovation Fund, where competition is high.

3.2 Regulatory and market barriers

Clear, long-term policy and regulations are required to ensure consistency and reduce uncertainty for all markets Currently, Norwegian SAF producers experience several barriers related to regulatory frameworks.

- **There is a high uncertainty as to whether (and when) Norway will implement EU regulations:** Norway has yet to fully implement key EU directives, such as the Renewable Energy Directive (RED) II and III as well as the ReFuelEU Aviation package. Without a clear regulatory framework that aligns with EU standards, the uncertainty for producers and investors increase. Moreover, these EU regulations provide important incentives for SAF production, including free allowances under the EU Emission Trading Scheme (ETS), which puts Norwegian SAF producers targeting the home market at a competitive disadvantage.
- **The blending mandates are low compared to neighbouring countries:** Norway's SAF blending mandate has remained at 0.5% since its introduction in 2020. This target is significantly lower than the ambitious blending mandates set by the ReFuelEU Aviation programme, which are designed to rapidly increase SAF demand. Although Norway could export SAF to meet the growing demand in the EU, the lower blending mandate may not provide sufficiently strong market signals to encourage investments in SAF production for the home market.

[12] The 9 Stages of Complex Engineering Projects (assai-software.com)

- **Norway lacks a clear political direction for the next generation SAF industry**, as compared to more targeted decarbonisation strategies for the maritime and road transport sector. For instance, the Norwegian government has set a clear maritime decarbonisation strategy with a published action plan for green shipping[13] and its Hydrogen Strategy has more emphasis on the maritime sector compared to aviation[14]. This, in turn, leads to more funding available for these sectors and more certainty on priority and direction for producers and investors.
- **Complex permitting and uncertainty on grid access:** Next generation SAF production, particularly e-SAF, requires large-scale access to renewable electricity. However, the permitting process for SAF projects in Norway is often slow and complex, particularly when it comes to securing grid capacity for renewable energy. Delays in obtaining necessary permits and accessing the grid create additional uncertainty and risk for developers. This challenge also links to the renewable power production and the market for power purchase agreements (PPAs) to ensure additionality and correlation of new power generation which might be required.

3.3 Feedstock and supply chain barriers

Securing a stable and scalable supply of diverse feedstocks is a key challenge for next generation SAF production, as the supply chain complexity increases compared to traditional HEFA:

Lack of national feedstock strategy: While HEFA-based SAF production relies primarily on waste oils and crops, next generation SAF pathways involve a wider range of feedstocks, including forestry and agricultural residues, household waste, industrial by-products, and renewable electricity. The multiple value chains and infrastructure required to secure feedstock access compared to other fuels (such as hydrogen or ammonia) creates complexity and increased risk. While Norway has significant potential in feedstock for SAF production, there is currently no clear strategy or support mechanisms to ensure that feedstock supply is available at the scale required.

Focus on Carbon Capture and Storage (CCS), not on Carbon Capture and Utilization (CCU): CCU plays an important role in several next generation SAF production pathways which require captured CO_2 as feedstock. Although Norway has a strong history within funding and developing CCS technologies, notably through the Longship project receiving state funding of 20 billion NOK (see more details in Appendix), there is no clear policy or funding framework to support CCU. As of today, only a marginal amount of funding has been given to CCU projects (around 1% of total funding for CCUS projects in Norway)[15]. This limits the ability of Norwegian SAF producers to integrate CCU technologies into their production processes. Moreover, competition for access to CO_2 – notably from investors with a high willingness to pay for carbon removal credits from BECCS (bioenergy CCS) or DACCS (direct-air CCS) such as Microsoft – could hinder the development of CCU projects.

[13] The Government's action plan for green shipping (regjeringen.no)
[14] The Norwegian Government's hydrogen strategy - Climate Change Laws of the World (climate-laws.org)
[15] HEILO: Søtte til CCUS (enova.no)

4 BENCHMARKING AGAINST OTHER COUNTRIES

To address the barriers identified in Chapter 3, this chapter examines how other countries have developed frameworks to support next-generation SAF production. Each section provides examples of policies and funding mechanisms that have proven effective in overcoming specific challenges, to serve as inspiration for how Norway could facilitate more favourable frameworks conditions for next generation SAF production. These have been categorised into financial incentives, and regulatory framework and market signals. The following countries are assessed: the United Kingdom (the UK), the United States (the US), Sweden, Denmark, and Germany.

4.1 The United Kingdom (UK)

The UK has positioned SAF production as a critical component of its aviation decarbonisation strategy, triggering several announcements of SAF production projects. With both comprehensive funding and clear regulation, the UK addresses many barriers also present in Norway's SAF landscape. Key takeaways for Norway from the UK approach include:

- Establishing funding that covers all stages of SAF project development, from early-stage feasibility to commercial-scale deployment, to support scaling.
- Setting progressive SAF blending mandates to create consistent demand signals and boost investor confidence.
- Implementing mechanisms to ensure price stability for SAF producers, addressing the volatility in feedstock costs and market demand.

4.1.1 Financial incentives

The UK has designed its financial support to span the entire lifecycle of SAF projects, helping to address the high costs and financial risks associated with scaling SAF production. **By providing funds from early-stage feasibility through to FEED and EPC, the UK reduces financial barriers and enhances project bankability.** Two major government-backed investment opportunities for SAF exist:

- **The Advanced Fuels Fund (AFF)** offers a unique funding opportunity for SAF producers in the form of one-off grants. So far, it has awarded most of the recent SAF-funding in the UK[16] at a total of £135 million to 14 projects over two rounds, including several next generation pathways. Funding is available for all project stages, from feasibility studies, Pre-FEED, FEED, and even parts of the EPC scope[17]. Examples include £24.9 million to the **DRAGON Alcohol-to-Jet project** (using waste gases from steel mill emissions to produce synthetic kerosene at a capacity of 102 million litres per year) and £27 million to the **Velocys AltAlto project** (using municipal waste as feedstock, with a capacity of 60 million litres per year).[18]
- A **revenue certainty mechanism (RCM)** is proposed for next generation SAF producers, although not implemented yet. The RCM would offer a long-term funding opportunity where up to 100% of the green premium could be covered through annual payouts of up to 15 years, starting from 2026 or 2027[19]. There are currently four options for mechanisms shortlisted, where all require legislation updates[20]:
    1. Guaranteed Strike Price (GSP), guaranteeing a minimum price per litre for SAF producers.

[16] Examples of SAF projects not awarded by AFF includes the $484,000 grant to Speedbird from the Department of Transports' Green Fuel fund, for their feasibility study of a 100 million litres facility using agricultural and wood waste as feedstock.

[17] Advanced Fuels Fund (AFF) competition winners - GOV.UK (www.gov.uk)

[18] Existing and Planned SAF Projects | SAF Investor

[19] Sustainable Aviation Fuels Revenue Certainty Mechanism (publishing.service.gov.uk)

[20] GSP and BOLS include private law contracts which require updates to the primary legislation, while MFP and MAR would impact the UK's SAF mandate and require an additional secondary legislation update.

2. Buyer of Last Resort (BOLS), guaranteeing a minimum price for SAF certificates if market prices fall below a specified threshold.
3. Mandate Floor Price (MFP), where an adjustable mandate can set the SAF price closer to the buy-out price to avoid oversupply in the market.
4. Mandate Auto-Ratchet (MAR), where the mandate includes a minimum price for the SAF certificates.

4.1.2 Regulatory framework and market signals

The UK's **JetZero Strategy** provides a **clear political direction for how to achieve net zero emissions in the aviation sector**. This ensures long-term market clarity and confidence towards producers and investors alike. The strategy is aimed at three main pillars to support SAF development:

1. **Creating a growing demand for SAF by introducing SAF blending mandates**. The UK has mandated a 2% SAF blending target by 2025, increasing to 10% by 2030 and 22% by 2040[21].
2. **Supporting the creation of a SAF industry in the UK through targeted funding.** The Government has provided grants since 2014 for developing advanced fuels, with examples provided in Chapter 4.1.1. In total, funding of £171 million has been provided, including development of SAF production, with the aim to have five SAF production plants in construction by 2025.
3. **Facilitate long-term collaboration between government, industry and investors** to remove key barriers to scaling SAF production, including the proposed introduction of RCM (see Chapter 4.1.1) to **share the financial risk** between producers, investors and government.

4.2 The United States (US)

The US has taken significant steps to promote SAF production, primarily through financial incentives, clear regulatory strategies, and a supportive feedstock ecosystem. The US approach highlights several lessons for Norway in overcoming barriers to SAF production:

- Leveraging tax credits and grants to reduce high SAF production costs, especially by linking financial support to emissions reductions.
- Developing a national SAF roadmap to provide strategic direction and long-term market clarity for investors and producers.
- Supporting feedstock innovation and supply chain development through dedicated incentives.

4.2.1 Financial incentives

The US leverages tax credits and grants to reduce SAF production costs, linking financial support directly to emissions reductions to encourage lower-carbon SAF production.

- The **Inflation Reduction Act (IRA)** from 2022 introduced a **SAF tax credit**, offering a base credit of $1.25 per gallon for any SAF produced with a minimum of 50% reduction in lifecycle greenhouse gas (GHG) emissions. The credit increases $0.01 per additional percentage point of GHG reduction, up to $1.75 per gallon[22]. Although the credit expires in 2025, it is replaced by a Clean Fuel Production Credit (CFPC) that will run

[21] Creating the UK SAF Mandate: government response to the second consultation on the SAF Mandate (publishing.service.gov.uk)
[22] Sustainable aviation fuel credit | Internal Revenue Service (irs.gov)

through 2027. The CFPC applies to a wider range of clean fuels, starting at $0.20 per gallon for non-aviation fuel with a maximum of $1.00 per gallon. **The credits are higher for SAF**, starting at $0.35 per gallon with a cap of $1.75 per gallon[23].

  - The IRA also includes a **tax credit on hydrogen production and CCU projects.** For CCU (under Section 45Q), the credit is equal to $60 per ton of CO_2 (or CO) utilised to produce low-carbon fuels, as well as other products. For CO_2 captured from air (Direct Air Capture), the credit increases to $130 per tonne[24]. This helps provide **crucial support to feedstock for next generation SAF production**, reducing barriers relating to supply chain challenges.

- Similarly to the UK, the US has also introduced **one-off grants to provide financial support that span the entire lifecycle of SAF projects.** This is done through the **Fueling Aviation's Sustainable Transition** (FAST) grant, with a total of $244.5 million to support build out of infrastructure projects related to SAF production, transportation, blending and storage, as well as £46.5 million to develop and demonstrate new low-emission aviation technologies. The full grant ($291 million) was awarded to 36 projects last year, of which 22 were related to build-out of SAF infrastructure[25]. Examples of next generation SAF production grants include $50 million to Martinez Renewables Facility to convert an existing plant to eSAF production (planned to produce 100-350 million gallons per year from 2027); $16.8 million to a project in Minnesota converting an existing production facility to Alcohol to Jet; and $14.6 million for FEED studies to Arcadia eFuels Project Arc (planned to produce 23.2 million gallons of eSAF per year from 2028).
- Examples also exist from the **banking sector**, with the Bank of America making a commitment of $2 billion in sustainable finance for SAF production and other low carbon aviation solutions, as well as partnering with SkyNRG to support the production of 1.2 million gallons of SAF per year from 2025[26].

4.2.2 Regulatory frameworks and market signals

The US has established a **national SAF production roadmap**, creating clear targets and a strategic pathway that supports long-term investment and aligns public and private efforts.

- **The SAF Grand Challenge** roadmap sets a target of 3 billion gallons of SAF produced by 2030, with the aim to meet 100% of US aviation fuel demand by 2050. The roadmap is led by three governmental departments (Energy, Transportation and Agriculture), and outlines six action areas to help scale SAF production and reduce costs: feedstock innovation, conversion technology innovation, building supply chains, policy and valuation analysis, and enabling end use[27].
- As part of the roadmap, the **feedstock innovation** action pillar suggests implementing incentives that directly benefit farmers to grow SAF-specific crops[28], to ensure a stable and diverse feedstock supply and address key supply chain challenges.

4.3 Germany

Germany's approach to supporting SAF production focuses on clear mandates, collaborative industry initiatives, and targeted funding to drive innovation and production. Key lessons for Norway include:

[23] Clean Fuel Production Credit (energy.gov)
[24] What is the 45Q tax credit? (Carbon Herald)
[25] Fueling Aviation's Sustainable Transition (FAST) Grants | Federal Aviation Administration (faa.gov)
[26] Sustainable Aviation Fuel: Ready for Takeoff (Bank of America)
[27] SAF Grand Challenge Roadmap: Flight Plan for Sustainable Aviation Fuel Report (energy.gov)
[28] Sustainable Aviation Fuel (SAF) State-of-Industry Report: State of SAF Production Process (nrel.gov)

- Establishing more aggressive SAF mandates to create demand and attract investment.
- Encouraging collaboration within the aviation sector to address industry barriers and coordinate on SAF production goals.
- Offering funding initiatives that incentivize SAF development, while addressing regulatory challenges that can hinder projects. Particularly, Germany's experience with the failed H2Global Scheme for SAF highlights the need for regulatory clarity to avoid project delays and ensure economic feasibility.

4.3.1 Financial incentives

Germany's financial support for SAF production includes direct funding for projects, collaborative industry initiatives, and the H2Global Scheme – which, though promising, faced challenges in its SAF application due to regulatory complexities. This highlights the need for regulatory clarity to avoid project delays and ensure economic feasibility.

- The Federal Ministry for Digital and Transport's Renewable Fuels Initiative provides funding for projects at the demonstration, innovation or market preparation stage contributing to renewable fuel development. As of last year, a total of €100 million was awarded to 12 projects[29]. **Although not targeted specifically at SAF production, several SAF projects have received funding**. Examples include €15 million to the SAFari project, aimed at receiving approval certification of their e-SAF pathway, and €3.1 million to the M2SAF project (synthetic methanol using green hydrogen and CO_2) run by the consortium of BASF, Thyssenkrupp, and OMV. The latter covers the **whole fuel value chain**, including catalyst development, techno-economic assessments, and demo-plant design, aiming to accelerate eSAF technology commercialization[30].
- The **German-funded H2Global Scheme** encourages purchasing hydrogen derivatives, like SAF, outside the EU to sell within the EU, bridging the gap between production costs and market prices. **However, Germany's first SAF auction under the H2Global program faced regulatory hurdles and received no final bids**[31]. Developers were put off by uncertainties in GHG emissions accounting rules, specifically around byproducts under RED II[32]. Due to these limitations, the scheme's €300 million SAF funding was ultimately reallocated to e-methanol. This experience underscores the importance of clear regulatory frameworks for SAF projects to be economically viable.
- The **Aviation Initiative for Renewable Energy in Germany (AIREG)** fosters collaboration across the aviation sector, bringing together government, industry, and academia to address SAF challenges[33]. Through regular publications and policy advocacy, AIREG plays a key role in aligning the industry's needs with public policy goals. In its recent paper on SAF ramp-up in Germany, it highlighted the need for **more supportive government funding** to achieve the country's ambitious target for sustainable aviation (see Chapter 4.3.2).

4.3.2 Regulatory frameworks and market signals

Germany has **introduced SAF-specific mandates along with a national SAF roadmap integrated with its hydrogen strategy.** These measures help address demand certainty and provide regulatory stability.

[29] BMDV funding guideline on developing renewable fuels garners huge interest – 100 million euros in funding already approved

[30] German Government Funds New SAF Production Development | Aviation International News (ainonline.com)

[31] EU must clarify rules to enable e-SAF development | Latest Market News (argusmedia.com)

[32] Under the current RED II requirements, GHG savings are proportionally allocated between all end-products causing too much dilution when some of the byproducts lack market opportunity for renewable hydrogen input and/or supporting subsidies. The programme managing company, Hinto, highlights that the RED II either needs to allow the renewable hydrogen production to be solely for e-SAF in emissions savings accounting or include subsidy frameworks for the byproducts created.

[33] About us – aireg – Aviation Initiative for Renewable Energy in Germany e.V.

- **Germany's SAF mandates focus specifically on Power-to-Liquid (PtL) fuels**, starting at 0.5% blending by 2026, increasing to 1.0% by 2028, and 2.0% by 2030, with financial penalties for non-compliance (€70 per GJ, based on marginal costs)[34]. The target is aimed at suppliers of jet fuel rather than aircraft operators, with the suppliers being responsible for reporting percentage of PtL supplied to the market by 2026[35]. This creates a predictable demand for PtL SAF, which can drive investment and project development in the sector.
- Germany's **SAF roadmap**, linked to its national hydrogen strategy, lays out **production targets, key project locations, and development priorities for SAF**. AIREG has also published a strategy paper to urge the ramp up of SAF in Germany to meet international aviation climate targets[36]. The paper emphasises measures needed to ensure Germany's SAF utilisation targets can be achieved:
  - PtL specific financial support to ensure long-term targets are met.
  - Improved promotion of all SAF pathways (both next generation and HEFA SAF) to ensure short and medium-term targets for SAF EU blending mandates can be met, as well as reduce risks (technical and economic) for SAF ramp up.
  - Review and possibly adapt regulatory framework for sustainable raw materials supply for SAF. This should include local SAF production near feedstock supply when suitable (such as biomass strategies).

4.4 Sweden

Compared to the abovementioned countries, Sweden has a less direct focus on supporting next generation SAF production through funding incentives and regulatory mechanisms. However, Sweden has implemented several funding mechanisms that are available for SAF producers, such as tax incentives for biofuels and grants for large-scale industries.

4.4.1 Funding incentives

Sweden uses tax exemptions, green financing, and grants to support the decarbonisation of industry, including aviation. Although less targeted towards next generation SAF than other countries, these initiatives can help **address cost competitiveness and encourage investments.**

- Since 2002, Sweden has **exempted liquid biofuels from both energy and CO_2 taxes.** This exemption, extended with state aid approval from the EU, significantly reduced costs for biofuel producers and can also be accessed for next generation SAF production. In 2022, the scheme was extended through 2026, adding €662 million in support to maintain biofuel competitiveness with fossil fuels[37].
- The **Swedavia Sustainable Aviation Fuel Incentive Programme** supports up to 50% of the premium cost of for airlines and other industry players choosing to refuel with SAF at any Swedavia airports[38]. Note that this is not targeted specifically at next generation SAF, and also includes support for HEFA. More than SEK 100 million has been invested and paid out since the programme started in 2020, with SEK 40 million set aside for this year's round.
- Through the **Industrial Lead initiative ("Industriklivet"),** the Swedish Energy Agency provides one-off grants to support decarbonisation of the country's industrial sector. The initiative is part of the Next Generation EU, focusing on greening European industry, and has led to a total of SEK 5.7 million funding across 167 projects

[34] How do Germany's SAF requirements differ from those of the European Union? - Lexology
[35] How is SAF implemented in the legislation of EU member states? Germany - EBAA - European Business Aviation Association
[36] Strategy paper – Germany as a leading market for sustainable aviation fuels – aireg – Aviation Initiative for Renewable Energy in Germany e.V.
[37] Tax exemption for biofuels in Sweden prolonged until the end of 2026 (trans.info)
[38] saf-incentive-programme-2023.pdf (swedavia.se)

and over seven industries. For SAF, a grant of SEK 133 million was awarded to the SkyFuelH2 project last year to support a feasibility study on next generation SAF production[39].

- Similarly to the Norwegian Eksfin, Sweden has several measures to provide green loans and credit guarantees to more mature projects. **Svensk Exportkredit** (SEK) issues **green loans**, financed with green bonds, to companies and projects that work towards enabling a low-carbon economy through Sweden's export industry[40]. However, there is currently no record of investing in SAF projects. Additionally, the **Swedish National Debt Office** issues **state credit guarantees for loans** supporting large industrial investments aligned with Swedish and EU environmental objectives[41]. The minimum loan amount is 500 million SEK, covering up to 80% of loan amounts with a maximum maturity of 15 years. The applicant should include feasibility studies (where available), along with a business plan, cash flow forecast, and copies of permits obtained[42]. Guarantees can be issued until the end of 2024 at an upper limit of SEK 80 billion. So far, no SAF projects are announced, although credit guarantees for loans have been awarded to hydrogen projects: H2 Green Steel was guaranteed a green loan of €1.2 billion in December 2023[43].

4.5 Denmark

Denmark's approach to sustainable fuels has largely focused on power-to-X (PtX) and hydrogen production, with a limited SAF-specific strategy. Apart from the SAF targets set on EU level, there is no clear national strategy in place for SAF yet. However, there are some movements in the SAF market through **industry partnerships**, for example Arcadia eFuels, Sasol and Topsoe signing a single lease agreement on Denmark's first commercial e-SAF plant and moving the project to FID[44]. That being said, Norway can draw inspiration from other sectors in Denmark that have gotten further in political strategy and targeted funding opportunities, such as hydrogen and CCUS.

4.5.1 Funding incentives

Denmark has implemented significant funding for PtX projects, which indirectly benefits SAF production, though there are no direct SAF funding mechanisms. This approach supports hydrogen and PtX production, which are critical for e-fuels, but lacks targeted SAF incentives.

- Denmark's PtX tender from 2023 awarded six projects, including substantial subsidies for hydrogen and PtX infrastructure development. The largest lump sum of DKK 910 million was awarded to Padborg PtX ApS given as a **fixed subsidy over a 10-year period**[45].
- Denmark **also provides support to the CCUS sector,** notably through the CCS and CCUS fund by the Danish Energy Agency. The CCS fund offers a total of 28 billion DKK over a 15-year period through targeted tenders, to aid the country's goal of reducing CO_2 emissions by 70% by 2030 with 2.3 million tonnes of CO_2 captured annually. The first round was awarded to Ørsted at DKK 8 billion in the form of an amount per tonne of CO_2 permanently stored[4647]. Although no funding has been provided for CCU projects yet, the planned CCUS fund focuses on utilisation of CO_2, planned from 2025/26 with a maximum funding of DKK 815 million per year to reduce CO_2 emissions by 0.9 million tonnes per year from 2030.

[39] SEK 133 million for a unique production facility for sustainable aviation fuel (energimyndigheten.se)
[40] Green financing | Svensk Exportkredit (sek.se)
[41] Credit guarantees for green investments - Riksgälden.se (riksgalden.se)
[42] Investeringsbeskrivning_engelska_final (riksgalden.se)
[43] Green credit guarantee for a loan to H2 Green Steel - Riksgälden.se
[44] First commercial eFuels-for-aviation plant in Denmark on schedule for 2026 | Biofuels International Magazine
[45] The first PtX tender in Denmark has been determined: Six projects will establish electrolysis capacity on more than 280 MW | The Danish Energy Agency
[46] CCS tenders and other funding for CCS development | The Danish Energy Agency (ens.dk)
[47] The Danish Energy Agency opens public consultation on multi-billion fund for CO2 capture and storage | The Danish Energy Agency

5 EU DEVELOPMENTS ON SAF AND IMPLICATIONS FOR NORWAY

This chapter explores key EU initiatives, funding opportunities, and regulatory frameworks supporting SAF production, with a focus on opportunities available to Norway as well as possible limitations due to regulatory gaps.

5.1 Opportunities for the Norwegian SAF industry

Several EU initiatives and public funding mechanisms are available to Norwegian SAF producers. This creates an opportunity to strengthen the competitiveness of next generation SAF and remove some barriers, provided the projects meet EU sustainability and emissions reduction requirements. However, competition for access to funding remains high.

- The **EU Innovation Fund** is one of the world's largest funding programs for innovative low-carbon technologies, including **next generation SAF and CCU**: 10 out of 41 projects that received grants in the last round were related to producing synthetic fuels using green hydrogen and CO2 captured from various industrial processes or direct-air capture. This includes the Norwegian company Nordic Electrofuel, who received the maximum grant allowance of €40 million for an e-SAF plant under this fund, showing the potential for Norway to secure significant funding[48].
- The **InvestEU Biofuels Framework** by the European Bank for Reconstruction and Development offers €60 million for biofuel projects, including bio-based SAF, to support technical assistance and scaling[49]. Norway's SAF producers could utilize this framework for projects that meet EU biofuel criteria, helping to build essential infrastructure for SAF.
- The **Alternative Fuel Infrastructure Facility (AFIF) –** part of the Connecting Europe Facility program **–** supports deployment of alternative fuels supply infrastructure to decarbonise transport along the Trans-European Transport Network (TEN-T). This includes the corridor from Norway. The second call for proposal, running through 2025 with a total funding of €1 billion, is aligned with the objectives set out in ReFuelEU Aviation, amongst others. Within aviation, it includes funding for hydrogen supply infrastructure at airports[50].
- The **EU Hydrogen Bank** is another major funding mechanism, where hydrogen production projects compete on the lowest bid for green premiums for the whole production volume, up to a total funding limit. The focus on price competitiveness makes it difficult for SAF projects to compete with other sectors, as the premium required for eSAF is typically higher than other competing fuels. Moreover, **the current focus is towards other sectors**, with the second auction round setting aside a dedicated portion of the total funding (€200 million of the total €1,200 million) to the maritime sector[51].

On measures relevant to secure feedstock supply to produce next generation SAF **–** notably CO_2 **– the Net Zero Industry Act (NZIA) has included CO_2 utilisation as an eligible strategic net zero technology.** This means that CCU can be referred to as net zero in national policies, provided sustainability criteria are met, and is an important step in enabling more incentives for CCU technologies. Notably, the **"CCU for the production of fuels"** call was recently launched, under the "Horizon Europe **–** Cluster 5 **–** Destination 3" funding programme. The call focuses on projects that utilise CO_2 to produce sustainable fuels, with the aim to help technologies read a TRL of 6 to 7 and an estimated contribution of €7 million per project. Although not specifically targeted towards SAF, SAF projects can participate. The call is open to Norwegian players, with bids closing 21st January 2025[52].

[48] Press-release-Nordic-Electrofuel-getting-EU-Innovation-fund-grant-40M-Euro.pdf (nordicelectrofuel.no)

[49] www.ebrd.com

[50] CEF Transport Alternative Fuels Infrastructure Facility (AFIF) call for proposal - European Commission (europa.eu)

[51] The 1st auction of Hydrogen Bank led to 7 renewable hydrogen projects in Europe receiving a total of €720mn in April earlier this year. None of the projects focused on e-fuels or SAF as end product, but one of the projects is based in Norway (SkiGA, focusing of green ammonia)

[52] https://www.euro-access.eu/en/calls/1538/CCU-for-the-production-of-fuels

5.2 Limitations and gaps due to regulatory misalignment

The delay in implementation of important EU regulation and directives, such as RED II, RED III, and ReFuelEU Aviation, affects Norwegian SAF producers. Importantly, it creates regulatory uncertainty and may limit Norwegian players' ability to fully participate in all of EU's SAF initiatives and benefits.

- The Delegated Acts for Renewable Fuels of Non-Biologial Origin (RFNBOs) and Recycled Carbon Fuels (RCFs) under RED II[53][54], as well as the upcoming Delegated Acts for Low-Carbon Fuels and Gases under the Gas Directive[55], set clear sustainability standards and lifecycle emissions criteria for renewable and low-carbon fuels, including SAF. Work is currently ongoing in the EU to harmonise standards and set foundations for certification schemes based on these Delegated Acts, which will be key for all SAF producers aiming to target the European market. An important development is the creation of a Union Database (UDB). The UDB plays a key role in facilitating cross-border trade of fuels by ensuring a system for traceability of certifications, verification of compliance, and transparency across the supply chain. With the latest revision of the directive (RED III), the scope of the database was proposed extended to cover data from point of production/collection of raw materials used to produce biofuels[56]. **Without aligning with these directives, Norwegian SAF may face challenges in obtaining access to the UDB and verifying their fuel's compliance with EU standards, limiting their ability to export SAF to EU markets.**
- Another potential limitation for Norwegian SAF producers is the **possibly restricted access to SAF allowances within the EU Emission Trading Scheme (ETS).** Under the revised EU ETS, 20 million ETS allowances have been reserved to cover some, or all, of the price gap between conventional fossil fuels and SAF (and other alternative aviation fuels) eligible under the ReFuelEU regulation. Although the allowances are available to all airport operators of flights subject to the EU ETS, with equal treatment on routes (including non-EEA operators), there is still uncertainty around how to prove eligibility of SAF if the EU regulations are not implemented (as noted above).
- Under the ReFuelEU Aviation, the EU mandates a progressive SAF blending requirement, starting at 2% in 2025 and gradually increasing, with dedicated sub-targets for e-SAF (see **Figure 1**). **This creates strong market signals compared to Norway**, which remains at a lower 0.5% with no clear plan to increase it.

[53] Delegated regulation - 2023/1184 - EN - EUR-Lex (europa.eu)
[54] Delegated regulation - 2023/1185 - EN - EUR-Lex (europa.eu)
[55] Methodology to determine the greenhouse gas (GHG) emission savings of low-carbon fuels (europa.eu)
[56] Call for feedback: Extending the scope of the Union Database on renewable fuels (europa.eu)

6 APPENDIX

6.1 Existing financing mechanisms in Norway

Norway has several financial support mechanisms aimed at encouraging the development of sustainable technologies, but these are largely focused on other sectors than aviation and not tailored for next-generation SAF production, as well as being primarily geared towards funding early-stage projects.

- **Enova** plays a key role in supporting energy-related projects in Norway. Although it has provided funding for pilot SAF projects, including 507 million NOK to Biozin in 2022[57], **the focus for funding alternative fuels projects has been for hydrogen and ammonia production dedicated to the maritime industry**. In the past year, these projects have received a total of 1.22 billion NOK across 15 projects, and Figure 3 shows the maritime industry has been heavily prioritised with significant funding for fewer projects This is, amongst others, due to the Norwegian government setting a clear maritime decarbonisation strategy with a published action plan for green shipping[58] and its Hydrogen Strategy with strong emphasis on the maritime sector[59]. Moreover, **Enova's funding is generally aimed at innovation and early-stage technologies, with limited funding for later-stage development**, such as Front-End Engineering Design (FEED) and Engineering, Procurement, and Construction (EPC). This leaves a significant funding gap for projects to move beyond the demonstration phase into full-scale production.

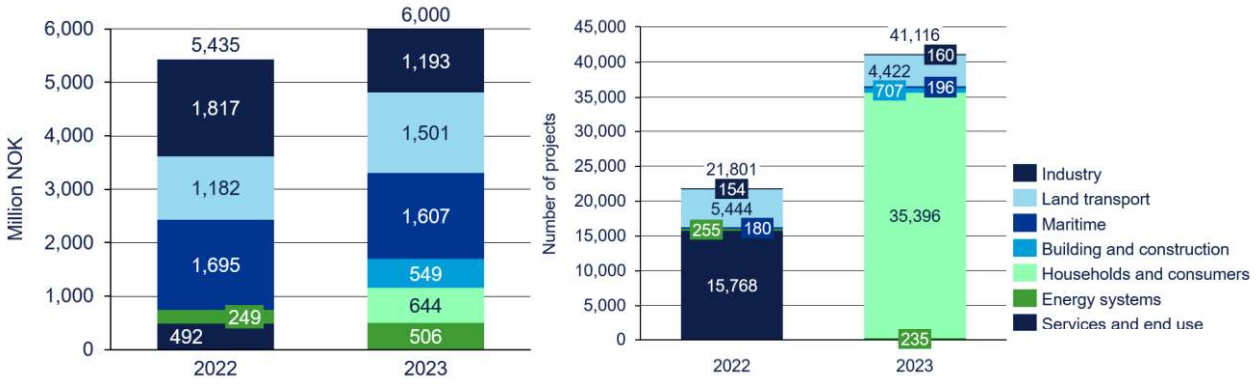

Figure 3. Total Enova funding and number of projects per sector, 2022 vs 2023[60].

- **Innovation Norway** is another important funding source, offering grants to aid development, pilot testing and demonstration of technologies with significant environmental impact. As an example, Norsk e-fuel received 1.5 million NOK for project initiation[61]. Innovation Norway recently launched a new financing mechanism aimed specifically at large industrial projects, "Green industrial financing", which will provide loans alongside other financing actors to reduce risks and help boost green, industrial growth in Norway[62]. **This could be an opportunity for next generation SAF projects looking to access financing for maturing projects towards commercial scale.** Up to five billion NOK will be available in total.

- **SkatteFUNN** offers tax deductions for research and development expenses[63], with up to 25 million NOK for internal R&D and 50 million NOK for external R&D[64]. As an example, Nordic Electrofuels[65] received 4.75 million

[57] Biodrivstoff til flyindustrien (Enova.no)
[58] The Government's action plan for green shipping (regjeringen.no)
[59] The Norwegian Government's hydrogen strategy - Climate Change Laws of the World (climate-laws.org)
[60] Enova Annual Report 2022 - Home
[61] About us | Norsk e-Fuel (norsk-e-fuel.com)
[62] Green industrial financing (Innovation Norway)
[63] Deductions for research and development – SkatteFUNN - The Norwegian Tax Administration (skatteetaten.no)
[64] Support schemes – SkatteFunn | RSM Norway
[65] Nordic Electrofuel has recently completed a FEED study for e-fuel production plant with green hydrogen produced onsite and CO_2 supplied by Eramet, where planned capacity is 8,000 tonnes at pilot and 160,000 tonnes at full-scale with 70% of production planned for SAF. Home | Nordic Electrofuel

NOK from SkatteFUNN in 2021 for R&D activities to reduce risks and optimise processes[66]. Although a substantial amount, it is far from maximum funding available per project and only focuses on R&D activities.

- For more mature projects, Norway's export credit agency, **Eksfin**, offers financing to Norwegian companies engaged in export activities. Although SAF production is not currently a major focus, this mechanism could potentially be expanded to support SAF exports in the future. In order to secure financing from Eksfin, the projects need to be sufficiently matured and have a long-term offtake agreement in place.

In addition to direct funding support, next generation SAF will benefit from indirect funding mechanisms available for ensuring access to feedstock, such as renewable electricity, hydrogen, CO2 and advanced biomass.

- Although Norway has been a global leader in funding and development of Carbon Capture and Storage (CCS), notably with the Longship project receiving state funding of 20 billion NOK and the CLIMIT programme to support early development of CCS projects[67], **there are limited funding schemes available for Carbon Capture and Utilization (CCU) –** a necessity for several next generation SAF production pathways.
- **Hydrogen** projects see more significant funding in Norway, as it can cover broader range of applications and sectors. As an example, Enova supported five renewable hydrogen production plants along the Norwegian coast with a total funding amount of 669 million NOK[68]. As of today, most funding has been geared towards hydrogen production for the maritime or road sector.
- The Norwegian CO_2 Compensation Scheme[69] (valid until 2030) could potentially benefit next generation SAF utilising hydrogen as feedstock, with a grand total of 7 billion NOK available (linked to the EU ETS) for eligible industries. It is intended to produce a more level playing field where energy intensive industries won't be tempted to move their industry elsewhere where CO_2 penalty costs are lower, but energy emissions are higher and thus ensuring greener industry. The scheme requires industries to invest 40% of the compensation towards emission reduction and energy efficiency improvement projects.

[66] Independent auditor`s report(translated from Norwegian) (nordicelectrofuel.no)
[67] About the CLIMIT programme and the funding opportunities
[68] Enova Supports Hydrogen Projects in the Maritime Sector With NOK 1.12 Billion (fuelcellsworks.com)
[69] Norwegian Government and Industry Stakeholders Forge Agreement on CO2 Compensation Scheme for Decarbonization | EuropaWire

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