European Commission

Green Deal Projects Support Office

How the Green Deal Call-funded projects are tackling mobility aspects of the **Fit for 55 proposals**

Independent Expert Report

Research and Innovation

How the Green Deal Call-funded projects are tackling mobility aspects of the Fit for 55 proposals – Report Four

European Commission
Directorate B – Healthy Planet
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Unit B.1 — Green Transitions

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How the Green Deal Call-funded projects are tackling mobility aspects of the **Fit for 55 proposals**

Green Deal Projects Support Office

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Directorate-General for Research and Innovation

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About the Green Deal Projects Support Office

The Green Deal Projects Support Office has been developed to facilitate coordination between projects funded under the Horizon 2020 Green Deal Call and to maximise their positive impact in the longer term. The Green Deal Projects Support Office will operate until November 2026 and the key activities it carries out include supporting Green Deal projects to engage in effective collaboration, providing networking and knowledge exchange opportunities to develop synergies, and helping projects boost efforts to communicate their results. The Green Deal Projects Support Office supports networking, knowledge exchange and common capacity-building activities through five working groups:

For more information on the Green Deal Projects Support Office, please contact: **support@greendealprojects.eu**

1

Introduction: science and policy for sustainable transport

1.1 Evidence of the need to decarbonise transport

At the core of the European Union's (EU's) commitment to global climate action under the Paris Agreement is the objective of transitioning to a climate-neutral economy by 2050. To realise this, substantial reductions in emissions must be achieved, particularly within highly polluting sectors. The transport sector produces approximately 25% of all EU greenhouse gas emissions[1], and there is therefore a need for focused investment in innovative solutions to drive the sector's decarbonisation.

Breaking down the EU's transport sector emissions, 13.5% is attributed to the maritime sector and 14.4% to aviation. Although these shares are lower than those of road transport (71%), mitigating emissions in these sectors faces notable challenges, due to the significant costs and logistical concerns associated with replacing existing fleets and infrastructure[2].

Emissions from fossil fuels used in the transport sector create various detrimental impacts on public health and the environment that extend beyond their global warming potential. Sulphur dioxide, a byproduct of burning fossil fuels, can lead to respiratory diseases in humans and acidify atmospheric rain. Ships calling at European ports contributed 16% of global sulphur dioxide emissions from ships in 2019. Other byproducts of fossil fuel combustion like particulate matter, nitrogen oxides, and volatile organic compounds can also contribute to air and water pollution, leading to habitat degradation, ecosystem disruption, and a loss of biodiversity. Additionally, the climate change effects can lead to shifts in habitats and endanger vulnerable species.

The switch from fossil fuels to low-carbon energy sources can also generate positive impacts for the economy. Although costs of production and operation may rise in the short run through regulation, carbon taxes, and the need for mitigation measures, investing in sustainable transport solutions can enhance operational efficiencies, provide opportunities for innovation and market differentiation, and therefore reduce costs in the long run. Furthermore, an energy transition in transport can reduce reliance on fossil fuels for transportation, which makes societies less vulnerable to fossil fuel supply disruptions and price fluctuations. Diversifying energy supply in transport can improve energy resilience and reduce dependence on imported fuels.

These impacts necessitate urgent mitigation efforts and well-informed policy decisions to ensure a sustainable transport sector that minimises harm to the environment and public health, and benefits the long-run potential of the European economy.

[1] European Environment Agency, Transport and Mobility

[2] EU maritime transport: first environmental impact report acknowledges good progress towards sustainability and confirms that more effort is needed to prepare for rising demand

1.2 Building a bridge between science and policy

At the heart of the transition towards a decarbonised transport sector must be clear and decisive policy action. Technologies are constantly being developed to enable this transition and their development, in parallel with strong policy, is essential in order to ensure the EU meets its climate commitments.

A strong scientific foundation is essential for informing new policy decisions: scientists and researchers play a pivotal role in understanding the art-of-the-possible in regard to implementing sustainable transport solutions. To start, accurate and up-to-date data collection is crucial. Researchers can employ advanced data analytics and modelling techniques to gauge the current state of transportation systems, energy consumption, and emissions. Furthermore, research institutions can investigate emerging technologies, such as electric vehicles, hydrogen fuel cells and sustainable fuels, to determine their feasibility and potential impact on the environment.

However, scientific discoveries alone are insufficient to bring about meaningful change. Effective communication and collaboration between scientists, policymakers, and industry stakeholders are imperative to bridge the gap between science and policy. Policymakers must align their goals with scientific findings, acknowledge the realities of climate change, and consider the role transportation plays in exacerbating it. Scientific data should be at the forefront of policy discussions and evidence that is collected must feed into policy impact assessments that analyse the environmental, economic and societal consequences of proposed policy mechanisms on the transport system.

If science can prove a particular idea and inform policy decisions how can this be translated into deployable technology that can begin decarbonising the transport sector?

Within the EU there are many funding programmes available to scale technologies across the broad technology readiness level spectrum, from early research to pre-commercialisation. The most notable is Horizon Europe, a EUR 95.5 billion programme running from 2021–27 that includes a ~EUR 15 billion budget for climate, energy and mobility.

Another is the Connecting Europe Facility (CEF), which is a key EU funding instrument in delivering the EU Green Deal and enables the decarbonisation of transport, energy and digital services. The goal is to make travel easier and more sustainable across all Member States, and funding largely focuses on supporting investments in transport infrastructure. The transport budget for CEF is set at EUR 25.81 billion.

To support the development of sustainable transport technologies within these funds, the EU employs varying initiatives to develop technology:

Early-stage research

These initiatives provide funding and support for early-stage research and development projects. They help researchers prove the feasibility of novel technologies and concepts.

Large-scale demonstrators

These initiatives focus on scaling up technologies and testing them in real-world scenarios. They often involve significant investments and partnerships with industry players, showcasing the potential for widespread adoption.

Public–private partnerships

Collaboration between public institutions and private companies is essential for accelerating

the deployment of sustainable transport solutions. These partnerships combine resources, expertise, and innovation to drive progress.

Key to the success of funding programmes yielding innovative yet commercially viable technologies is ensuring industry buy-in and participation. Examples of platforms/initiatives that coordinate industry involvement include the following:

Clean Aviation Joint Undertaking: A collaborative initiative within the European aviation sector, with the primary goal of advancing sustainable and environmentally friendly aviation technologies. Its key objectives include reducing carbon emissions, noise pollution, and other environmental impacts associated with aviation. This initiative brings together industry stakeholders, research organisations, and policymakers to promote research and development efforts focused on innovative aircraft design, propulsion systems, and air traffic management. By fostering cooperation and knowledge exchange, the Clean Aviation Joint Undertaking aims to accelerate the deployment of cleaner and more efficient aviation technologies, making air travel more sustainable and environmentally responsible in Europe.

Waterborne Technology Platform: A collaborative initiative within the European maritime sector aimed at advancing sustainable and innovative technologies for waterborne transport. Its primary objectives include fostering research and development to improve the environmental performance, safety, and efficiency of maritime transportation. This platform brings together stakeholders from industry, academia, and policymaking to drive innovation, create a competitive advantage for European maritime industries, and address the challenges of decarbonisation and digitalisation in the maritime sector. By facilitating cooperation and knowledge sharing, the Waterborne Technology Platform seeks to enhance the competitiveness and sustainability of European waterborne transportation.

Clean Hydrogen Partnership: Focused on accelerating the development and deployment of hydrogen technologies for a sustainable and decarbonised future. Its primary objectives involve promoting hydrogen as a clean energy carrier across various sectors, including transportation, industry, and energy production. This partnership aims to establish a hydrogen ecosystem, encourage investment in hydrogen projects, and support research and innovation to make hydrogen production and utilisation more efficient and environmentally friendly. By bringing together stakeholders from different sectors, the Clean Hydrogen Partnership seeks to play a pivotal role in Europe's transition to a low-carbon economy powered by hydrogen.

At all points in technology development there exist opportunities to inform policy decisions. What is an example of a mechanism that aids this process? Institutions such as the **Joint Research Centre (JRC)** are dedicated to providing independent, evidence-based scientific support to EU policies. The JRC's fundamental objectives encompass conducting research and analysis across a wide range of disciplines, including transport, to inform and shape EU policies and regulations. The JRC serves as a vital bridge between science and policy, assisting in the development of evidence-based, effective, and sustainable policies that benefit the EU and its citizens. Through its research, data collection, and expert insights, the JRC plays a pivotal role in addressing societal challenges, fostering innovation, and advancing the EU's goals for a prosperous and sustainable future. The JRC helps to make the connection between research and policymakers. This is also an area in which the Green Deal Support Office can assist Green Deal Call-funded projects.

2

Fit for 55

2.1 Goals

Fit for 55 refers to the EU's target of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. It is a comprehensive and ambitious legislative package that aims to ensure that the EU is in line with meeting its climate goals. The overarching aim of the Fit for 55 package is to accelerate the EU's efforts to become climate-neutral, while also ensuring that the EU remains competitive and resilient.

The timescales for the goals set forth in Fit for 55 are both ambitious and urgent. The package includes a range of targets and deadlines for emissions reductions. This intermediate target is seen as a critical milestone on the path to achieving climate neutrality by 2050, in line with the European Green Deal, which is at the heart of the EU's sustainability agenda.

The proposed legislative changes within the Fit for 55 package are expected to be implemented gradually over the coming years, with some measures taking effect in the short term, while others will be phased in over the next decade. A wide range of sectors will be subject to the proposed policies, including the energy (district heating and cogeneration), land use and forestry, road transport, and energy taxation sectors. Figure 2.1 shows the policy areas that are covered by the Fit for 55 proposals.

Figure 2.1: Policy areas covered by the Fit for 55 proposals

2.2 Proposals that are relevant to sustainable transport

Of the policy areas covered above, the broad policy categories that are relevant to sustainable mobility are as follows:

- Fuels (greenhouse gas intensity and cost)
- Fuel infrastructure
- Emissions trading
- Buildings infrastructure (nature and quantity of energy consumption in ports and airports)

The focus of this report is on proposals related to fuels used in transport vehicles, and their associated emissions, although it is worth noting that other proposals also have transport implications. The proposed revision to the Energy Efficiency Directive and the Energy Performance of Buildings directive would also affect buildings in port and airport terminal areas. Likewise, the revised regulation on CO_2 emissions of cars and vans will require ground handling equipment in airports and onward freight transportation by road to be zero emission. Finally, the Energy Taxation Directive would increase the relative cost of fossil fuels used in transport.

Outlined below are the proposals which are critical to the challenge of achieving transport decarbonisation in the EU.

- **FuelEU Maritime:** This mandates vessel carbon intensity reduction targets beyond International Maritime Organization (IMO) measures and encourages shore power use from 2030 onwards. Further, it requires 2% of fuel (averaged annually) to come from renewable fuels of non-biological origin (RFNBOs) from 2034 onwards.
- **ReFuelEU Aviation:** This aims to increase use of sustainable aviation fuels (SAF), targeting 2% of jet fuel consumption by 2025 being SAF. Additionally, the SAF mandate requires SAF availability at all European airports by 2030, and that SAF are blended into conventional jet fuel at a rate of at least 5%. These policies are poised to significantly reduce aviation carbon emissions.
- **Alternative Fuel Infrastructure Regulation** This aims to establish a common framework for the deployment of infrastructure supporting various alternative fuels, including electricity, hydrogen, natural gas (liquefied and compressed), and biofuels. The regulation sets out specific targets for the deployment of alternative fuels infrastructure, such as electric vehicle charging points and hydrogen refuelling stations. These targets are designed to ensure that the infrastructure is adequate and widely accessible. Member States are required to report regularly on the progress of alternative fuels infrastructure deployment and compliance with the regulation.
- **The EU Emissions Trading Scheme (ETS)** This is the EU's primary mechanism to reduce greenhouse gas emissions in all sectors, and has been extended to shipping in 2023.

  The ETS works by putting a cap on the maximum amount of carbon that can be released across the EU. The emissions caps progressively reduce to align with climate goals, and companies are required to monitor and report their emissions, meeting their own individual targets by purchasing and surrendering ETS allowances for CO_2 on an open market. The internal aviation sector has been part of the EU ETS since 2012, but this year the European Council has agreed to phase out free emissions allowances for the aviation sector by 2027, in a gradual process, and to align the proposal with the global Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), a complementary scheme aimed at flights entering and leaving the EU (more information on CORSIA is provided in Section 4.1). Furthermore, in 2023 a separate ETS has also been created to cover maritime transport, targeting larger shipping vessels over 5 000 gross tonnes.

- **Renewable Energy Directive**

  This is the legal framework for the development of clean energy across all sectors of the EU economy. The revised directive introduces stronger measures to ensure that all possibilities for the further development and uptake of renewables are fully utilised. This will be key to achieving the EU's objective of climate neutrality by 2050 and to strengthen Europe's security of energy supply. In addition to a new headline target to double the existing share of renewable energy sources, a strong policy framework will facilitate electrification in different sectors, with new increased sector-specific targets for renewables in heating and cooling, transport, industry, buildings and district heating/cooling, but also with a framework promoting electric vehicles and smart recharging.

Table 2.1 below shows the key features of each of these proposals and their implementation status. All have now been approved by the European Council and will come into force. They are shown in chronological order by their adoption date.

PROPOSAL INFORMATION			
FIT FOR 55 PROPOSAL AREA	**CHANGES PROPOSED**	**KEY FEATURES**	**STATUS**
FuelEU Maritime	Introduction of targets for transport fuels	• Targets to reduce the **average carbon intensity** of energy used onboard ships above 5 000 gross tonnes, from -2% in 2025 to -80% in 2050. • All containerships and passenger ships that can should be connected to **shore power connections** while berthed (where possible) from 2030 onwards, subject to some exemptions. • From 2034 onwards, 2% of fuel (averaged annually) should be **RFNBOs**.	**Adopted by the Council July 2023**
Alternative fuels infrastructure	Introduction of the alternative fuels infrastructure regulation	• **Ports:** >90% of container and passenger ships must have access to shore-side electricity from 2030. • **Airports:** Electricity supply must be provided for all aircraft stands by 2025, and all remote stands by 2030. • **Road:** More alternative fuels infrastructure should be available on main roads from 2025. • **Urban nodes:** There is particular attention to gaseous hydrogen refuelling infrastructure.	**Adopted by the Council July 2023**
EU emissions trading system	Reform of the ETS system	• ETS already covers commercial aviation within the European Economic Area (EEA). The reforms will: 1) **Increase the 2030 target** CO_2 reduction from -43% to -62% from 2005 levels 2) Extend the ETS to **maritime** transport 3) Create a new ETS for **buildings and road transport**	**Adopted by the Council July 2023**
ReFuelEU Aviation	Introduction of targets for transport fuels	• Aircraft **fuel suppliers** to increase the share of SAF that they distribute, from 2% in 2025 to 63% in 2050. • Flights leaving EU airports can no longer **overfill** – only enough fuel to cover the distance needed. • EU airports to guarantee the necessary **infrastructure** to deliver, store, and refuel SAF.	**Adopted by the Council October 2023**
Renewable energy	Revised Renewable Energy Directive	• Across **all sectors**, an increased 2030 target for the proportion of energy consumed from renewable sources from 32% to 40%. • The **transport** sector has a specific target of 29%, or alternatively a reduction in greenhouse gas intensity of 13%.	**Adopted by the Council October 2023**

Table 2.1: Key features of the Fit for 55 proposals

3

How Green Deal Call-funded projects are contributing to Fit for 55 targets

3.1 Challenges that Fit for 55 presents

Considering the proposed and active targets presented in previous sections, aviation and shipping will face critical challenges in achieving reductions in carbon intensity in the coming years, and they are looking for novel methods of energy delivery to achieve this. Below we present some of the core challenges associated with the Fit for 55 proposals.

Key challenge 1

Vehicle technologies still need to be developed to function using alternative fuels.

Maritime

- The targets to reduce the average carbon intensity of energy used onboard ships (FuelEU Maritime) and to meet CO_2 targets required by the maritime ETS mean that a large proportion of vessels will need to fit new engines capable of running on alternative fuels which produce less CO_2.
- Existing engines require fewer modifications to be compatible with biofuels, but the fuels that are anticipated to be adopted at scale in high-capacity shipping (methanol, ammonia) require entirely new engines to be developed, and these engines are only in their infancy.
- Some ships also need to be modified to meet the FuelEU Maritime requirements that all able ships should run on shore power while at berth in ports, which will require investment by ship operators.

Aviation

- The stricter CO_2 reduction target for the ETS covering aviation will necessitate increased uptake of SAF, which can be blended with existing fossil fuels and combusted using existing aircraft engines.
- However, some of this target can be met by replacing smaller aircraft propulsion (operating shorter journeys) with hydrogen-powered aircraft, which are not yet commercially available.

Key challenge 2

Low-carbon infrastructure needs to be developed to safely deliver electricity or fuel from the site of production to vehicles.

Maritime

- Twinned with the challenge of developing engines to meet decarbonisation targets presented by FuelEU Maritime and the maritime ETS, bunkering infrastructure will need to be developed to supply vessels with sufficient quantities of these fuels. Additional dangers present themselves in the pressurisation and/or cooling of alternative fuels like hydrogen and ammonia, implying novel safety and operational challenges.
- Alternative Fuel Infrastructure Regulation requirements to enable the vast majority of ships to charge using shore power connections at ports will require new landside infrastructure to deliver power from the grid to vessels at the correct voltage/frequency. In many ports, this will require upgrades to existing grid capacity in the region.

Aviation

- If the provisional deal on ReFuelEU Aviation is eventually adopted by the Council, the scale of SAF delivery, storage, and refuelling operations will have to increase significantly in the coming years. Business models and operational models are not yet in place for the variety of SAF expected to come to market.
- Further, Alternative Fuel Infrastructure Regulation requirements will drive airports to enable electricity delivery to all aircraft stands, which (like ports) will require new landside infrastructure and potentially grid reinforcements.

Key challenge 3

Feedstock supply chains and energy generation infrastructure needs to be secured to deliver alternative fuels in sufficient volume and at a competitive cost.

Maritime and aviation

- The requirement for falling carbon intensity will place particular emphasis on securing supply chains for the inputs that are eventually made into alternative fuels. In particular, the organic fraction of local municipal solid waste will be in high demand for producing biofuels for use in both aviation and shipping, while synthetic pathways will rely on a reliable source of carbon dioxide. This could require the expansion of carbon capture technologies, which are still at a nascent stage.
- Furthermore, if the provisional deal on the Renewable Energy Directive is eventually adopted by the Council, a large proportion of energy consumed in transport will need to be from renewable sources, i.e. waste-based biofuels or green fuels (produced from renewable electricity). Waste feedstocks face significant competing demand, and green fuels require significant development of electrolyser technologies in order to reach cost parity with conventional fuels, placing a critical emphasis on developing and securing these supply chains.

3.2 Objectives and results of the Green Deal Call-funded projects

In order to tackle some of the key challenges presented in the previous section arising from the Fit for 55 proposals, the EU has funded a number of research projects that aim to tackle these challenges by demonstrating novel technologies, establishing partnerships and business models for the operation of future-looking ports and airports, and creating plans to scale these innovations across Europe.

Table 3.1 below maps the projects being funded through the Green Deal Call to the Fit for 55 proposal areas, noting in particular the topic areas which these projects are focusing on. Topic areas are largely shared between airport and port projects, with the exception that the projects, their objectives and their progress to date are recorded in the sections below.

Table 3.1: Mapping of the research topics covered by the Green Deal Call-funded mobility projects against Fit for 55 proposal areas

FIT FOR 55 PROPOSAL AREA	AIRPORT PROJECTS: OLGA, Stargate, TULIPS	PORT PROJECTS: PIONEERS, MAGPIE
Renewable Energy Directive		
EU ETS		
Alternative fuels infrastructure		
ReFuelEU Aviation		
ReFuelEU Maritime		

3.2.1 MAGPIE

The **MAGPIE** consortium is a collaboration between ports, research institutes, universities, and private companies. The project's primary objective is to address the critical gap between the supply of green energy and its utilisation in port-related transportation. MAGPIE seeks to demonstrate technical, operational, and procedural solutions within a living lab environment. These solutions aim to promote green, smart, and integrated multimodal transport, while accelerating the adoption of green energy carriers, such as batteries, hydrogen, ammonia, bioLNG, and methanol. Additionally, the project focuses on implementing digitisation, automation, and autonomy to enhance transport efficiency in port operations. Earlier this year, the MAGPIE yard automation truck was demonstrated during the European Automotive Week 2023 and was the first project result showcased publicly.

Seaports will play a significant role in the advancement of cleaner technologies, sustainable energy solutions, and innovative logistics strategies within maritime transport, port activities, and in-land transportation networks (road, rail, barge, and pipelines). This concerted effort aims to reduce greenhouse gas emissions.

By accelerating the introduction of technologies like batteries, hydrogen, and ammonia, the project contributes to reducing greenhouse gas emissions – a key component of the Fit for 55 targets. Additionally, the implementation of digitisation and automation in port operations aligns with the EU's goal of fostering innovation and sustainability in the transport sector. The living lab environment facilitates the development and demonstration of these solutions, ensuring they are technically feasible and operationally effective. Furthermore, MAGPIE's efforts to engage stakeholders, collaborate with other actions, and disseminate project results contribute to the broader European Green Port of the Future Master Plan and support the overall goals of the Fit for 55 initiative by promoting green, smart, and integrated transport solutions.

PIONEERS

3.2.2 PIONEERS

PIONEERS is a collaborative effort that is uniting four distinct ports, each with unique characteristics but a shared dedication to achieving the objectives of the Green Deal and fostering the socio-economic goals of the EU Blue Growth Strategy. The primary objective is to address the challenge faced by European ports: reducing greenhouse gas emissions while preserving competitiveness and offering added value in a sustainable global trade ecosystem. To realise these aspirations, the ports of Antwerp-Bruges, Barcelona, Constanta, and Venlo will execute innovative green port demonstrations across four key areas: clean energy production and distribution; sustainable port infrastructure; modal shift and optimisation of flows; and digital transformation. Concrete actions encompass the generation of renewable energy and deployment of electric, hydrogen, and vehicles; retrofitting heating networks and infrastructure for enhanced energy efficiency and the incorporation of circular economy principles; along with the deployment of digital platforms utilising AI and 5G technologies to encourage modal shifts for both passengers and freight. These platforms will ensure optimised movements and allocations for vehicles, vessels, and containers, while also facilitating vehicle automation.

These demonstrations will be comprehensive packages aligned with other relevant activities within the ports and their adjacent communities. By establishing an Open Innovation Network to facilitate knowledge exchange, the ports and their technology partners will progress through various project phases, including innovation demonstration, scaling up, and promoting transferability. Stringent processes will be in place to assess technology, develop business cases for exploitation, and establish institutional, regulatory, and financial frameworks that are conducive to the growth of green ports, with an evolution from technical innovation pilots to widespread, sustainable solutions. These processes will run concurrently with the development and refinement of a Master Plan, which will result in a comprehensive roadmap for energy transition in the PIONEERS ports, as well as a handbook to guide green port planning and implementation that will be tailored to different port typologies across Europe.

Currently, there are 19 ongoing initiatives aimed at strengthening ports as key hubs for sustainable shipping, emphasising greenhouse gas-neutral operations. In a ground-breaking stride, Antwerp Terminal Services (ATS) and PSA Antwerp NV (PSAA) have jointly developed a cutting-edge technology: a pioneering hydrogen dual fuel straddle carrier, the first of its kind in the world. This innovative carrier operates using a blend of hydrogen and diesel, resulting in a substantial reduction of greenhouse gas emissions at terminals. By employing this dual fuel technology, it is possible to substitute up to 70% of diesel usage with hydrogen, with aspirations of achieving full-scale hydrogen integration in new straddle carriers. In the coming months, a thorough evaluation of the demonstrator's performance, design, and critical aspects for upscaling, like hydrogen sourcing and storage, will take place. Other demonstrations in the project are featured in the Euronews OCEAN series, portraying how ports act as drivers of the energy transition, decarbonisation, and environmental sustainability.

World's first hydrogen dual fuel straddle carrier

3.2.3 OLGA

OLGA (hOlistic & Green Airports), a project initiated in October 2021 under the Horizon 2020 scheme, is playing a significant role in the broader initiative to decarbonise aviation and is a vital contributor to achieving the European Green Deal's goal of climate neutrality by 2050.

The OLGA project focuses on reducing the aviation sector's environmental footprint. The acceleration of the environmental transition of airport operations is being achieved through a broad approach. The project pioneers solutions to reduce CO_2 emissions, enhance energy efficiency, preserve biodiversity, and improve air quality and waste management, involving the entire aviation value chain. Paris Charles De Gaulle Airport serves as the frontrunner of the project, with partners Air France taking part in the demonstration of decarbonisation scenarios. Three other airports are also involved in the project in different demonstrative and supportive capacities.

OLGA brings together a diverse group of partners, ranging from airports, airlines, handlers, industry, and research institutions, to small and medium-sized enterprises, each contributing a wealth of expertise to address the intricate challenge of decarbonising the aviation sector. The project's objectives encompass achieving efficient and carbon-neutral airport and airline operations, sustainable logistics, smart energy and mobility solutions, intermodality for both passengers and freight, comprehensive assessments of emissions and air quality, eco-friendly construction, and sustainable end-of-life practices. The project aims to integrate SAF into the existing conventional jet fuel infrastructure, alongside showcasing various low-emission mobility solutions, such as electric ground support equipment, hydrogen infrastructure, and carbon-reduced airside operations. Within the project's initial three years, OLGA seeks to achieve significant quantifiable advancements that are ripe for implementation and utilisation by its partners. The envisioned sustainable impacts span the societal, environmental, and economic dimensions at local, national, and EU scales. OLGA is slated to run for a duration of 60 months, with a grant request of 25 million euros. Capitalising on the 2024 and 2026 Olympics (to be held in Paris and Milan, respectively), OLGA's partner airports are uniquely positioned to demonstrate their environmental innovations, while airports in Zagreb and Cluj will highlight scalability and applicability at an EU-wide level.

Recent developments of the OLGA project include the planned installation of solar panels on passenger jet bridges. Connected to an electric ground power unit (eGPU), this can generate up to 400Hz of electrical energy needed by aircraft and thus replace existing conventional electrical converters. Its use can also reduce CO_2 and noise emissions from the kerosene-powered auxiliary power unit in the aircraft and the diesel-powered GPU.

3.2.4 STARGATE

Stargate embodies the collective effort of a consortium comprising 22 entities led by Brussels Airport, all dedicated to fashioning green airports into multimodal hubs for sustainable and intelligent mobility. The initiative aims to significantly enhance the competitiveness of the European air transport ecosystem. The consortium's mission within Stargate is to conceptualise, experiment with, and implement a range of innovative solutions, markedly enhancing the sustainability of the airport ecosystem. The overarching vision is to establish Stargate as a gold standard, inspiring and guiding other airports across Europe and globally. Stargate is built on five key pillars. The first involves a digital twin ecosystem for airports, modelling the Lighthouse and Fellow Airports. The second focuses on sustainable and smart mobility, emphasising intermodal hubs and digitisation. The third optimises terminal operations, employing a terminal command centre and resource efficiency. The fourth explores energy advancements, specifically SAF, as well as alternative fuels for ground operations (electric, hydrogen). The fifth addresses the improvement of local environmental quality by investigating improvements in air quality and investigating further collaboration with local surroundings.

Recent developments of the Stargate project include researching innovative ways to help decarbonise ground handling activities. Partners DHL are switching to electric vehicles to load and unload air cargo containers and pallets, and electric hydrant fuel dispensers have been extensively tested over 2 200 refuellings to gain insights into the best operating parameters for their charging infrastructure, prompting Skytanking to order their own to put into operation in early 2024. Stargate is also in the process of permitting a proof-of-concept hydrogen fuelling and hydrogen ground support equipment (GSE) facility at the BRUcargo facility at Brussels Airport. They have developed a catalogue that provides airports with an overview of actions they can take to stimulate SAF uptake, and a conceptual framework supporting other airport professionals to implement, measure, and evaluate new circularity processes in airports. Additionally, Stargate is working on improving mobility at Brussels Airport and its surroundings, and promoting alternatives to cars. A dedicated bike manager has been appointed, and new cycling infrastructure (improved paths, bike parking) and bicycle counters have been established, among other actions. Also, Stargate has launched a carpool tool for 24 000 employees within the airport community.

3.2.5 TULIPS

The **TULIPS** project has brought together a consortium of 29 skilled and synergistic partners, bolstered by external advisory board support. Together, they are committed to advancing the implementation of innovative and sustainable technologies to emissions at airports. Airports are set to play a pivotal role in the transition to climate-neutral aviation. This transformation hinges on two primary objectives: sustainable energy generation and utilisation, both on the airside and landside of airports, and a shift towards more environmentally friendly multimodal transportation options. The overarching goal is to significantly reduce greenhouse gas emissions and enhance local air quality in the vicinity of airports.

TULIPS will carry out a total of 17 real-life demonstrations showcasing a spectrum of green airport innovations, encompassing technological, non-technological, and social aspects. These demonstrations will primarily take place at the Lighthouse Schiphol, with some extending to fellow airports in Oslo, Turin, and Larnaca. The project's focus revolves around measuring and quantifying the benefits derived from these innovations and projecting their potential impact on the EU's climate objectives. By doing this, TULIPS will yield practical, data-driven roadmaps detailing how these technologies and concepts can be effectively deployed across airports of varying sizes, spanning international hubs and regional facilities. These roadmaps will consider economic, geographical, and political factors across Europe and beyond.

TULIPS aligns seamlessly with the Fit for 55 challenge by directly addressing several critical facets of sustainable aviation and emissions reduction. Through improved multimodal transportation options for both passengers and freight, the project seeks to reduce traffic congestion and provide seamless, eco-friendly travel alternatives. There are seven main challenges of the project (listed below), with each challenge featuring one or more demonstrator projects:

- **Intermodal services**
- **Energy supply for future aircraft (enhancing airside infrastructure to accommodate future electric/hybrid aircraft)**
- **Smart energy hub**
- **Zero-emissions airside operations (integration of hydrogen fuel cell technology into existing ground support equipment)**
- **SAF incentives and logistics**
- **Circular airports**
- **Clean air and land (ultra fine particle mitigation)**

4

Beyond Fit for 55: the wider policy context

In the previous section it was explained how Green Deal Call-funded projects are contributing towards the realisation of the Fit for 55 agenda, but it is worth noting that their efforts are contributing beyond the European context as well. The following section outlines two key international agreements that the EU is party to in the aviation and maritime sectors, the objectives of which the Green Deal Call-funded projects also contribute to.

4.1 CORSIA

Amidst growing concerns about the aviation industry being a significant contributor to greenhouse gas emissions, CORSIA was launched. It represents a collaborative endeavour involving nations, airlines, and international organisations, that aims to curb the aviation sector's environmental impact.

CORSIA, established by the International Civil Aviation Organization, is a global framework that is designed to mitigate the carbon footprint of international aviation. It is a pioneering scheme that seeks to offset and reduce greenhouse gas emissions produced by international flights. CORSIA's primary objective is to cap net carbon dioxide emissions from international civil aviation at 2020 levels, and to ensure that any emissions beyond this cap are offset through various measures. With over 190 member countries participating in this concerted effort, CORSIA boasts an impressive international scope. The collaborative approach involving nations, airlines, and other stakeholders reflects the urgency of mitigating aviation emissions worldwide, and the shared responsibility for doing so.

CORSIA sets forth clear and ambitious goals. Firstly, it aims to stabilise net CO_2 emissions from international aviation at 2020 levels through a phased approach, with the pilot and first phase between 2021 and 2026 being voluntary. By July 2023, 125 countries had agreed to participate in the voluntary phase, which starts in 2024. Secondly, CORSIA emphasises the importance of offsetting any emissions that exceed the established cap. This is achieved through the purchase of carbon offsets, which fund projects and initiatives aimed at reducing emissions in other sectors, such as reforestation and renewable energy projects.

In recent years, CORSIA has seen significant developments, with more nations and airlines committing to its principles and the voluntary pilot phase coming to a close. CORSIA's objectives and those of the Fit for 55 initiative are aligned with each other, with both initiatives aiming to reduce greenhouse gas emissions, albeit through different mechanisms and at different scales. There is existing synergy between the two, as the Green Deal Call-funded projects that aim to reduce emissions in aviation, such as TULIPS and OLGA with their focus on SAF and improved fuel efficiency, also align with CORSIA. Moreover, the EU has indicated plans to integrate CORSIA into the EU ETS for flights within the EEA, reflecting the alignment of CORSIA with Fit for 55. This integration seeks to create a harmonised and comprehensive approach to regulating aviation emissions while avoiding duplication of efforts and ensuring that emissions are effectively reduced.

4.2 IMO Greenhouse Gas Strategy

IMO is a United Nations specialised agency that seeks to promote safe, secure, environmentally sound, efficient, and sustainable shipping. It holds an international remit and is responsible for implementing intergovernmental regulations concerning maritime trade, safe shipping, and access to seas. It also regulates matters relating to ocean pollution and accidents at sea.

The remit of the IMO is vast but environmental preservation is one of its key focal areas. Within the organisational structure of the IMO there are several Committees and sub-committees; the committee responsible for environmental matters is the Marine Environmental Protection Committee (MEPC), which addresses topics relating to the control and prevention of ship-sourced pollution. In 2020, through the MEPC, the IMO published the results of their fourth greenhouse gas emissions study. The results show the global shipping sector contributed 1 076 million tonnes of greenhouse gas to the atmosphere in 2018 – a significant figure. According to the same report, based on long-term projections to 2050, emissions are likely to increase by 90–130% by 2050 (based on 2008 levels). The report's findings have heightened the need to introduce further policy measures to curb emissions from shipping and incentivise the shipping industry to move towards lower-/zero-carbon technologies.

At the most recent meeting of MEPC, held in July 2023, an update to the IMO's Greenhouse Gas Strategy (originally published in 2018) was issued to reflect that current global policies and measures were insufficient to achieve the goals outlined in the original strategy. The revised Greenhouse Gas Strategy increases the level of ambition to target net zero on or around 2050, with indicative checkpoint targets at 2030 and 2040. There is an additional target of at least 5% (aiming for 10%) of the energy used by international shipping by 2030 to be from zero or near zero greenhouse gas fuels or technologies.

Green Deal Call-funded projects that are developing and deploying infrastructure in ports to support alternatively fuelled/powered vessels are directly supporting the targets set by the IMO. To ensure the maritime sector is on the correct trajectory to hit net zero by or around 2050, complementary infrastructure is required to enable the successful operation of new vessels fuelled by methanol, ammonia, or hydrogen, as well as accommodate the use of shore power. Such vessels are now entering service, with Laura Maersk, the first methanol-powered container vessel, conducting its maiden voyage in September 2023.

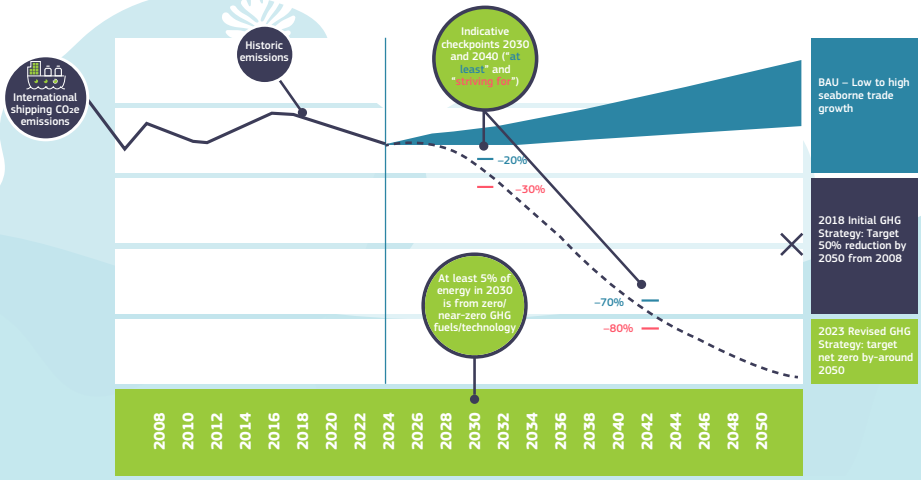

Figure 4.1: Revised IMO Greenhouse Gas Strategy targets

5 Conclusions

In conclusion, the imperative to decarbonise transport within the EU cannot be overstated. The transportation sector accounts for a significant portion of the EU's greenhouse gas emissions, making it a critical focus area in the effort to combat climate change. Within the Fit for 55 proposals, the EU has set ambitious targets and regulations to reduce carbon emissions in the transport sector, and it is clear that addressing this challenge is a top priority. The urgency of this endeavour is underscored by the growing threat of climate change, and it calls for a multifaceted approach that combines scientific research and policy initiatives to pave the way for a sustainable and low-carbon future.

Scientific research plays a pivotal role in guiding policymaking efforts and achieving the targets set forth in the Fit for 55 proposals. By providing valuable insights into the technological advancements, behavioural changes, and sustainable practices required to reduce emissions, research can inform policy decisions that are not only effective but also evidence based. Research enables policymakers to design regulations that align with the latest innovations and scientific understanding, such as those funded under the Green Deal Calls, thus facilitating the transition to a more sustainable and eco-friendly transport system.

While the Fit for 55 proposals present a promising path towards a greener transport sector, it is undeniable that they also pose significant challenges for the industry. Meeting the stringent emissions reduction targets and implementing the necessary changes will require substantial investments, technological innovation, and a collective effort from manufacturers, service providers, and consumers alike. It is clear that both the public and private sectors must adapt and collaborate to drive the necessary transformations in the transportation industry, with governments playing a central role in providing the regulatory framework and incentives to incentivise sustainable practices.

The Green Deal Call-funded projects are playing a pivotal role in the development of innovative solutions aimed at achieving the ambitious policy targets set by the EU. New technologies are being developed that can facilitate the rollout of new fuels and propulsion techniques, and important networks are being created between transport hubs (ports and airports) and their upstream and downstream stakeholders. Moreover, the impacts of these projects can extend far beyond the confines of EU policymaking. These projects are catalysts for change, offering potential solutions that transcend geographic boundaries and possess the potential to contribute significantly to international sustainability goals.

The Green Deal Projects Support Office is proud to support these projects in achieving their goals by fostering closer collaboration between scientists and policymakers, and enhancing the chances of translating scientific findings into actionable policies. The Support Office also aims to facilitate engagement with other research projects that these teams might not connect with otherwise, leading to cross-fertilisation of innovative concepts and methodologies, and to help project teams to effectively communicate their messages to a wider audience.

This report delves into the core challenges faced by the aviation and shipping sectors in meeting Fit for 55 targets, emphasising the need for technological development and low-carbon infrastructure. These challenges are addressed by several Green Deal-funded projects through a number of innovative solutions, whilst supporting international agreements such as CORSIA in aviation and the IMO Greenhouse Gas Strategy in shipping. Finally, it underscores the pivotal role of scientific research and policy initiatives, exemplified by these projects, in achieving sustainable, low-carbon mobility and meeting Fit for 55 targets.

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