STUDY

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The aviation and maritime sectors and the EU ETS System: challenges and impacts

Overview briefing

Transport and Tourism

Policy Department for Structural and Cohesion Policies
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RESEARCH FOR TRAN COMMITTEE

The aviation and maritime sectors and the EU ETS System: challenges and impacts

Overview briefing

Abstract

This paper gives an initial overview of the market structure in a revised EU ETS for the European aviation and maritime sectors. Key design options like the scheme's geographical scope, the baseline year(s), cap and allocation of allowances, and – in the case of aviation – the relationship with CORSIA, can have impacts on the competitive situation of EU carriers and vessels. This is the first stage in the research project focusing on the implementation and socio-economic perspectives related to the eventual inclusion of aviation and maritime in the EU ETS system. The analysis of the Commission's proposal is expected to follow in fall 2021.

This document was requested by the European Parliament's Committee on Transport and Tourism.

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LIST OF ABBREVIATIONS

ANSP	Air Navigation Service Provider
CDA	Continuous descent approach
CER	Certified Emission Reduction
CII	Carbon intensity indicator
CO_2	Carbon dioxide
Coreper	Permanent Representatives Committee
CORSIA	Carbon offsetting and reduction scheme for international aviation
DCS	Data collection system
dwt	Deadweight tonnage
EASA	European Union Aviation Safety Agency
EEA	European Economic Area (EU-27+ Iceland, Norway and Liechtenstein)
EFTA	European Free Trade Association (EEA countries + Switzerland)
EEDI	Energy Efficiency Design Index
EEX	European Energy Exchange
EEXI	Energy Efficiency Existing Ship Index
EUA	European Union Allowance
EUAA	European Union Aviation Allowance
EU ETS	EU Emissions Trading System
EU-27	27 EU Member States (post-Brexit)
GHG	Greenhouse gas
GT	Gross tonnage
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization

IMO	International Maritime Organization
int'l	international
LCC	Low Cost Carrier
MEPC	Marine Environment Protection Committee
MRV	Monitoring, reporting and verification
MTOM	Maximum Take-Off Mass
NC	Network Carrier
OD	Origin-destination
p.a.	per annum
PSO	Public service obligation(s)
RPK	Revenue passenger kilometres
RTK	Revenue tonne kilometres
SARPs	Standards and Recommended Pratices
SEEMP	Ship Energy Efficiency Management Plan
SME	Small and medium-sized enterprise
t	tonne
UAE	United Arab Emirates

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EXECUTIVE SUMMARY

KEY FINDINGS

- The forthcoming revision of the EU ETS is likely to include maritime shipping and to strengthen the existing scope and rules for aviation – also considering its interplay with the Carbon offsetting and reduction scheme for international aviation (CORSIA). Key design options of a revised EU ETS with impacts on the competitive situation of EU carriers and vessels include the scheme's geographical scope, baseline year(s), cap and allocation of allowances, and – for aviation – the relationship with CORSIA.
- The heterogeneity of the maritime shipping sector and the fluctuation of ships' annual emissions within the potential scope of the EU ETS can be a challenge for certain design elements. The design of the EU MRV system and the data provided by the system play an important role in this context.
- Aviation activities so far covered by the EU ETS are intra-EEA flights, with only limited impacts on competition. The situation is different on extra-EEA routes: after the Pandemic, CORSIA will require the airline sector to purchase offsets for its emissions exceeding 2019 levels on international routes and between participating states. The CORSIA baseline (2019) is less ambitious than the EU ETS baseline (2004-06). Hence, routings from, to or via the EEA would have a competitive disadvantage compared to routes via non-EEA airports, especially if the EU ETS was extended to extra-EEA flights.

The forthcoming revision of the EU ETS is likely to include maritime shipping and to strengthen the existing scope and rules for aviation – also considering its interplay with the Carbon offsetting and reduction scheme for international aviation (CORSIA).

This overview briefing provides initial background information on the two sectors, the EU ETS system and its revision process, and on other international Greenhouse gas (GHG) regulation of relevance as well as first considerations on the eventual full integration of the two sectors into the EU ETS. This shall help Members of the European Parliament to systematically assess the upcoming Commission proposal for a revised EU ETS.

The EU-ETS System

The EU ETS is a policy instrument where for each tonne of CO_2 emitted, an emission allowance has to be submitted at the end of a compliance period. The total number of allowances issued is limited in accordance with a politically set emissions cap, the environmental goal. If a participating entity needs more allowances than initially received/bought, it may purchase them from other entities which manage to reduce their emissions more quickly or more cheaply, for example by investing into emission reducing technologies. Advantages of an ETS are its environmental effectiveness (the environmental goal, i.e. the cap, is definitely achieved) and its economic efficiency (emissions are first reduced where it is most cost-effective to do so).

The maritime shipping sector

- State of play

Since maritime shipping is currently not included in the EU ETS, various design options have to be considered when the sector is included in the system. The impact on the sector's compliance costs and the associated economic and social impacts will thereby have to be weighed against the benefits. The heterogeneity of the sector and the fluctuation of ships' annual emissions within the potential scope of the EU ETS can be a challenge for certain design elements. The design of the EU MRV system, which requires ships to monitor and report different parameters like their fuel consumption and CO_2 emissions, and the data provided by the system play an important role in this context.

- Perspectives

The integration of maritime shipping into the EU ETS can have different economic and social impacts. Due to the compliance costs associated with the EU ETS, the costs of maritime transport/activities on routes within the scope of the EU ETS can be expected to increase. Some actor in the value chain will have to carry the additional costs and since the EU ETS is a regional and not global measure, it entails the risk of market distortions.

A potential shift from sea to road, rail or air transport due to EU ETS has to be considered too. A modal shift to other transport modes is, from a social perspective, however, only an issue if the other modes of transport are subject to no or to a less strict environmental regulation.

As the International Maritime Organization (IMO) has not yet started to consider global market-based measures to address GHG emissions from ships, in line with its so-called Initial Strategy, there is at present no need to align the EU ETS with a global measure.

The aviation sector

- State of play

The EEA aviation sector can roughly be divided into the liberalized intra-EEA market and various extra-EEA markets. Within the EEA, direct point-to-point flights by pan-European, 'homeless' low cost carriers operating between airports all across Europe compete with network carriers which have a strong market presence on flights to and from their hubs, usually the European capitals. Between the EEA and third countries, European hub carriers compete with direct or indirect routes offered by extra-EEA carriers. Key hubs outside the EEA through which these carriers route their traffic are London or Zürich in Europe, North American gateways like New York or Atlanta, and Middle Eastern hubs like Dubai, Doha and Abu Dhabi. Also, Turkish Airlines or Aeroflot have strongly increased their presence in the EEA from where they route passengers through Istanbul and Moscow, respectively.

- Perspectives

Key design options of a revised ETS with impacts on the competitive situation of EU carriers and on carbon leakage include the scheme's geographical scope (routes covered), the baseline year(s), cap and allocation of allowances, and the relationship with CORSIA.

- International dimension

So far, the EU ETS only covers intra-EEA flights. Its competitive effects are limited as all intra-EEA routings, both by low cost and network carriers, fall under the scheme. On flights from and to extra-EEA countries, the situation is different: CORSIA requires airlines to purchase offsets for their emissions exceeding 2019 levels on international routes. As the CORSIA baseline (2019) is less ambitious than the EU ETS baseline (2004-06), routings from, to or via the EEA would have a competitive disadvantage compared to routes via non-EEA airports, especially if the EU ETS was extended to extra-EEA flights.

This overview briefing is part of an ongoing larger research project aimed at analysing the implementation and socio-economic effects and perspectives related to the eventual inclusion of aviation and maritime in the EU ETS system. The full analysis and assessment of the Commission's proposal is expected to follow in fall 2021.

1. INTRODUCTION

1.1. Aim of briefing

This briefing is part of the 'Research project on the aviation and maritime sectors and the EU ETS system: challenges and impacts' commissioned by the Committee on Transport and Tourism. With this project the TRAN Committee wants to inform its members on foreseeable key challenges and impacts (economic and social implications) stemming from an eventual full inclusion of aviation and maritime shipping into the EU Emissions Trading System (EU ETS).

As the research project is still at an early stage, the briefing will present background information and preliminary findings to allow the Members of the Parliament to systematically assess the Commission proposal for a revised EU ETS scheduled to be published as part of the 'Fit for 55' package in July 2021.

Section 1.2 provides background information on the EU ETS revision process and the main characteristics of the EU ETS, chapter 2 a detailed description of the current EU ETS and an overview on other Greenhouse gas (GHG) regulations relevant for the sectors. Chapter 3 presents elements to be considered concerning the eventual full integration of the two sectors into EU ETS and chapter 4 provides some tentative conclusions for analysis. For the interested reader, the Annex presents background information on the aviation and maritime shipping sector to better understand the potential impacts of the inclusion of the sectors into the EU ETS.

1.2. Background of briefing

1.2.1. Political background: EU ETS revision process

In order to meet the goals as agreed upon in the Paris Agreement, in December 2019, the European Commission has proposed the European Green Deal (EC, 2019a) (COM(2019) 640 final), which includes a proposal to revise the 2030 EU GHG reduction target, a commitment to climate neutrality in 2050, as well as proposals for various measures to meet the revised 2030 and the 2050 targets.

Meanwhile, the European Council's and European Parliament's negotiators reached a provisional agreement setting into law the objective of a climate-neutral EU by 2050, and a collective, net, greenhouse gas emissions reduction target of at least 55 % by 2030 compared to 1990 (Portugal, 2021). And the European Commission presented its 'Sustainable and Smart Mobility Strategy' (COM(2020) 789 final) to further specify how the transport sector's emissions can be cut by 90 % by 2050. A revision of the EU ETS is part of the action plan accompanying this strategy.

Currently, the emissions of maritime shipping are not included, and the emissions of aviation are only partially included in the EU ETS.

For the aviation and the maritime shipping sector, three major elements have been announced to be part of the European Commission's EU ETS revision proposal[1]:

1. An increase of the share of auctioned allowances for aviation.

[1] For the according European Commission initiatives, please see:
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12494-EU-emissions-trading-system-updated-rules-for-aviation_en
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12660-Climate-change-updating-the-EU-emissions-trading-system-ETS-_en

2. The implementation of the carbon offsetting and reduction scheme for international aviation (CORSIA) in a way that is consistent with the EU's 2030 climate objectives.
3. An extension of the system to new sectors, including maritime shipping.

On top of these proposals, other aspects related to the aviation sector play a role in the EU ETS revision process, which are not directly linked to the European Green Deal or the Sustainable and Smart Mobility Strategy. It is being discussed whether the non-carbon dioxide (CO_2) emissions of aviation should also be regulated by means of the EU ETS and whether, given CORSIA, extra-EEA flights should be exempted from the revised EU ETS or whether the current temporary derogation of the extra-EEA flights from EU ETS should be lifted.

The European Commission's proposal for the revised EU ETS is scheduled to be published in July 2021.

Ultimately, Regulation (EU) No 2015/757 on the monitoring reporting and verification of carbon dioxide emissions from maritime transport ('EU MRV Regulation') will also be revised to take account of the global Data Collection System as implemented at the IMO (International Maritime Organization) level.[2] The European Parliament adopted its position on the European Commission's proposal at its plenary session on 16 September 2020 including a proposition for the extension of the EU ETS to maritime shipping (P9_TA-PROV(2020)0219). In the following we will refer to this proposal as the 'EP's Shipping EU ETS Proposal'.[3]

1.2.2. Main characteristics of the EU Emissions Trading System

An emissions trading system is a policy instrument that aims to (fully or partly) internalise the external costs of the emissions covered by the system by setting a price for the emissions that reflect their external costs, also considering the damage they cause.

The EU ETS is a cap and trade emissions trading system. The basic principles of the system are as follows: for each tonne of, e.g. CO_2 emitted, an emission allowance has to be submitted at the end of a compliance period.[4] The system does not prescribe individual emission targets at the firm (i.e. individual emitter) level, it rather sets an overall emissions target for the participating sector(s). The total number of allowances issued in a compliance period is limited in accordance with the total emissions cap. In the first instance, the emission allowances are issued for free and/or auctioned which is referred to as the initial allocation of the allowances. Irrespective of the initial allocation method, emission allowances are also tradeable on the secondary market. If an entity needs more allowances, it may purchase them from other entities which manage to reduce their emissions more quickly or more cheaply, for example by investing into emission reducing technologies. By reducing the cap and hence the number of allowances that are issued in a compliance period, the overall emissions are reduced over time. In contrast to an emissions tax, the price for the emissions is not fixed in an ETS but is endogenous.

The key advantages of an ETS are its environmental effectiveness (the environmental goal, i.e. the cap, is definitely achieved except for cases of incorrect reporting or fraud, which are hence highly sanctioned) and its economic effectiveness (emissions are first reduced in the sectors where it is most cost-effective to do so).

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2 See 2019/0017 (COD) the revision proposal of the European Commission.

3 Coreper agreed the Council mandate for negotiations with the Parliament on 25 October 2019. The position was limited to the EU MRV system and did touch on a potential inclusion of shipping into EU ETS. See the Legislative Observatory for a documentation of the process.

4 In the EU ETS, the compliance period is equal to the calendar year. It is the temporal basis for monitoring, reporting and verification of emissions and for the purchase of allowances.

Currently, emissions of certain stationary installations of different sectors (manufacturing, power supply, etc.) located in EEA countries and emissions from intra-EEA flights are covered by the EU ETS. Emissions from extra-EEA flights are temporarily derogated until the end of 2023. Beginning of 2020, the system has also been linked to the Swiss emissions trading system, but is currently not linked to the UK emissions trading system which came into force on the 1st of January 2021.

The system mainly covers CO_2 emissions. For some activities of stationary emission sources, however, other emissions are included too (e.g. nitrous oxide for production of nitric acid).

Emissions from maritime shipping are currently not included in the system at all.

Section 3.1.1 provides further details on the design of the current EU ETS.

2. EU ETS AND OTHER GHG REGULATION

This chapter provides an overview of the current EU ETS according to the 'EU ETS Directive' (Directive No 2003/87/EC) and other GHG regulation at the EU, global level and national/regional level, relevant for the two sectors.

2.1. GHG Regulation at EU level

2.1.1. Current EU ETS

In 2005, the EU implemented the EU ETS to ensure that the EU countries would meet the GHG emissions reduction targets as laid down in the Kyoto Protocol (first commitment period: 2008-2012). Since then, the EU ETS has been a key tool for meeting EU GHG emissions reduction targets, which have been set internationally and at the EU level.

Entities and emissions included

The following entities and emissions are currently included in the EU ETS (European Commission, 2021a):

- CO_2 from (a) electricity and heat generation, (b) energy-intensive industry sectors including oil refineries, steel works, and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals, and (c) commercial and non-commercial aviation within the EEA;
- nitrous oxide from production of nitric, adipic and glyoxylic acids and glyoxal;
- perfluorocarbons from production of aluminium.

In some sectors, only stationary installations above a certain size are included, and in aviation very small operators are exempted when meeting very strict de-minima rules or qualifying as so-called 'small emitters'.

Emissions from maritime shipping are currently not included in the system at all.

Geographical scope

Stationary installations located in EEA countries are currently covered by the EU ETS.

Air transport activities within the EEA have been included in the EU ETS since 2012. Extra-EEA flights are temporarily derogated until end of 2023. Geographical exceptions are air services from continental EEA to the EU outermost regions[5] and between, but not within, these EU outermost regions. Furthermore, non-European countries and territories of Member States like Greenland, Faroe Islands, French Polynesia or Svalbard are excluded.[6] Since the beginning of 2020, the EU ETS has also been linked to the Swiss ETS. According to the linking agreement for aviation, flights from EU-27, Iceland and Norway to Switzerland are subject to the EU ETS, whereas flights from Switzerland to the EEA fall under the Swiss ETS.

[5] Like the Canary Islands, the Azores and Madeira, and the French Overseas territories like Guadeloupe, Martinique and La Réunion, as defined in Article 349 of the Treaty on the Functioning of the European Union.

[6] The full list can be found here: https://www.dehst.de/SharedDocs/antworten/EN/Aviation/LV_005_scope.html

Types and initial allocation of allowances

The current EU ETS knows two types of emission allowances: EUAs (European Union Allowances) and EUAAs (European Union Aviation Allowances). Aviation is allowed to submit both types of allowances to comply with the regulation, whilst operators of stationary installations are bound to EUAs. In the past, aviation has been a net buyer of allowances, i.e. also submitted EUAs for compliance (European Commission, 2020c).

The initial allocation of emission allowances to the sectors is as follows:

- The power sector receives no free allowances.
- For other stationary installations, product benchmarks are used to allocate free allowances. In 2013, 80 % of the allowances were freely allocated, in 2020 these amounted to 30 %. Sectors deemed at risk of carbon leakage[7] however receive free allowances covering 100 % of their product benchmark.
- For aviation, it holds that 82 % of the allowances are freely allocated based on a benchmark of 0.6422 emission allowances per 1,000 tonne kilometres; 3 % make a special reserve for new entrants and 15 % are auctioned.

Auctioning of allowances is considered efficient and the method to be applied by default, i.e. as far as possible, from phase 3 (2013-2020) on.[8] Before the ongoing revision of the EU ETS, the aim was to phase out free allocation of allowances to stationary installations not at risk of carbon leakage between 2027 and 2030 and to analyse the potential for a higher share of auctioned allowances to aviation. A reduction of the free allocation of allowances is still part of the ongoing revision, but the timing of the phase-out might be different.

Auctioning is organized on behalf of the different countries within the scope, which also receive the according revenue. Auctions are held at the European Energy Exchange (EEX) and are sealed bid auctions with a uniform clearing price.

Use of the revenue from auctioning

At least 50 % of the revenue from auctioning has to be used for certain purposes as specified in Article 10 of the 'EU ETS Directive', like the reduction of GHG emissions, the development of renewable energies, carbon capture and storage, energy efficiency, etc.

Emissions cap

For stationary installations, the 2013 emissions cap was determined on the basis of the average total quantity of allowances issued annually in 2008-2012, and in phase 3 of the EU ETS (2013-2020) the Union-wide cap decreased each year by a linear reduction factor of 1.74 %. The Union-wide cap for 2021 is fixed at around 1.57 billion allowances.

Since 2013, the emissions cap for aviation is defined as 95 % of the sector's average 2004-2006 emissions and the cap has not declined until 2020. From 2021 onwards, an annual linear reduction factor of 2.2 % is applied to the emissions cap for both stationary installations and aviation.

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7 Carbon leakage refers to the situation that may occur if, for reasons of costs related to climate policies, businesses were to transfer production to other countries with laxer emission constraints. This could lead to an increase in their total emissions (European Commission, 2021b).

8 According to an estimation of the European Court of Auditors (2020), however, for both phase 3 and 4 (2021-2030) of the EU ETS, allowances allocated for free continue to represent more than 40 % of the total number of available allowances.

2.1.2. Other GHG regulation at EU level: maritime shipping

With the adoption in April 2015 of Regulation (EU) No 2015/757 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, in the following referred to as 'EU MRV Regulation', the European Commission has accomplished the first step of its strategy to integrate maritime transport emissions in the EU greenhouse gas reduction policies.[9]

The EU MRV Regulation provides valuable information for potential integration of maritime shipping into the EU ETS. It requires companies, from January 2019 on, to monitor the fuel consumption and other parameters of their ships above 5,000 GT[10] within all ports under the jurisdiction of a Member State and on any voyages to or from a port under the jurisdiction of a Member State. And from 2019 on, for each of these ships, the companies have to submit each year an emissions report to the Commission and to the authorities of the flag States concerned, reporting the ships' CO_2 emissions and other relevant information on an aggregated basis for the previous calendar year.

The EU MRV Regulation is currently being revised to take account of the global Data Collection System as implemented at the IMO level. In February 2019, the European Commission published a proposal for a revised EU MRV Regulation and in September 2020, the European Parliament adopted its position on the Commission proposal, including a proposition for the extension of the EU ETS to maritime shipping (P9_TA-PROV(2020)0219). The ensuing inter-institutional negotiations on the revision of the EU MRV system have not started yet.[11]

The decarbonisation of the maritime shipping sector requires the use low-/zero-carbon fuels. It is expected that, should EU ETS be extended to maritime shipping, the CO_2 price would not be high enough to stimulate the uptake of these fuels by the sector – the expected price differential with the conventional fossil fuels is expected to be higher. As part of the FuelEU Maritime Initiative, the European Commission therefore also develops additional measures to stimulate the uptake of the low-/zero-carbon fuels.

In addition, the ongoing revision of the Energy Taxation Directive, of the Renewable Energy Directive, and the revision of the Alternative Fuels Infrastructure Directive, as scheduled for 2021, can also be expected to set extra incentives for the supply and use of low-/zero-carbon fuels.

2.2. Other GHG regulation

2.2.1. Maritime shipping: IMO level

At the IMO level, there are three global measures in force. The Energy Efficiency Design Index (EEDI), the Ship Energy Efficiency Management Plan (SEEMP), and the Data Collection System (DCS).

Regulation 21 of MARPOL Annex VI, which entered into force in January 2013, sets, by means of the EEDI, a minimum standard for the technical energy efficiency of new ships of certain ship types.

[9] COM(2013) 479 (European Commission, 2013b); The subsequent steps of the three-step strategy are: 1. The definition of greenhouse gas reduction targets for the maritime transport sector and 2. The implementation of further measures, including market-based measures like EU ETS.

[10] According to Article 2 of the regulation, it does not apply to warships, naval auxiliaries, fish-catching or fish-processing ships, wooden ships of a primitive build, ships not propelled by mechanical means, or government ships used for non-commercial purposes. The following fifteen ship type categories are differentiated: Bulk carrier, chemical tanker, combination carrier, container ship, container/ro-ro cargo ship, gas carrier, general cargo ship, LNG tanker, oil tanker, passenger ship, refrigerated cargo carrier, Ro-Pax ship, Ro-Ro ship, vehicle carrier, other ship type.

[11] Coreper agreed the Council mandate for negotiations with the Parliament on 25 October 2019. The position was limited to the EU MRV system and did touch on a potential inclusion of shipping into EU ETS. See the Legislative Observatory for a documentation of the process.

According to MARPOL Annex VI, Regulation 22, each ship of 400 GT and above has to keep a SEEMP on board. The SEEMP has to be ship specific and has to be set up in accordance with the IMO guidelines. The measure relies on self-evaluation and no binding reduction targets are set, which is why the effect assessed is limited.

The DCS, which is a facilitating measure only, requires ships to annually report to their Flag State the amount of fuel consumed, distance travelled, and hours underway (Resolution MEPC.278(70)). Flag State administrations or Recognised Organisations verify the data and transfer them to the IMO Secretariat, which maintains a database.

In April 2018, IMO's Marine Environment Protection Committee (MEPC) adopted the 'Initial IMO Strategy on Reduction of GHG Emissions from Ships' (MEPC 72/17/Add.1, Annex 11).

The strategy aims to phase-out GHG emissions from international shipping as soon as possible in this century. In addition, the strategy sets the ambitions to

- improve the carbon intensity of shipping by at least 40 % in 2030, relative to 2008 and pursue efforts to improve it by 70 % by 2050; and
- reduce the greenhouse gas emissions of shipping by at least 50 % in 2050, relative to 2008.

To achieve these levels of ambition, short-, medium- and long-term policy measures will be developed as part of the strategy.

Specific short-term measures have recently been adopted by MEPC. For ships already subject to the IMO DCS requirements, a mandatory Carbon Intensity Indicator (CII) and a rating scheme based on the CII has been agreed upon[12] as well as the Energy Efficiency Existing ship Index (EEXI) which requires existing ships to meet similar design standards as new ships.

The medium- and long-term GHG measures are still to be developed at this stage. A revised IMO strategy, including an implementation schedule for the different measures, is planned to be approved in spring 2023 at MEPC 80.[13] The indicative timing in the current strategy assumes that mid-term measures are finalized and agreed between 2023 and 2030 and long-term measures beyond 2030. The work plan for the mid-term measures as adopted by MEPC 76 envisages that proposals for measures are collated and initially considered in the period between spring 2021 and spring 2022, that in the period spring 2022 to spring 2023 measures(s) are assessed and selected for further development and that in the subsequent phase 3, a measure/measures are developed to be finalized within (an) agreed target date(s).

2.2.2. Aviation: ICAO level

At international ICAO (International Civil Aviation Organization) level, several measures to reduce GHG emissions are in operation. In 2009, the International Air Transport Association (IATA) and other aviation stakeholders agreed on the following global climate goals for the international aviation sector: average annual improvements in fuel efficiency of 1.5 % between 2009 and 2020 and carbon-neutral growth (CNG) from 2020, i.e. a freeze of the sector's net CO_2 emissions at 2020 levels followed by a reduction to 50 % of 2005 levels until 2050 (IATA, 2018). To achieve these goals, four different measures were defined:

[12] Each year, the actual achieved CII and the according ranking of the ships (A to E) will be determined, with the rating thresholds becoming increasingly stringent towards 2030. For ships that achieve a D rating for three consecutive years or an E rating, a corrective action plan needs to be developed and approved as part of the Ship Energy Efficiency Management Plan.

[13] See Roadmap for developing a comprehensive IMO Strategy on reduction of GHG emissions from ships (MEPC 70/18/Add.1).

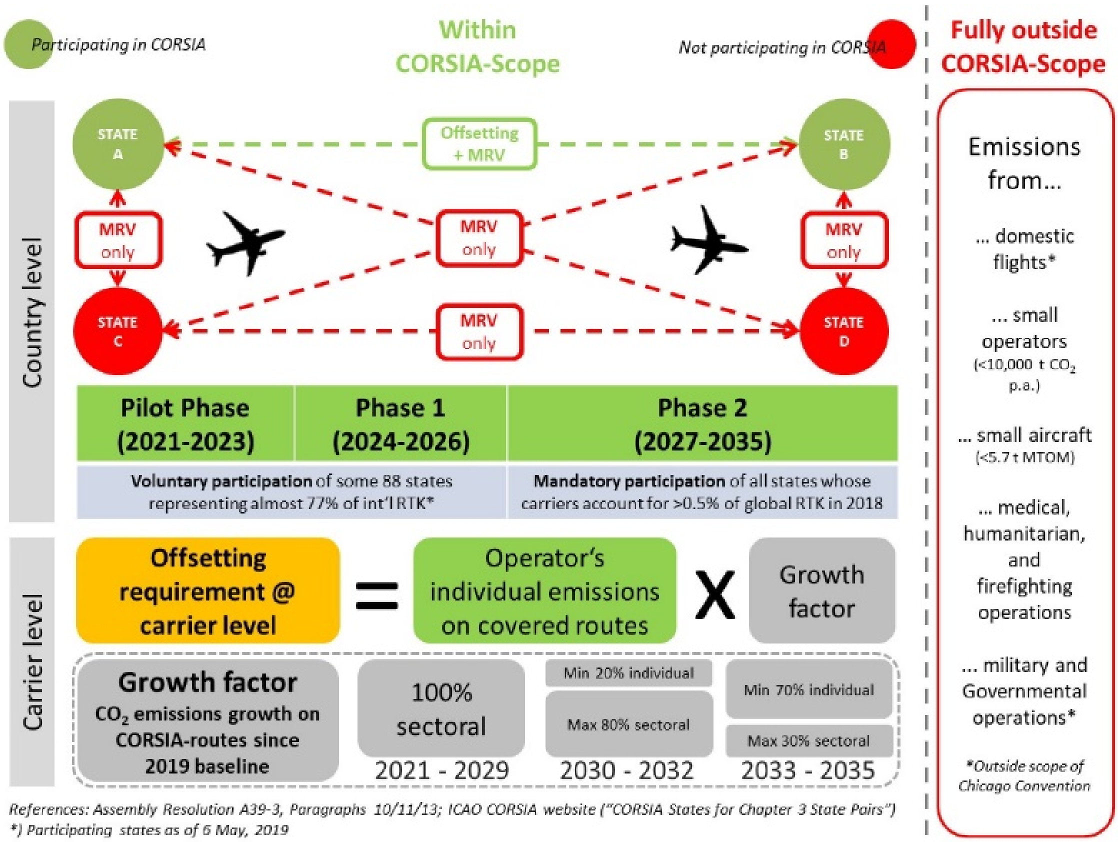
1. New technologies, including alternative fuels.
2. Fuel-saving operations like continuous descent approaches (CDA), allowing for smooth, constant-angle descent to landing.
3. Modernization of air traffic management and other infrastructural improvements.
4. A single global market-based measure to fill any remaining emission gap.

This market-based measure has, in the meantime, been given birth as CORSIA: the Carbon Offsetting and Reduction Scheme for International Aviation (ICAO, 2016). Unlike the EU ETS, CORSIA is a global measure where the international airline sector, subject to some exceptions, is obliged to offset any post-2019/2020 ('baseline') growth in CO_2 emissions on international routes from 2021 onwards. For this, tradable carbon credits are used for compliance which have to be purchased by the carriers for emissions from routes subject to CORSIA. The rationale behind the scheme is that airlines will choose to offset their emissions whenever this is cheaper than to reduce them directly or where other technology options are not (yet) available.

Eligible carbon credits are issued by certified greenhouse gas reduction projects like reforestation which, in return, shall deliver measurable reductions in emissions. This way, international aviation's net CO_2 emissions shall be stabilized while other emissions reduction measures will be further pursued. Emissions from domestic operations are not regulated under CORSIA as they are covered by the UNFCCC Paris Agreement, and because the ICAO is only competent for international air traffic.

Figure 1 illustrates the design and functioning of the scheme as ruled in Assembly Resolution A39-3 (ICAO, 2016) and in the related Standards and Recommended Practices (short: SARPs) document 'Annex 16 to the Convention on Civil Aviation, Vol. IV' (ICAO, 2018).

Figure 1: Schematic overview of CORSIA



Source: Authors' own illustration, based on Maertens et al. (2019)

In brief, CORSIA functions as follows:
Apart from domestic operations, emissions from small operators (<10,000 t CO_2 p.a.), from small aircraft (< 5.7 t CO_2) and rotorcraft, and those from humanitarian, medical and firefighting operations do not fall under the scheme (Assembly Resolution A39-3, §13). In addition, military and governmental aviation are excluded as they are not subject to the Chicago Convention.

All other emissions from international routes are subject to CORSIA offsetting if they originate from flights between participating states (§10a), hereinafter referred to as 'CORSIA-states'. Until 2026, participation is voluntary (§9a, §9b). 88 states have agreed to participate from 2021 on, which represents more than 75 % of international revenue tonne kilometres (RTKs). Key countries that have not volunteered are Brazil, China, Russia and India (ICAO, 2020b). From 2027, all countries have to participate in CORSIA offsetting, except for small islands, least developed countries, land-locked developing countries and states whose carriers account for less than 0.5 % of 2018 international revenue tonne kilometres, unless they decide to volunteer (§9e).

While emissions from flights between CORSIA-states and non-CORSIA-states, or solely between non-CORSIA-states, are not subject to any offsetting, they still have to be monitored, reported and verified under the CORSIA-scheme (§10b, §10c). This shall happen according to the internationally uniform standards ruled in Annex 16, Volume IV.

Actual offsetting at the carrier level was expected to commence in 2021, under supervision of the responsible competent authority. To calculate an airline's offset obligation, in each year from 2021-2029, this airline's individual emissions from CORSIA-routes are to be multiplied with the sectoral global emission growth rate (over all carriers on routes subject to offsetting requirements) since the baseline period (§11).

The intention behind the uniform application of the average sector growth to all carriers was to get a certain balance between the offsetting requirements for older and new carriers, respectively. Otherwise, fast-growing airlines, e.g. from the Middle East or China, would have to shoulder most of the burden, while large but stagnating carriers like the big US, Japanese or European network airlines would hardly show any individual emission growth and therefore have no or only very moderate offsetting obligations. From 2030, however, individual emission growth will be attributed to the carriers to an increasing extent. New entrants are free from any offsetting obligations for a period of up to three years if their annual emissions do not surpass 0.1 % of global emissions in 2020 at an earlier point.

The original CORSIA baseline was the average of 2019/2020 emissions. To reflect 2020 demand decreases caused by the COVID-19 pandemic, the year 2019 was agreed on by the ICAO Council as new, single baseline year for the period 2021-2023 amid the COVID-19 pandemic (ICAO, 2020a). As a short-term effect, there will not be any actual offsetting obligations as long as emissions from CORSIA routes remain below the 2019 level.

The following table summarizes the key differences between CORSIA and the EU ETS in its current form. In brief, CORSIA has a larger geographical scope but is less ambitious due to the relatively high baseline. Another drawback of CORSIA is the questionable environmental effectiveness of the offsets, along with a need for double MRV - both at the airline and at the offsetting project levels. Cames et al. (2016) found that '73 % of the Certified Emissions Reduction (CER) supply have a low likelihood' and only '7 % have a high likelihood of ensuring that emission reductions are additional and not over-estimated'. These quality-related issues of CORSIA are not further dealt with in this report.

Table 1: EU ETS versus CORSIA – key differences

		EU ETS	CORSIA
Fundamental differences	Methodology	Cap&Trade	Baseline&Credit (Offsetting)
	Environmental integrity	Not critical, overall cap is fixed	Dependent on offset quality standards and enforcement
	Need for verification by authorities	Only at emitter level	Both at emitter and at offsetting project level
Differences in current implementation and application (coverage & baseline)	Cap/Baseline	95 % of avg. 2004-2006 emissions; stepwise further reduction of cap envisaged	Avg. 2019/2020 emissions; no further reduction envisaged
	Scope	Intra-EEA including domestic flights, fixed-wing and rotorcraft	International routes between participating states, fixed-wing only
	Affected carriers	All airlines operating on covered routes, unless exceptions apply	

Source: Authors' own table

CORSIA and the EU ETS in its current form both apply to, and hence overlap on, international intra-EEA operations. If the EU ETS was extended to all flights to and from the EEA, the two schemes would also overlap on extra-EEA routes from and to participating CORSIA states. Both could mean double counting and charging. This aspect will be discussed in the full study.

2.2.3. Aviation: National levels

At national levels, there are emission trading schemes in operation in a couple of non-EEA countries. The **Swiss ETS** for example has been in operation since 2008 for stationary sources (BAFU, 2021). Aviation was included here in 2020 and the system has been linked to the EU ETS. The **United Kingdom** is now outside the scope of the EU ETS (Environment Agency, 2021; Verifavia, 2021), but has put its own UK ETS in place, which applies to flights from the United Kingdom to the United Kingdom, Gibraltar and the EEA. As, so far, no linking agreement with the EU ETS has been concluded, aircraft operators are currently exempted from obligations under the EU ETS for flights from the EEA to the UK. And **South Korea** has an ETS in place since 2015, which also includes domestic aviation.

2.2.4. Aviation: Additional measures and their interaction with the EU ETS

If adopted, other instruments intended to limit the climate impact in aviation may have indirect impacts on the EU ETS. Mandatory **blending quotas for sustainable aviation fuels** are in discussion on national and EU levels. As such fuels are more expensive than fossil fuels, additional instruments are needed to encourage usage. In an ETS, the reduced carbon intensity of alternative fuels (preferably calculated on the basis of lifecycle emissions) should be considered when setting the obligation to surrender allowances. Authorities have begun to consider fuels with biogenic components ('biofuels'), but further alternative fuels, such as power-to-liquid-fuels, need to be considered as well in future.

Passenger duties/ticket taxes are levied in various EU Member States. They are simply charged per passenger, depending on the destination and/or travel class, and not on the basis of actual emissions. Hence, they could be regarded as an indirect way to internalize external costs of aviation but do not create incentives for operators to use more climate-friendly technology or sustainable fuels. However, and this does also apply to **fuel taxes** (which would – within the EEA – require a revision of the Energy Taxation Directive), tax revenues could be used to support e.g. the production of sustainable aviation fuels. Other ideas to reduce aviation activities include **bans of domestic flights** on routes which are served by trains within certain journey time limits[14] and the mandatory introduction of **minimum airfares**.[15]

14 https://www.airport-technology.com/features/france-bans-short-haul-flight-industry-reacts/
15 https://www.reuters.com/article/eu-austria-airlines-idUSL1N2K92I9

3. CONSIDERATIONS ON THE (EVENTUAL) FULL INTEGRATION OF THE SECTORS INTO EU ETS

3.1. Elements to be considered when integrating the sectors into the EU ETS

3.1.1. Maritime shipping

The integration of maritime shipping into the EU ETS can have different economic and social impacts. The integration of the sector in the system will establish a price for the CO_2 emissions of the sector. As a consequence, ship owners/operators will reduce the CO_2 emissions of their ships against abatement costs and/or submit allowances covering the remaining CO_2 emissions, with the price of the allowances depending on various factors. In addition, the system will also be associated with administrative costs. Due to the compliance costs, the costs of maritime transport on routes within the scope of the EU ETS can therefore be expected to increase. Some actor in the value chain will have to carry the additional costs associated with the EU ETS and since the EU ETS is a regional and not global measure, the measure entails the risk of **market distortions**.

Depending on the according market of the transported products, shipping companies might see a reduced profit margin or prices of the products might increase. The supplier of the products might therefore lose market share to the advantage of value chains outside the scope of the EU ETS. Shipping companies operating worldwide might however be able to shift their operations, which means that not the shipping companies, but the entities in the EU relying on seaborne trade might be affected most. An indication for the maximum price increase due to EU ETS is the share of transportation costs in the product price, which can be expected to be higher for low-value products.

A potential shift from sea to road, rail or air transport due to EU ETS has to be considered too. A **modal shift** to other transport modes is, from a social perspective, however only an issue if the other modes of transport are subject to no or to a less strict environmental regulation.

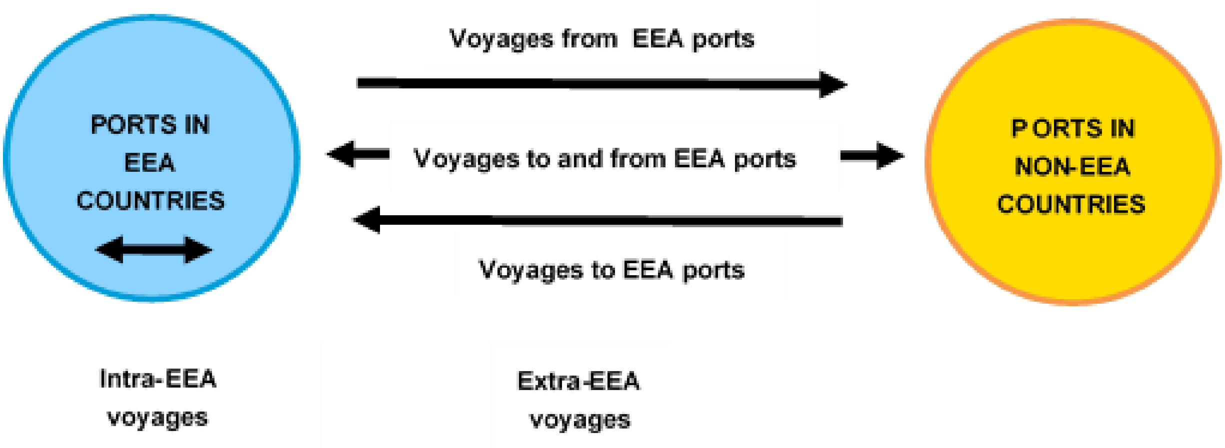
Since maritime shipping is currently not included in the EU ETS, various **design options** have to be decided. In the following, aspects to be considered in the selection of the main design elements are discussed, thereby focussing on impacts on the shipping sector's compliance costs.

The **geographical scope** of the system determines the geographical locations of the ship activities that fall within the scope of the regulation. Several options and delimitations are conceivable in this context (see Figure 2 for an illustration):

- Only voyages between ports in EEA Member States (intra-EEA voyages) or also voyages between a port in an EEA Member State and a port in a State outside the EEA (extra-EEA voyages) could fall within the scope of the system.
- For extra-EEA voyages, either both the voyages to and from ports in EEA countries ('EEA ports'), or only voyages to, or only voyages from ports in EEA countries could fall within the scope of the system.[16]
- For extra-EEA voyages, either the emissions of an entire voyage or a share thereof (e.g. 50 %) could fall within the scope of the system.

[16] For intra-EEA voyages, a voyage from an EEA port is, by definition, also a voyage to an EEA port.

Figure 2: Illustration of geographical scope options



Source: Authors' own illustration

When selecting the geographical scope, the trade-off between the environmental effect and compliance costs has to be considered: the larger the geographical scope, the more emissions are covered by the system and the higher the emission reduction potential, but the higher the potential compliance costs and the risk for potential market distortions.

When determining the geographical scope, special attention should be given to outermost regions and EEA Member States' overseas territories which might heavily rely on ship transportation and where geographic remoteness might lead to relatively high additional costs.

Note that the geographical scope of the EU MRV Regulation and the EP's Shipping EU ETS Proposal includes 100 % of all intra-EEA and extra EEA voyages, including in- and outgoing voyages. It also includes the emissions in EEA ports. Voyages to nine ports in EU outermost regions are also included in the scope of the EU MRV Regulation.[17]

In the context of the geographical scope, the **definition of a 'voyage'** and a 'port call' also plays an important role. The definition should be such that strategic behaviour is discouraged without losing sight of further consequences for the scope of the system. If for example the emissions on voyages from the last call at a non-EEA port to the first call at an EEA port fall within the scope of the system, then ships have an incentive to make an additional, strategic port call at a non-EEA port at a relative short distance to the destination EEA port. If however a port call only qualifies as a port call if ships actually load/unload cargo in a port, then an additional port call becomes less attractive due to the additional time and costs associated with the port call. At the same time, this means that emissions associated with the transportation of the goods from a non-EEA port to an EEA port can fall outside the scope of the system if a ship picks up cargo during a voyage which is for example common practice for container ships. In the EU MRV regulation, a 'port of call' is defined as a port where a ship stops to load or unload cargo or to embark or disembark passengers, while the EP's Shipping EU ETS Proposal suggests that a 'port of call' should defined as a port where a ship stops to load or unload *a substantial part* of its cargo or to embark or disembark passengers.

[17] According to Lloyd's Register (2018), port calls in the following nine EU outermost regions fall within the scope of the EU MRV Regulation: Açores, Madeira, Canarias, Guadeloupe, French Guyana, Martinique, Mayotte, Saint Martin and Réunion.

The degree of **openness of the system** together with the **stringency** of the maritime shipping **emissions cap** are major factors determining the compliance costs of the sector. The emissions cap for the shipping sector should be chosen such that the sector has an incentive to reduce its emissions and that there is an incentive to develop emission reducing technologies, but at the same time that the financial burden for the sector is not too high. Whether the sector will be allowed to use the other sectors' allowances for compliance and whether the other sectors are allowed to use shipping allowances for compliance will have an impact on the price of the shipping allowances and the sector's compliance costs. It should be noted in this context that aviation is currently allowed to use allowances for stationary installations (EUAs) for compliance whilst operators of stationary installations are not allowed to use aviation allowances (EUAAs) for compliance. The EP's Shipping EU ETS Proposal suggests that the EU ETS Directive should be amended to cover maritime emissions, but is not explicit with regards to the degree of openness of the system between the sectors.

When determining the maritime shipping emissions cap, the stringency of a potential future *global* GHG reduction measure should be kept in mind to avoid distortions. It can be expected that the EU ETS maritime shipping emissions cap will be determined based on the data collected under the EU MRV, but the selection of the baseline year/period and the translation of the global target(s) into a regional target is not straight forward. It is useful to use a baseline period instead of a baseline year since this allows to average out fluctuating effects. However, the representativeness of the years within the baseline period, also given the COVID-crisis, might be an issue. The IMO works with a baseline year of 2008, the EU MRV Regulation however only provides data from 2018 on.

The maritime shipping allowances can either be allocated as free allowances, can be auctioned, or a certain share of the allowances can be allocated for free while the remaining share is auctioned.

When determining the **initial allocation mode** for the maritime shipping allowances, several aspects have to be considered:

- When allowances are allocated for free, it has to be determined how many free allowances the different ships receive. In principle, a benchmark like the benchmark applied in aviation is conceivable for maritime shipping too. However, due to the heterogeneity of the sector, differentiated benchmarks (e.g. per ship type) are probably required. The trade-off between the administrative costs to determine and apply the different benchmarks and the sector's lower compliance costs when receiving free allowances has to be considered in this context.
- There should be a level playing field with the other sectors covered by the EU ETS, i.e. the same line of reasoning for the allocation of free allowances should be applied, like the risk of carbon leakage and the inability to pass compliance costs through. Carbon leakage may occur, if, due to EU ETS, sea transport was shifted to another transport mode, if ships outside the scope of the EU ETS (e.g. small ships) might carry out more transport work at the expense of ships inside the scope of the system, if less efficient ships are increasingly used outside the scope of the system or if goods transported by ships within the scope lose market share at the expense of goods transported outside the scope.
- The fluctuations of ship activities inside the scope of the system should be accounted as follows: a ship that is not sailing within the scope of the system in a specific year should not receive free allowances and be able to sell the allowances, due to the fact that the ship has been sailing inside the scope of the system in the base year/period. In general, the fluctuations of ship activities inside the scope of the system make it difficult to apply a benchmark to allocate free allowances comparable to the benchmark applied in aviation, which is based on a historical activity level of aircrafts.

The EP's Shipping EU ETS Proposal suggests that all maritime shipping allowances should be auctioned.

Should (a share of) the maritime shipping allowances be auctioned, the **entity/entities** that is/are **allowed to auction the allowances** has/have to be determined, as well as the amount of allowances that each of these entities is allowed to auction. The same principle as applied to aviation is conceivable here too. This would mean that a ship's administering Member State would be the according EU flag state and that non-EU flagged ships would be assigned to a Member State based on which routes they emit most in the reference year/period.[18] And to avoid that shipping companies with ships sailing different EU flags have to report to several administering Member States, an assignment on a company basis could be an option. The share of the shipping allowances that a Member State can auction, then, depends on the share of the emissions of the ships under its administration. Drawback of this approach could be that some countries with major ports might profit most.[19]

The EP's Shipping EU ETS Proposal suggests that at least 50 % of the revenues generated from auctioning should contribute to a Fund while the rest of the revenues stays with the Member States, with certain shares of the revenues being hypothecated to be used for specific aims. The allocation of the allowances over the Member States is not specified. When it comes to the **use of the revenues from auctioning**, some of the revenues might be used to stimulate the uptake of emission reduction measures in the sector or to compensate the sector for the additional costs. If this is the case, to avoid distortions, funds should also be available to shipping companies located outside the EU. The EP's Shipping EU ETS Proposal suggests in this context that the 'Commission shall engage with third countries with regard to how they can also make use of the Fund'.

Regarding the administrative costs of the system, the administrative requirements of other EU and **current/future global regulations** should be considered to avoid unnecessary costs. In this context it could also be efficient to exempt from the system **SMEs/small ships/ship types** with a small contribution to the emissions or to offer them an alternative compliance option. For ships that rarely call at an EEA port this might be useful too. Note that to limit the administrative burden for SME's and companies that are not frequently active within the scope of this Directive, the EP's Shipping EU ETS Proposal suggests contributions to an Ocean Fund as an alternative compliance option.

3.1.2. Aviation

As explained in more detail in the previous section on the maritime sector, fundamental design options for an ETS in the transport sector include:

- The types of emission species falling under the scheme: especially in aviation, climate impacts result not only from CO2 emissions but also, and as things stand even more, from non-CO2 emissions (see, e.g., European Commission, 2020d).
- The scheme's geographical scope: which routes are covered? (see below).

[18] If shipping is included into the EU ETS, then this has to be in a flag-neutral way. Changing flags would then have only administrative consequences.

[19] The auction shares of the aviation allowances are actually also rather unevenly distributed over the Member States. The share of Germany, Spain, Italy and France together accounts for almost 55 % (see Commission Decision (EU) 2020/2166 of 17 December 2020 on the determination of the Member States' auction shares during the period 2021-2030 of the EU ETS).

- The definition of affected operations: which transport services and aircraft types are covered on these routes? This aspect will be less of an issue as most types of operations are already included in the EU ETS and are likely to remain included also in a revised ETS.
- The baseline year, cap and any application of (e.g. linear) reduction factors: these have a direct cost impact because the lower the baseline year and cap, the higher the number of allowances to be bought from other sectors (see previous section on maritime transport).
- The initial allocation of allowances: the former also applies to the allocation method. The higher the share of auctioned (or otherwise paid-for) allowances, the higher the cash cost for the participating firms.
- The allocation of allowances to new entrants.
- The degree of openness of the system: as with the shipping sector, the degree to which aviation can use allowances from other sectors and vice versa will have an impact on the price of the aviation allowances and resulting compliance costs for the sector.

Other elements of importance include the definition of entities for the administration of the participating carriers, the use of revenues from auctioning, the consideration of alternative measures like blending quotas for alternative fuels or fuel taxes and the requirements for Monitoring, Reporting and Verification.

In the case of the ETS for aviation, which is already established and in operation, the forthcoming revision is unlikely to change the scheme's most fundamental settings, especially in the administrative context. It is also unlikely that the revision will contain concrete measures to integrate non-CO_2 emissions as those are more complex to measure and handle.

Hence, key issues more likely to be subject to the revision are:

- the scheme's geographical scope (e.g. integrating extra-EEA routes);
- the scheme's relationship with CORSIA;
- a reduction of the cap and/or a reduction of the share of free allowances (which would imply more auctioning).

As a consequence, we regard the following considerations as most relevant when it comes to a revision of the EU ETS for aviation and its potential economic impacts.

The **geographical scope** of the system is essential for its effectiveness at the global level, and it is closely related to the question of the **relationship with CORSIA**. Increasing the geographical scope of EU ETS for aviation is likely to increase the overall cost of aviation and – from a user perspective – air fares and air cargo rates, which again may impact demand and emission levels and incentivize airlines to supply aviation services in a more sustainable way.

The current EU ETS for aviation is restricted to intra-EEA services (plus the linking with Switzerland), of which all international routes are also subject to CORSIA. An extension to non-EEA routes, if legally feasible, would mean an even higher geographical overlap with CORSIA (see Table 2).

Table 2: EU ETS versus CORSIA – Geographical scopes and overlaps

	Intra-EEA domestic	Intra-EEA international	EEA – non-EEA	Overlap with CORSIA
CORSIA (as is)	Not covered	Covered	Covered (if participating)	
EU ETS reduced scope (as is)	Covered	Covered	Not covered	Intra-EEA int'l
EU ETS full scope	Covered	Covered	Covered	Intra-EEA int'l & EEA-non-EEA

Source: Authors' own table

A study by ICF Consulting et al. (2020) commissioned by the European Commission discusses several options for the relationship between the EU ETS and CORSIA. These include:

- return to the full EU ETS scope (incl. extra-EEA routes) without application of CORSIA;
- continuation of the current EU ETS scope (intra-EEA/EFTA) without application of CORSIA;
- CORSIA replaces the EU ETS; no regulation of EEA domestic emissions anymore;
- continuation of the current EU ETS scope (intra-EEA/EFTA) and application of CORSIA on routes to/from third countries;
- ETS continues in its current scope for emissions below the CORSIA baseline while CORSIA is applied to emissions exceeding the CORSIA baseline and on routes to/from non-EEA countries;
- continuation of the current EU ETS scope (intra-EEA/EFTA) for European operators and application of CORSIA for external operators and routes to/from third countries.

Other options could be to apply CORSIA as planned and the EU ETS only on EEA domestic flights, or to stop the EU ETS and to voluntarily extend CORSIA to domestic EEA flights (Maertens et al, 2019).

Apart from the relationship with CORSIA, another issue is the envisaged relationship with the UK ETS, with a linking agreement following the example of the EU/Swiss linking agreement. Given the increasing number of national emission trading schemes on a global scale, in the long-run also a further linking with such schemes could be envisaged (e.g. with the Korean ETS).

Other important elements are the definition of the future **cap** and of the **allocation of allowances** which strongly determine the compliance costs of the sector. As already explained in the previous section on maritime transport, emissions caps should be selected in a way that the sector has an incentive to reduce emissions and to develop emission reducing technologies, while it should be avoided that the financial burden for the sector is too high.

3.2. Examples of implications and obstacles, depending on design options

3.2.1. Maritime shipping

Definition of voyage and avoidance

The amount of emissions in the scope of the system depends to a large extent on the length of the voyage to an EEA port. This means that the definition of a voyage determines to a large extent the emissions within the scope of the system. The definition should limit to the extent possible the opportunities that shipping companies have to reduce emissions by making an additional port call just outside the scope of the EU ETS. This can be done, for example, by linking the voyage to the route of the cargo as defined in the bill of lading[20]. For ships with multiple bills of lading, like container ships, this is not an option, however.

Avoidance of the EU ETS by making additional port calls has implications for the emission reductions and for the competitiveness of ports. When ships make additional port calls, their incentive to reduce emissions is lower, and in addition, a mismatch between the number of allocated allowances and the emissions may be introduced. When ships make additional calls in ports (just) outside the EEA, this may increase the competitiveness of these ports vis-à-vis European ports as transhipment hubs or as manufacturing locations.

Allocation of shipping companies to Member States

Tramp ships do not sail on regular routes, by definition. This means that shipping companies which offer tramp shipping may have highly variable emissions under the scheme. Also, they may be active in one Member State in one year, and in another in the next year. This unpredictability makes it harder to allocate shipping companies to Member States in a similar way as in aviation.

Initial allocation of free allowances

Because tramp shipping companies have highly variable emissions within the system, free allocation in a similar way as is done in aviation will result in shipping companies having too many allowances in one year, while others face a shortage. This may have impacts on the competitiveness of shipping companies.

Another difficulty of free allocation is that the emissions per unit of transport work (typically a tonne of cargo transported over one mile, although for some ship types volume of cargo is more relevant than mass) vary significantly over ship types and ship sizes. Larger ships are more efficient than smaller ships, and container ships typically have higher emissions than bulk carriers or tankers of a similar size. Moreover, some ship types use a relatively high share of fuel for cargo heating, cooling, or handling. Ships sailing through ice have higher emissions than ships sailing in calm waters.

3.2.2. Aviation

Community (EEA) carriers compete with non-EEA carriers on many different routes, which can be regarded as relevant markets. Competitive distortion by a market-based measure like the EU ETS at the operational level can occur if carriers have to bear different levels of environmental related burdens on the same relevant markets. In addition, in a globalized world, EEA carriers may be less attractive for

[20] A bill of lading is a legal document issued by a carrier to a shipper that details the type, quantity and destination of the goods being carried. A bill of lading also serves as a shipment receipt when the carrier delivers the goods at a predetermined destination (Investopedia, 2021).

investors if they have – on average – to bear a higher environmental-related cost burden than airlines from outside the EU.

Route competition

It is not straightforward to identify relevant markets in air transport. Are different carriers flying from the same or a nearby airport, or from the same country, always competitors? There is no simple 'yes' or 'no' as answer, as this depends on the passenger's requirements. A passenger flying from Nice to London may only regard airlines offering this route as competitors, while another airline operating from Nice to Morocco may be of less relevance (as long as competition between destinations is not considered).

Competition on origin-destination (OD) level

However, things even get further complicated as air transport services can also be offered indirectly, via so-called hub or transfer airports. Imagine easyJet operating from Nice to London directly, while Air France offers indirect connections from Nice via Paris to London. In this case, both airlines could still be regarded as competitors, at least for the market volume of passengers who would accept to change planes. This shows that the consideration of direct routes only as relevant markets may not be sufficient.

For these reasons, when assessing the competitive impact of the current or an amended EU ETS on the Community carriers, it has to be clearly sorted out which origin-destination markets (as requested and booked by the passengers) they serve and if there are competing carriers on these markets, which may be more or less affected by the scheme.

Hence, when determining the geographical scope and the cap as well as the allocation of allowances, the risk of **carbon leakage** (which means apparent reductions in CO_2 emissions in the EEA or on EEA routes in exchange for increased emissions elsewhere) and the degree of **competitive distortion** should be assessed, considering the relevant markets. Passengers on connecting routings via the EEA may switch to alternative connections if fares increase, and carriers may implement so-called 'tankering' in uplifting extra fuel at intermediate stops at airports outside the EEA.

Competitive implications of key design options

We discuss the competitive implications of some key design options.

- Currently, with the EU ETS only being applied within the EEA, the risk of carbon leakage and competitive distortion in **intra-EEA traffic** is low as alternative routings between two EEA airports via a non-EEA airport are scarce. When CORSIA will be in operation or the EEA will be extended to extra-EEA routes, these issues will be even more marginal.

- On **extra-EEA routings**, the situation is more critical: If extra-EEA routes were covered by an EU ETS with a much stronger cap than the CORSIA baseline, routes via non-EEA airports close to the EEA would have a competitive advantage. E.g., most of a routing from the EEA via Istanbul to Bangkok would fall under CORSIA (the segment Istanbul-Bangkok), with just the shorter portion from the EEA to Istanbul being subject to the EU ETS, while a routing directly from the EEA to Bangkok would completely fall under the EU ETS and cause higher compliance costs.

- Another area where EEA carriers would have a competitive disadvantage compared to non-EEA carriers if a stronger EU ETS replaces – or even joined – CORSIA on international extra-EEA routes are **routes between extra-EEA territories via the EEA**. One common example here are flights between the USA and India where passengers have the choice between nonstop flights and indirect routings via airports in the EEA (like Paris or Frankfurt) and airports outside the EEA (like Dubai or Istanbul).

To assess and quantify the competitive impacts on a case study basis, ETS-related airline cost increases could be estimated on RPK basis or in relation to the airline’s total revenues. To quantify the cost increases, assumptions on the key design options of the revised EU ETS (geography, cap, auctioning share, etc.) and on, e.g., expected carbon prices will be required. For resulting changes in air fares and demand, assumptions for cost pass-through and applicable price elasticities would be needed, as was done, e.g., in a study by CE Delft and MVA Consultancy (2007) ahead of the initial introduction of the EU ETS for aviation.

4. CONCLUSIONS AND NEXT STEPS

4.1. General perspectives

The integration of maritime shipping into the EU ETS can have different economic and social impacts. Due to the compliance costs associated with the EU ETS, the costs of maritime transport/activities on routes within the scope of the EU ETS can be expected to increase. Some actor in the value chain will have to carry the additional costs and since the EU ETS is a regional and not global measure, the measure entails the risk of market distortions.

Depending on the according market of the transported products, shipping companies might see a reduced profit margin, or prices of the transported products might increase. The supplier of the products might therefore lose market share to the advantage of value chains outside the scope of the EU ETS which could have an indirect impact on the sector. An indication for the maximum product price increase due to EU ETS is the share of transportation costs in the product price, which can be expected to be higher for low value products.

Due to EU ETS, service and work vessels may have a competitive disadvantage if operating outside the scope of the system.

A potential shift from sea to road, rail or air transport due to EU ETS has to be considered too. A modal shift to other transport modes is, from a social perspective, however only an issue if the other modes of transport are subject to no, or to a less strict, environmental regulation.

4.2. Maritime shipping

Since maritime shipping is currently not included in the EU ETS, **various design options have to be considered** when the sector is included in the system. The impact on the sector's compliance costs and the associated economic and social impacts will thereby have to be weighed against the benefits. Design elements that are crucial for the potential economic impacts of the system are the geographical scope of the system, the initial allocation of the allowances and the stringency of the system.

The **geographical scope** of the system will have a major impact on both the environmental effect of the system and the compliance costs. When determining the geographical scope, attention should also be paid to the definition of a 'port call' and the impacts on outermost regions.

The carbon leakage potential should be assessed to determine the **share of free and auctioned allowances**. Carbon leakage may occur if sea transport was shifted to another mode of transport, if ships outside the scope of the EU ETS (e.g. small ships) might carry out more transport work at the expense of ships inside the scope of the system, if less efficient ships are increasingly used outside the scope of the system, or if producer of goods transported by ships within the scope of the system might lose market share at the expense of producers of goods transported outside the scope. The fluctuation of ships' annual emissions within the potential scope of the EU ETS of the sector and the heterogeneity of the fleet can be a challenge for certain design elements, like the **initial allocation of free allowances**. In contrast to the sectors that are currently included in the EU ETS, the emissions of many shipping companies in the scheme are expected to vary highly from year to year. A significant part of the shipping sector is tramp-shipping, meaning that the ships follow the cargo and sail unpredictable routes.[21] Moreover, the emissions per tonne-mile of ships of different types and sizes varies highly. As

[21] For liner shipping, mainly container ships are used – according to the Word Shipping Council (2021), 20 % of liner vessels are vessels other than container ships. From the approximately 100,000 vessels that are globally active, around 5 500 are container vessels (Clarksons Research, 2021).

a result, it may be a challenge to set up a historical activity baseline and issue free allowances on the basis of past activity.

The **stringency of the system** does not only depend on the emissions cap, but also on the degree of **openness of system** towards other sectors, i.e. the degree to which the sectors are allowed to use each other's emissions allowances for compliance. When determining the **emissions cap** for shipping, EU MRV data on historical emissions are crucial, but impact of COVID on historical emissions should be accounted for. And to avoid distortions, also potential targets of a future global MBM, in line with the IMO Initial Strategy, should be accounted for.

To minimize the **administrative costs** of the system, the high number SME's in the sector, and also the overlap/divergence with a potential future global GHG reduction measure should be accounted for.

4.3. Aviation

Market structure

The EEA aviation sector can roughly be divided into the **liberalized intra-EEA market** and **various extra-EEA markets**. Within the EEA, direct point-to-point flights by pan-European, 'homeless' low cost carriers compete with network carriers which have a strong market presence on flights to and from their hubs, usually the European capitals. Between the EEA and third countries, traffic flows generated by the European hub carriers via their hubs compete with direct or indirect routes from extra-EEA carriers. Key hubs outside the EEA through which these carriers route their traffic are London and Zürich in Europe, North American gateways like New York or Atlanta and Middle Eastern hubs like Dubai, Doha and Abu Dhabi. In addition, Turkish Airlines and Aeroflot have strongly increased their presence in the EEA from where they route passengers through Istanbul and Moscow, respectively.

Competitive implications of the current EU ETS

Key aviation activities so far covered by the EU ETS are **intra-EEA flights**. The socio-economic and competitive effects of the existing ETS are limited as all intra-EEA routings, both by low cost and network carriers, fall under the scheme. Moreover, a switch to non-EEA carriers usually makes no sense as detours would become too long (except for few routings via non-EEA hubs, e.g. from Greece via Istanbul to Northern Europe).

On **extra-EEA routes**, the situation is different as routings via EEA hubs fall partly under the EU ETS while routings via non-EEA hubs or direct routings do not fall under the EU ETS in its current, reduced scope. A routing from Lisbon via Athens to Beirut is hence relatively more affected by the EU ETS than a non-stop flight to Beirut or a routing via Istanbul. In the years to come, without any EU ETS revision, this competitive distortion would however weaken over time as CORSIA will require airlines to purchase an increasing number of offsets for their emissions, exceeding 2019 levels on most international routes. Both the Lisbon-Beirut direct flight and the routing via Istanbul will then fall under CORSIA.

Revised EU ETS design options

Key **design options** of a revised ETS, which can have further impact, e.g., on the competitive and hence socio-economic situation of EU carriers and on carbon leakage, include the scheme's geographical scope (which routes are covered?), the baseline year(s), cap and allocation of allowances, and the relationship with CORSIA.

Competitive implications of a revised EU ETS

The competitive impacts of a revised EU ETS depend on the actual design proposed by the Commission.

In any case, the CORSIA baseline (2019) is larger, i.e. less ambitious, than the EU ETS cap (2004-2006). Hence, routings from, to or via the EEA would have a competitive disadvantage compared to routes solely via non-EEA airports. This would especially be the case if the EU ETS was extended on extra-EEA flights. A routing via Istanbul or Dubai to Asia would only partly fall under the EU ETS (namely the portion to/from the EEA), while a non-stop flight or a flight via an EEA hub would fully be covered by the EU ETS.

As a result, European (hub) carriers could struggle to keep pace with their non-EEA counterparts, such as neighbouring Turkish Airlines or the Gulf carriers. This could result in employment and gross-value added (not only at the airline but also at, e.g. airport, maintenance provider and air navigation service provider levels) being shifted abroad.

4.4. Next steps

In the further course of the project and based on the Commission proposal expected for July 2021, the current analysis will be deepened, including the following elements:

- An analytic overview of the revised ETS legislative framework and an analysis and evaluation of the relevance and appropriateness of the market indicators selected for the legislative impact assessment;
- The identification of implementation issues, challenges and obstacles and the associated impacts/trade-offs and solutions;
- An assessment of the consequences of the inclusion of the sectors into the EU ETS on competitiveness and employment, considering environmental policies in force among extra-EU top players;
- The identification of policy actions to counterbalance identified, unintended market effects leading to competitive disadvantages and detailing the way forward for strengthening the EU players.

The analyses will be mainly based on literature review, case study analysis and calculations, and on stakeholder interviews, and will be available in fall.

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ANNEX: EU/EEA AVIATION AND SHIPPING MARKET

Maritime shipping: general characteristics

Ship types/sizes and operational profiles

The commercial maritime shipping fleet[22] can be divided into three main categories of ships. First, ships that carry cargo or passengers or a combination thereof; second, work and service vessels; and third, fishing vessels.

There is a whole range of different types of cargo carrying ships[23]. These ships are designed to carry a specific category of cargo, but in many cases are still flexible to carry different specific types of cargo within this category. To give an example: dry bulk ships are designed to carry dry bulk cargo (cargo category), but are able to carry different types of dry bulk cargo such as grain, coal, iron ore, etc.

Smaller cargo carrying ships are mainly used for coastal/short sea shipping, while larger ships are generally engaged in ocean going voyages. Some of the cargo carrying ships operate on fixed routes and according to fixed time schedules (liner trade) while others are used flexibly according to demand (tramp trade). Many larger cargo ships operate all over the world.

Ships that transport passengers can be divided into two main categories: ferries and cruise ships. Ferries operate on fixed routes and according to fixed time schedules whereas cruise ships have annually scheduled routes which can vary highly between years.

Examples for work and service vessels are dredging vessels, offshore supply vessels or pilot boats. Work, service and fishing vessels in general have a specific home port, but work and service vessels might not call on a regular basis at this home port. This means that their activity within the scope of a regional measure can vary highly between years.

The maritime shipping fleet is thus quite heterogeneous and the ships that are calling at EU/EEA ports can differ highly between years.

Responsible entities

Some cargo carrying ships are owned and operated by the same entity, whilst others are owned and operated by different entities[24]. This has to be considered for the allocation of legal obligations and their enforceability.[25]

What is also characteristic for the shipping market is that there are many shipping companies that own only a small number of ships[26], while a relatively small share of shipping companies own a relatively large fleet. As Table 3 illustrates, the largest shipping companies located in EU-27 countries own more than 200 ships each.

[22] Next to commercial vessels, there are navy vessels and pleasure crafts which are not considered in this context.

[23] In the Fourth IMO GHG Study (CE Delft at al., 2020), eleven different main categories of cargo carrying ships are differentiated.

[24] Ships can be chartered. Depending on the charter contract, the responsibilities are differently distributed between owner and charterer. Ships can be chartered for short, but also for long periods of time (like several years).

[25] The current EU MRV Regulation designates companies as responsible person; company thereby means the shipowner or any other organisation or person, such as the manager or the bareboat charterer, which has assumed the responsibility for the operation of the ship from the shipowner.

[26] According to Clarksons Research (2021), there are around 4,030 EU shipping companies, 400 of which own more than 10 ships while around 2,090 of which own one ship only.

Table 3: Top-10 shipping companies located in EU-27 countries (in terms of number of ships owned)

	Number of ships owned	Main vessel type owned	Nationality
MSC	241	Container	Switzerland
Maersk	233	Post-Panamax Container	Denmark
Bourbon Offshore	198	Offshore Supply	France
Scorpio Tankers	127	Crude/Products Tanker	Italy
Briese Schiffahrts GmbH & Co. KG	127	General Cargo	Germany
Star Bulk Carriers	119	Bulker	Greece
Wagenborg Shipping	114	General Cargo	Netherlands
Oldendorff Carriers	111	Bulker	Germany
Hapag-Lloyd Cont	110	Post-Panamax Container	Germany
CMA CGM	102	Post-Panamax Container	France

Source: Clarksons Research (2021)

Carbon/energy efficiency

The maritime shipping fleet is relatively heterogenous and the energy consumption and energy efficiency of the different ship types also varies greatly. The energy efficiency of ships depends on many factors, such as the respective technical efficiency of the ships, their size, operational factors (such as speed) and environmental conditions, which can vary structurally between shipping routes and seasons. As a consequence, the operational energy efficiency of ships sailing to and from EEA ports can be expected to vary between voyages and the annual operational energy efficiency of the ships may vary between years too.

Economic contribution of sector

Data on the economic contribution of the EU shipping sector is rather uncertain and varies in the literature, also due to the use of different delimitations of the sector. A broad delimitation of the maritime transport sector also includes upstream and downstream sectors, like the shipbuilding and equipment industry, ports, etc. Some of this industry, like for example the shipbuilding industry, is only partially located in the EU.[27] The EU Blue Economy Report 2020 (European Commission, 2020a)

[27] The majority of ships is currently built in China, Republic of Korea, Japan, and the Philippines.

provides an overview of economic key indicators not only for EU maritime transport, but also for EU shipbuilding and repair as well as EU port activities.

Table 4: Economic key indicators for parts of the EU blue economy in 2018

	Maritime Transport	**Shipbuilding and repair**	**Port activities**
Gross value added (*billion EUR*)	35.6	17.3	35.2
Gross profit (*billion EUR*)	18.8	4.7	14.6
Turnover (*billion EUR*)	173.2	59.2	91.4
Persons directly employed in sector	407 525	319 315	549 340

Source: European Commission (2020a)
Note: Maritime transport includes passenger transport, freight transport, and services for transport; shipbuilding and repair includes shipbuilding, ship equipment and machinery; port activities include cargo handling, warehousing and storage, construction of water projects and service activities incidental to water transportation (the latter probably also including services to inland navigation).

Since ships operate worldwide, the turnover, gross value added and gross profit of the sea transport/maritime transport sector can be expected to be also depended on ship activities not related to the EU.

Competition with other modes of transport

Shipping companies compete with each other and compete with other transport modes for the transportation of goods and passengers. In general, it holds that maritime shipping costs are relatively low compared to other transport modes, but the competitive pressure from other transport modes can vary greatly depending on the segment. Maritime transport competes with road freight transport, if at all, on intra-EEA voyages only and also only competes for the transport of goods that can be transported by trucks. For coal, for example, road transport is not an option.

For some ferry or cruise passengers, flying can be an alternative. Regarding cargo, air transport is, due to the higher transportation costs, only an option for relatively high-value products. Grain, for example, is not transported by air. Rail transport can be an alternative for the transportation of cargo, with a gradual expanding long-distance network from Asia to Europe. This allows to reduce transportation time, but the capacity is, compared to shipping, relatively low and infrastructure costs can be expected to be relatively high.

Fleet monitored under EU MRV

Regulation (EU) No 2015/757 requires ships above 5 000 GT that carry cargo and or passengers to monitor, report and verify (MRV) their CO_2 emissions on voyages to and from EEA ports and in EEA ports (for further information on the regulation please see section 3.1.2)

According to European Commission (2020b), the fleet monitored under the EU MRV Regulation in 2018, consisted of 11 653 ships, performing 400 000 voyages and travelling 323 million nautical miles within the scope of the regulation.

The monitored fleet emitted in 2018 more than 138 million tonnes of CO_2 emissions under the scope of the regulation. 62 % of the emissions were related to extra-EEA voyages, 32 % to intra-EEA voyages and 6 % to ships at berth in an EEA port. With a share of 30 %, container ships were the ship type with the highest CO_2 emissions within the monitored fleet.

Close to 2 000 shipping companies reported data in 2018. Around half of these shipping companies are European. In terms of GT[28], EU companies own more than 50 % of the monitored fleet and around two-thirds of the monitored ships are non-EU flagged.[29]

The 2013 impact assessment (SWD(2013) 237 final) of the EU MRV Regulation (European Commission, 2013a) assesses that by applying a ship size threshold of 5 000 GT, at least 99 % of Small and Medium Sized Enterprises in the shipping sector are not concerned by the regulation. And if the thirteen main ship types and vessels of at least 5 000 GT are covered, the number of ships included is reduced to 56 % of the total number, representing around 90 % of the total EU related CO_2 emissions of maritime shipping.

A comparison of the monitored fleet in 2019 and 2018 shows[30] that of the around 12 200 ships monitored in 2019, around 9 390 were and around 2 810 ships were not part of the monitored fleet in 2018.

IVL and University of Gothenburg (2020) have analysed the data as published for the EU MRV fleet as monitored in 2018. The analysis confirms that the average energy efficiency differs highly between ship types.[31]

Maritime shipping: larger international market

Fleet

In 2018 the world fleet consisted of around 119 626 ships of 100 GT and above, emitting around 1 056 million tonnes of CO_2 (CE Delft et al., 2020). CO_2 emissions reported in the EU MRV system represented thus around 13 % of the global maritime shipping CO_2 emissions.

Since large ships operate worldwide, one cannot identify a fleet that structurally operates on EU-related routes – a comparison between an EU-related and a global fleet is thus only possible for a specific period of time.

Competition

Maritime shipping is a service sector potentially being impacted by, and having an impact on, the competition for the goods that are being transported by the sector. If, for example, the demand for crude oil from a certain region increases, then the demand for the transport of crude oil by ships from this region will also increase. On the other hand, maritime shipping transportation can have an effect on the prices of the transported products and thus on their competitiveness. The latter effect however highly depends on the share of the shipping costs in the overall price of the product. Statistics on seaborne exports and imports provide an insight into the products that are transported to and from the EU by ships.

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28 Shipping statistics are either in terms of number of ships or in terms of the carrying capacity of the ships, measured in GT or dwt.

29 Merchant ships have to register in a country. The ships sail under the flag of this country and are obliged to comply with the national laws of this country.

30 Own comparison based on the emissions report data as published by EMSA in February 2021.

31 To give an example, the median of the average CO_2 emissions per transport work of container ships amounts to around 20 g CO_2 per tonne nautical mile, while for bulker ships to around 8.5 g CO_2 per tonne nautical mile.

Table 5 gives an overview of the five types of goods with the highest share in value of extra-EU seaborn imports and exports in 2019, together accounting for 31 and 26 % of the total value of extra-EU seaborn imports (EUR 1 116 billion) and exports (EUR 921 billion) respectively.

Table 5: Types of goods with highest share in value of extra-EU seaborne imports and exports in 2019

Extra-EU seaborne imports		**Extra-EU seaborne exports**	
Type of good	**Share in total value**	**Type of good**	**Share in total value**
Crude oil	17.1 %	Motor cars and other motor vehicles designed for the transport of < 10 persons	11.2 %
Petroleum oils and oils obtained from bituminous minerals (excl. crude)	5.8 %	Petroleum oils and oils obtained from bituminous minerals (excluding crude)	6.9 %
Motor cars and other motor vehicles designed for the transport of < 10 persons	4.2 %	Parts and accessories for specific vehicles	3.4 %
Petroleum gas and other gaseous hydrocarbons	1.9 %	Specific medicaments	3.1 %
Telephone sets	1.5 %	Specific alcohols	1.2 %

Source: Eurostat (DS-1262527), HS2-4-6, 4-digit code classification

EU seaborne exports and imports accounted in 2018 for 17 and 20 % of the world seaborne exports and imports (European Commissions, 2020b). In terms of value, seaborne extra-EU imports and exports accounted for around 55 and 47 % of the total value of extra-EU imports and exports in 2018 (Eurostat, DS-1262527).

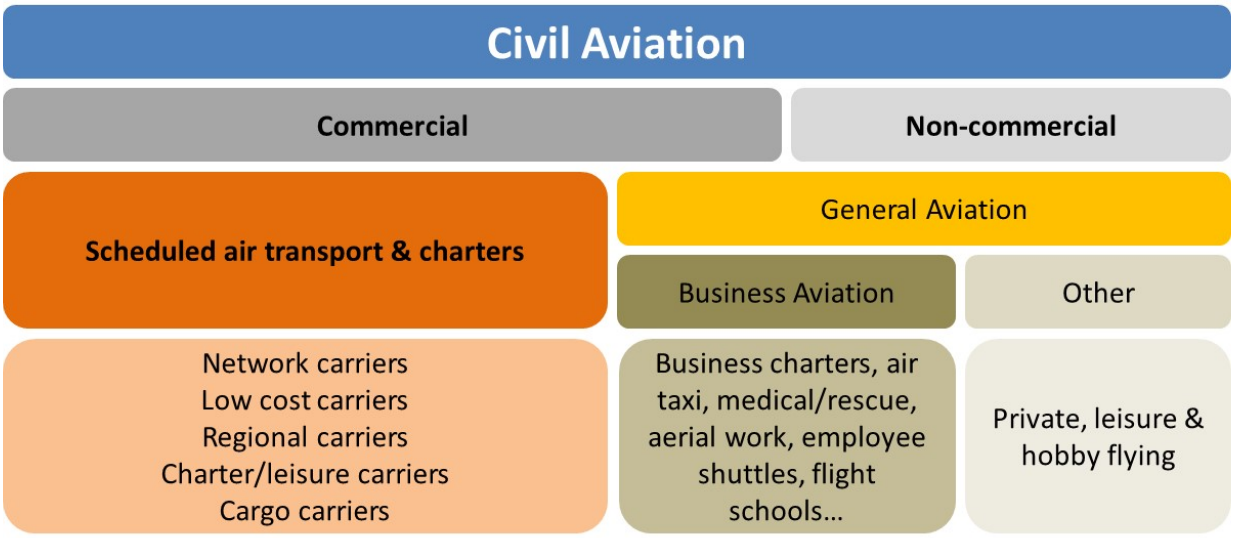
Some work and service vessels compete for work and services on a global level. Dredging vessels of EU companies are for example being hired for coastal development projects in other parts of the world.

Aviation: general characteristics and business models

Market segments

The aviation sector consists of a number of different market segments and business models which spread over commercial and non-commercial activities, as is summarized in Figure 3.

Figure 3: Civil aviation market segments



Source: Authors' own illustration

Business models in scheduled passenger air transport

Network carriers

Scheduled air transport is the largest and most relevant aviation segment. In passenger traffic, the network carrier (NC) and the low cost carrier (LCC) business models prevail. While these business models have been converging in recent years, there are still fundamental differences when it comes to, e.g., the network design and the pricing structure (Table 6).

Network carriers like Air France, Alitalia, Finnair, Iberia, KLM, LOT, Lufthansa, SAS or TAP operate so-called **hub-and-spoke** networks where they route all passengers from, to or through a central node, the hub. Both **'local' and 'indirect' passengers** travel in the same aircraft. The former fly from a spoke to the hub or vice versa, while the latter travel from a spoke to another spoke, via the hub where they change planes.

This way, economic benefits can be achieved. NC are less dependent on local point-to-point demand as they fill their aircraft both with local, point-to-point passengers and with indirect or transfer passengers coming from different origins or flying on to different destinations. All this allows network carriers to operate relatively **dense networks** at **high frequencies** and often also larger airplanes, especially on long-hauls. However, this comes at a cost in a way that a large number of passengers has to change planes and to take two or more flights to get to their destination, causing **higher specific emissions**. Another drawback of the hub-and-spoke system is **high capacity utilization at the hubs** in peak times, caused by 'waves' of arriving and departing flights. So-called **slot allocation** systems are in operation in Europe and other parts of the world which allocate scarce airport slots (time slots for take-offs and landing determined by an airport's infrastructure and other factors) to the airlines. Hereby, grandfather rights have led to a situation where incumbent (usually network) carriers can manage to hold their slots as long as they use 80 % (this minimum usage rate has in the meantime been reduced to accommodate for the effects of the Pandemic) of them in each schedules period, making it difficult for new entrants (often low cost carriers) to access larger (hub) airports.

Table 6: Key business models in European passenger air transport

	Network carriers	**Low cost carriers**
Network structure	Hub-and-spoke from few hub airports	Point-to-point between various bases and non-base airports
Geographical scope	Worldwide	Europe and vicinity
Fleet structure	Mixed fleet of short-, medium- and long-haul aircraft	Homogenous fleet of just one short-haul aircraft type or family
Inflight service	Complementary snacks/drinks at least on long-hauls	Snacks/drinks à la carte at extra cost
Travel class(es)	Economy, Business; sometimes also Premium Economy or First	Usually Economy only
Fares	Complex pricing based on, e.g. advance booking, length of stay, rebooking options	Simple, dynamic one-way based pricing

Source: Authors' own table
Note: A base is a home airport where aircraft, staff and technical services are based.

Network carriers offer **short, medium- and long-haul services** from their hubs and interconnect with their alliance partners based in other countries and world regions, which allows them to offer their passengers **large networks at the global scale**. They operate a **complex, booking-class based fare structure** where discount fares are usually subject to, e.g., advance booking rules or minimum stay requirements at the destination. In addition, they usually offer **two or more service classes**, from Economy to First, especially on longer routes.

Low cost carriers

Low cost carriers like easyJet, Eurowings, Ryanair, Volotea or Wizz Air usually do not offer transfers at hubs. They rely entirely on **local point-to-point** demand and are able to operate at much **lower average cost** as they route all passengers directly, which also causes **lower specific emissions**. To fill their planes, they have to operate at much **lower average frequencies** per route, meaning less choice for business travellers in terms of departure times. Also, they usually offer **one service class** with a low seat pitch, allowing them to sell more seats per flight, which brings average cost and CO_2 (and other) emissions further down. Pricing-wise, LCC usually offer **simple one-way fares** only which increase with increasing load factor.

Low cost carriers usually only operate **homogenous fleets** of single-aisle aircraft like Airbus A319/A320/A321 or Boeing 737-800, while Network Carriers require mixed fleets consisting of short-, medium and long-haul aircraft.

LCC focus on **short- to medium-haul services** from a large number of **base and non-base airports**. In the case of Europe, LCC like easyJet, Ryanair or Wizz Air connect many airports all over Europe and in Europe's vicinity, like e.g. Morocco.

The large number of bases and departure airports allows **pan-European** LCC to be **more flexible than NC** as they can relatively easily switch their aircraft between bases and routes, all of which have only a relatively small market share within the carriers' operations, while the NC are bound to their hubs. For example, Amsterdam-Schiphol accounts for about 50 % of all passengers of KLM, as it is the airline's single hub, while the biggest airport in the Ryanair network, London Stansted, only represented 7.8 % of Ryanair's total passenger numbers in 2019. This means Ryanair is less locked-in at its key airports and hence more flexible in terms of network adjustments.

Air Cargo

Air cargo is transported in dedicated cargo aircraft or in passenger aircraft as belly freight and is typically characterised by high-value goods. Table 7 gives an overview of the types of goods with the highest share in value of extra-EU imports and exports by air in 2019. In terms of total value, extra-EU imports and exports by air accounted for around 23 and 31% of total extra-EU imports and exports in 2019 (Eurostat, DS-1262527).

Table 7: Types of goods with highest share in value of extra-EU airborne imports and exports in 2019 (descending order)

Extra-EU airborne imports		Extra-EU airborne exports	
Type of good	**Share in total value**	**Type of good**	**Share in total value**
Gold	13.7 %	Medicaments	9.3 %
Telephone sets	10.0 %	Human blood, animal blood, antisera, vaccines, toxins and cultures of micro-organisms	8.2 %
Turbojets, turbopropellers and other gas turbines	8.1 %	Turbojets, turbopropellers and other gas turbines	6.6 %
Automatic data-processing machines	6.0 %	Gold	3.8 %
Electronic integrated circuits	4.3 %	Electronic integrated circuits	3.2 %

Source: Eurostat (DS-1262527), HS2-4-6, 4-digit code classification

Economic contribution

The most relevant actors further upstream or downstream in the air transport value chain are the aircraft manufacturers, the airport operators, ground handlers and air navigation service providers (ANSPs) (all upstream) as well as the global distribution systems, tour operators and travel agents (downstream).

Data on the economic contribution of the EU air transport industry and its upstream industries are available from Eurostat.

Table 8 provides an overview of economic key indicators for air transport, airport and ANSPs services, repair and maintenance, and aircraft manufacturing. Aircraft manufacturing includes not only the production for the EU air transport industry but for the entire global market. In addition, it includes not only the production of civil passenger and cargo aircraft but also of military aircraft. Therefore, just a part of EU aircraft manufacturing is related to EU commercial air transport.

Table 8: Economic key indicators for parts of the EU aviation industry in 2018

	Air transport	Airport and ANSP services	Repair and maintenance	Aircraft manufacturing
Gross value added (*billion EUR*)	29.9	28.9	5.2	38.5
Gross profit (*billion EUR*)	8.5	14.5	1.4	10.5
Turnover (*billion EUR*)	123.2	48.0	18.5	161.0
Persons directly employed in sector	296964	267 585	68 249	356 594

Source: Eurostat (sbs_na_1a_se_r2; sbs_na_ind_r2)

Note: Airport and ANSP services correspond to the industry sector 'service activities incidental to air transportation' as defined by the NACE Rev. 2 classification.

Aviation: air transport activities subject to MRV under the EU ETS

Currently, only flights within the EEA as well as flights from the EEA to Switzerland are covered by the EU ETS (so-called reduced scope until 2023), whereas a full inclusion of EEA aviation into EU ETS would mean that extra-EEA flights (flights from EEA countries to third countries other than Switzerland and vice versa) would also have to be included in the system.

Unlike the maritime sector, the monitoring, reporting and verification of greenhouse gas emissions from aviation in the context of the EU ETS is laid down in Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012.

In brief, Directive 2003/87/EC – in its most current version – applies to all flights which depart from or arrive in an EEA Member State (even though actual allowances are in the currently applied reduced scope regime only needed for intra-EEA flights), except for those listed under Annex 1. Exemptions include 'small' aircraft, 'small' and 'non-commercial' operators, certain flights under the rules of public service obligations (PSO), and governmental, military, search & rescue, firefighting, humanitarian and medical service flights as well as circuit, VFR, training and research, check and testing flights.

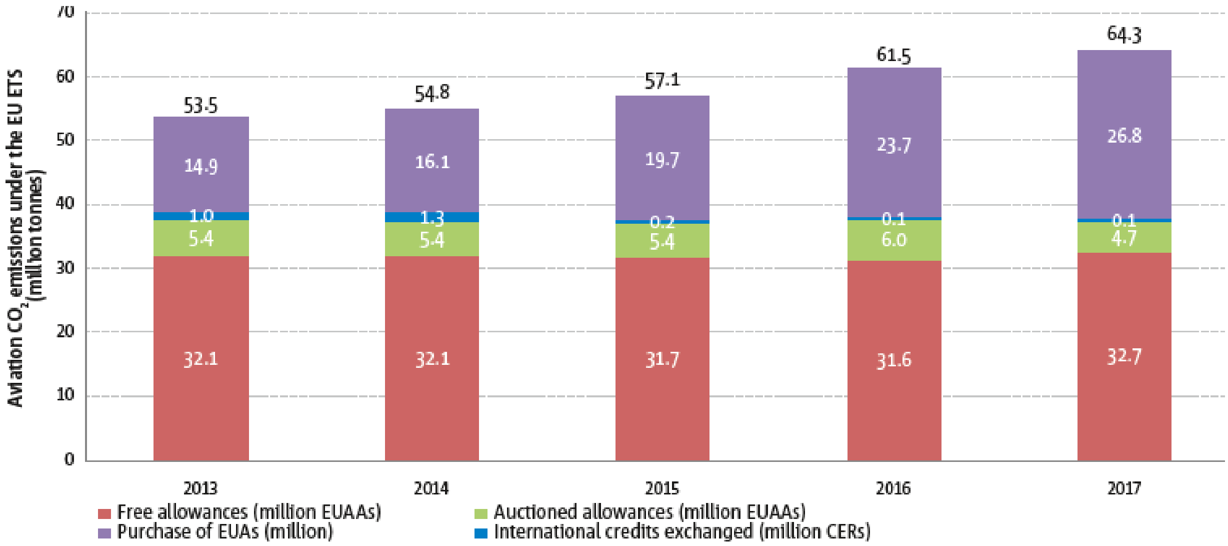
As a consequence, Commission Implementing Regulation (EU) 2018/2066 requires operators to monitor, report and verify their CO_2 emissions from all non-excluded flights to and from EEA airports and aerodromes. Guidance document 'The Monitoring and Reporting Regulation – General guidance for Aircraft Operators' (European Commission, 2018) supports the implementation of Regulation 601/2012 in providing in-detail guidance on the monitoring and reporting process (scope, compliance cycle, monitoring approaches for emissions and tonne kilometre data, biofuel determination, small emitters, monitoring plans, etc.).

EEA-based carriers are administered and monitored by the relevant authority of the country that issued their operating licence, while those based outside the EEA are administered by the most relevant EEA state in terms of the operator's emissions in the base year. The most current list of aircraft operators subject to the EU ETS along with the administering Member States is provided in Commission Regulation (EU) 2021/662 of 22 April 2021. However, a large part of these carriers does not regularly operate into the EEA area.

In the year 2017, according to EASA's latest European Aviation Environmental Report from 2019, 677 aircraft operators, of which more than 200 non-European ones, actually operated under the scope of the system (EASA, 2019).

In 2017, these operators emitted some 64.3 million tonnes of CO_2 covered by the EU ETS in its current, reduced scope. For 37.5 Mt, operators could use EU Aviation Allowances (with an auctioning share of 15 %), while for the remaining 26.8 Mt operators had to purchase EU Allowances from other sectors (Figure 4). Expected operator costs for the purchase of these allowances amount to EUR 189 million for 2017, which equals 0.3 % of total operating costs within the scope of the EU ETS (EASA, 2019).

Figure 4: Aviation CO_2 emissions under the EU ETS in 2013-2017



Source: EASA (2019)
Note: 1 EUAA or EUA equals 1 tonne of CO_2

EEA aviation in the international context

The EEA plays a relatively minor role in the global aviation sector. According to the Sabre MI database, which publishes air transport demand data based on booking data from reservation systems and statistical sources, 30 % of all passengers in 2019 departed from an EEA airport and just 11.5 % flew within the EEA, i.e. under the current scope of the EU ETS. In other words: almost 90 % of all air passengers in 2019 flew not within the EEA, and 70 % entirely outside the EEA.

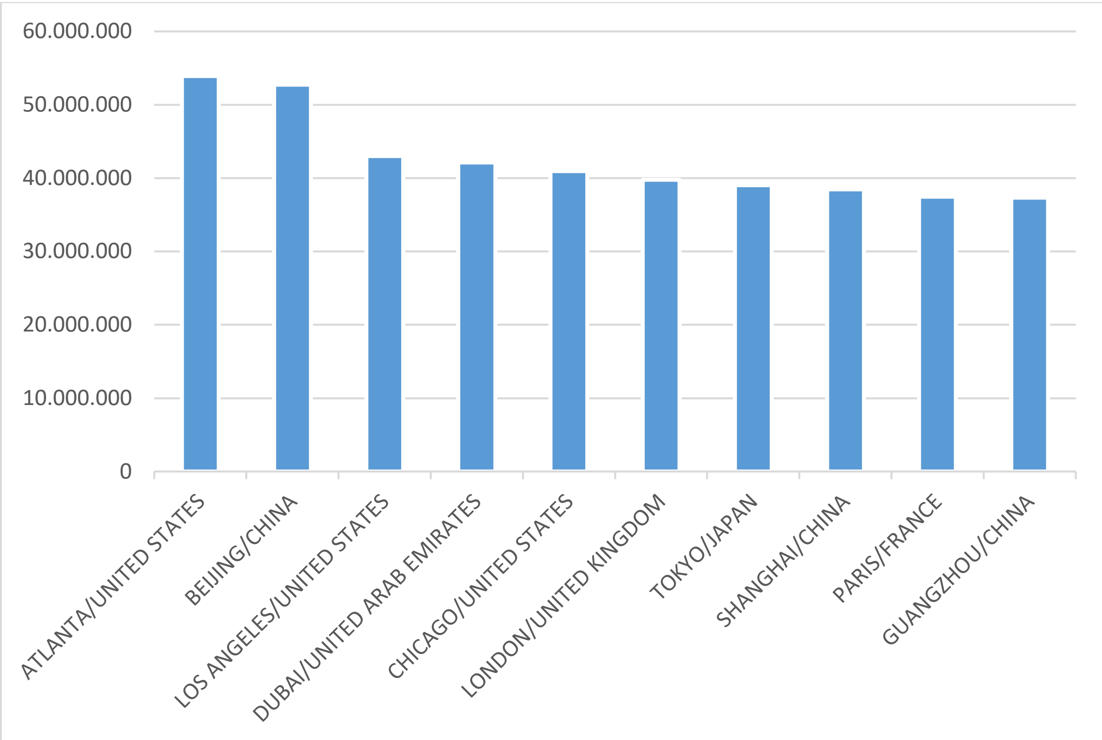
Table 9: EEA passenger share in international aviation (2019)

	Total (billion)	% of worldwide total
Departing passengers worldwide	4.6	100 %
Departing passengers from EU (without UK)	1.33	29 %
Departing passengers from EEA (without UK)	1.38	30 %
Departing passengers flying within EEA (without UK)	0.53	11.5 %

Source: Sabre MI database

With Paris Charles de Gaulle, according to Sabre MI figures, just one of the largest ten airports in 2019 is located in the EEA, in Western Europe only joined by London Heathrow. Three airports among the largest ten are in the United States (Atlanta, Los Angeles, Chicago), three in China (Beijing, Shanghai, Guangzhou), one in the UAE (Dubai), and one in Japan (Tokyo Haneda).

Figure 5: Top 10 airports worldwide, 2019 (number of departing passenger in millions)



Source: Sabre MI database

Accordingly, most of the largest airlines in the world are also based outside Europe. If ranked by passenger numbers, the only European airlines in the Top 10 are Ryanair and easyJet, along with airlines from the USA, China, and India. If ranked by revenues passenger kilometres (RPK), taking in account also the distances flown, only Ryanair reaches the global Top 10, along with carriers from the USA, UAE, China and Qatar.

Table 10: Top 10 airlines worldwide, 2019 (number of passenger and RPK)

#	Airline Name	Passengers	Airline Name	RPK (millions)
1	Southwest Airlines (USA)	166 388 753	Delta Air Lines (USA)	349 233
2	Delta Air Lines (USA)	162 654 234	United Airlines (USA)	339 278
3	American Airlines (USA)	154 906 318	American Airlines (USA)	338 229
4	Ryanair (Ireland)	122 848 116	Emirates (UAE)	292 481
5	China Southern Airlines (China)	117 059 802	Southwest Airlines (USA)	210 980
6	United Airlines (USA)	115 674 382	China Southern Airlines (China)	193 794
7	China Eastern Airlines (China)	109 666 187	Qatar Airways (Qatar)	169 660
8	easyJet (UK)	92 358 969	China Eastern Airlines (China)	161 949
9	Air China (China)	76 563 160	Ryanair (Ireland)	159 071
10	Indigo (India)	74 517 428	Air China (China)	156 375

Source: Sabre MI database

This paper gives an initial overview of the market structure in a revised EU ETS for the European aviation and maritime sectors, and related implications. Key design options like the scheme's geographical scope, the baseline year(s), cap and allocation of allowances, and – in the case of aviation – the relationship with CORSIA, can have impacts on the competitive situation of EU carriers and vessels.

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