Climate Change Mitigation in the Aviation Sector: A Critical Overview of National and International Initiatives

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Abstract
Climate change mitigation calls for the limitation and reduction of greenhouse gas (GHG) emissions across all sectors. However, limiting GHG emissions from aviation has proven to be problematic for technical reasons (e.g., lack of low-carbon alternatives) as well as legal reasons (e.g., international aviation does not readily fall within any one state’s jurisdiction). Relevant initiatives have followed two streams. At the international level, the International Civil Aviation Organization (ICAO) has adopted technical standards and, more recently, a market-based mechanism to limit emissions from international civil aviation. In parallel, states have adopted their own policies and measures to regulate emissions from both domestic and international aviation, ranging from tax and technical standards to traffic management and infrastructural development. While much of the literature on climate change mitigation in the aviation sector has focused on international efforts, this article reveals the importance of understanding the tensions and complementarities of the two streams.

Keywords: Climate change mitigation, Civil aviation, ICAO, CORSIA, National regulation

1. INTRODUCTION
States have agreed that anthropogenic emissions of greenhouse gases (GHG) are altering our climate system in dangerous ways.1 Accordingly, they have agreed on the need...
for broad international cooperation on climate change mitigation.\(^2\) Achieving the 2°C and 1.5°C targets,\(^3\) or carbon neutrality, in the second half of the century\(^4\) requires substantive mitigation achievements across all sectors. However, mitigation action in the aviation sector raises considerable technological and legal challenges. On the one hand, there is no demonstrated, scalable alternative technology for transporting people and goods rapidly over long distances without affecting the climate system. On the other hand, there is no consensus on how to allocate responsibilities for reducing international aviation emissions among states. As a result of this perfect storm, GHG emissions in the aviation sector have increased more quickly and more steadily in the last three decades than in almost any other sector; no state has achieved a durable, absolute reduction in GHG emissions from civil aviation.\(^5\)

This article explores the policies and measures that have been implemented to regulate civil aviation emissions.\(^6\) It includes a doctrinal analysis, complemented with comparative and critical perspectives building on an interdisciplinary literature, in order to assess the effectiveness of existing developments and consider the potential for further action. It shows that, despite the greater attention they have generally received,\(^7\) the initiatives adopted under the International Civil Aviation Organization (ICAO) are only part of a broader picture, and perhaps not the main part. Another major stream of action on climate change mitigation in the aviation sector consists of policies and measures adopted by states, ranging from carbon pricing (direct or indirect) and technical standards (such as aircraft efficiency and renewable-fuel content) to air-traffic management and infrastructure development.

These two streams may appear to be unrelated: while the ICAO addresses international civil aviation,\(^8\) one could expect that each state would seek only to address GHG emissions within its own territory\(^9\) – that is, emissions from domestic aviation. In reality, however, climate treaties (with the historical exception of the Kyoto

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\(^2\) Ibid., Art. 2.
\(^4\) Ibid., Art. 4(1).
\(^5\) See Section 2.1 below.
\(^6\) Military aviation raises similar technological issues but different regulatory challenges, as attribution to a state is generally unproblematic (with the notable exception of emissions from multilateral operations).
Protocol) leave it essentially for each party to decide whether its national policies and measures on climate change mitigation are to address the GHG emissions from international transportation. Some national policies and measures do regulate GHG emissions from international civil aviation or apply indiscriminately to domestic and international aviation. However, even when they apply only to domestic aviation, national actions may interact with international civil aviation, for instance, by achieving economies of scale on the deployment of more efficient aircraft or by causing carbon leakage when less efficient aeroplanes are redeployed. As such, devising effective efforts to reduce the climate impact of aviation requires close coordination between national and international efforts.

This article has two complementary objectives. Firstly, it documents the international and national streams of mitigation action. It shows that the focus on ICAO initiatives is misplaced: thus far, international initiatives have failed to deliver tangible benefits, while national initiatives have been (partially) successful. Secondly, the article highlights the interactions between the two streams. In so doing, it illustrates the need to think about climate law beyond the traditional divide between national and international law, through what could be called a ‘transnational’ analysis. The decarbonization of the aviation sector does not depend entirely on international or national action, but on the way in which the two interact.

The article is organized as follows. Section 2 flags the unique technological and legal challenges to climate change mitigation in the aviation sector. Sections 3 and 4 identify, respectively, international and national initiatives adopted to date. Section 5 analyzes the relations between these two streams.

2. AVIATION AND CLIMATE CHANGE MITIGATION

This section exposes the stakes and challenges of climate change mitigation in the aviation sector. It documents the sector’s increasing climate impact before identifying the technological and regulatory challenges faced by any initiatives aimed at reducing this impact.

2.1. GHG Emissions from Aviation

Aviation is of particular concern for climate change mitigation for three reasons. Firstly, its impact on the climate system is significant. Data compiled by the Organisation for Economic Co-operation and Development (OECD) suggests that civil aviation resulted in 883 megatonnes (Mt) of carbon dioxide (CO2) emissions in 2018, two-thirds of which from international flights. Aviation CO2 emissions represent about 2.4% of

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11 See Section 2.3 below.
global anthropogenic CO\textsubscript{2} emissions\textsuperscript{14} However, these numbers do not account for all of aviation’s climate impact: beside CO\textsubscript{2}, aircraft produce short-term radiative forcers (such as nitrous oxide and soot particles) and contrails, the climate impact of which is significant, albeit relatively poorly understood\textsuperscript{15}. Recent studies suggest that the non-CO\textsubscript{2} climate impact of aviation may exceed its CO\textsubscript{2} impact\textsuperscript{16}, especially on a short-to-medium-term horizon\textsuperscript{17}. When all factors are taken into account, in one estimate aviation contributes to ‘roughly 5% of the total anthropogenic warming’\textsuperscript{18}.

Secondly, the climate impact of aviation is increasing more rapidly than that of almost any other sector. OECD statistics show that aviation’s global CO\textsubscript{2} emissions increased by 28\% from 2013 to 2018\textsuperscript{19}. According to data from the International Energy Agency (IEA), emissions from international aviation increased 2.9 times from 1980 to 2017, compared with 1.9 times for overall CO\textsubscript{2} emissions from fuel combustion\textsuperscript{20}. Aviation emissions have increased markedly more quickly than emissions from other modes of transportation\textsuperscript{21}. Measures taken in response to the COVID-19 pandemic have led to emissions reductions, which, however, are not expected to alter long-term trends\textsuperscript{22}. Air traffic is predicted to increase several fold during the first half of the 21st century, which, despite market-driven fuel-efficiency gains, will significantly increase the sector’s climate impact\textsuperscript{23}.

Thirdly, states are yet to find ways to reduce significantly the climate impact of aviation, especially with regard to international flights. While much of the increase in

\textsuperscript{14} Our calculation based on 2018 global GHG emissions (including land use, land-use change and forestry activities) from CAIT Climate Watch, available at: https://www.climatewatchdata.org.


\textsuperscript{17} See P.A. Arias et al., ‘Technical Summary’, in Masson-Delmotte et al., n. 16 above, pp. 35–144, at 102, Figure TS.20.

\textsuperscript{18} Grewe, Matthes & Dahlmann, n. 15 above, p. 1.

\textsuperscript{19} OECD, n. 13 above.


\textsuperscript{22} Lee et al., n. 16 above, p. 15.

aviation emissions results from the economic development of emerging economies, developed countries have not demonstrated the possibility of decoupling the sector’s growth from its climate impact. Emissions from domestic aviation of the European Union (EU) (namely, within a Member State) decreased by 13% from 2000 to 2018, which is broadly in line with the EU’s 16% reduction in CO₂ overall emissions during that period; however, emissions from international civil aviation departing from the EU (including flights between Member States) increased by 51% during that same period. Following a comparable pattern, CO₂ emissions from domestic aviation in the United States (US) decreased by 9% from 2005 to 2018, while emissions from international flights departing from the US increased by 34%. Overall, emissions from international flights departing from the developed country parties listed in Annex I to the United Nations Framework Convention on Climate Change (UNFCCC) more than doubled between 1990 and 2018.

2.2. The Technological Challenge

Instead of structural changes, policies and measures have frequently focused on efficiency gains in aircraft design, air traffic management, and ground service equipment. These measures are partly economically driven, as they achieve fuel savings and reduce delays. Yet, these economic gains suggest that such measures could produce a ‘rebound effect’ whereby lower prices would allow airlines to meet additional demand and extend activity, thus even potentially increasing their climate impact. At any rate, none of these measures shows a clear path towards a deep decarbonization of the aviation sector.

24 Between 2013 and 2018, the CO₂ emissions of domestic aviation in China, India, and Indonesia increased respectively by 57%, 82%, and 52%, according to OECD, n. 13 above.
27 N. 1 above.
31 Sims et al., n. 21 above, p. 614.
Despite contrary suggestions from industry associations, societies have yet to come up with realistic, long-term plans for climate-neutral modes of rapid, long-distance transportation. Other modes of transportation (such as high-speed rail) provide realistic alternatives only to short-haul flights, whereas long-haul flights are responsible for most of the sector’s climate impact. Reliance on biofuel or hydrogen, or attempts to offset aviation emissions, would face challenges of their own. On the one hand, the production of biofuel is likely to require large spans of arable land, thus competing with food production or otherwise hindering the large-scale deployment of bioenergy with carbon capture and storage as a negative emissions technology. On the other hand, producing clean hydrogen fuel would require substantial amounts of energy, which is unlikely to be economically available. Overall, sustainable aviation fuels would only slightly reduce the non-CO₂ climate impacts of aviation. As such, the only known way to substantially reduce aviation’s climate impact in the long term appears to involve a limitation, and possibly a reduction, in aviation activities, an option that faces considerable political challenges.

2.3. The Regulatory Challenge

States have not been able to agree on a formula to allocate responsibility for the climate impacts of international civil aviation. Responsibilities could be attributed, for instance, on the basis of the state of departure, arrival or overflight, the nationality of the passengers or of the consumers of the cargo, the country of registration of the aircraft, or the nationality of the airline or that of the aircraft-leasing company. Achieving a political consensus is shown to be impossible because any of these criteria would have important implications for the interests of some states, for instance, because


40 Grewe, Matthes & Dahlmann, n. 15 above; Bock & Burkhards, n. 15 above; Lee et al., n. 16 above.

they host international aviation hubs, register large airlines, or rely disproportionately on international tourism or trade.\(^42\)

Climate treaties have never formally defined, as a matter of principle, the geographical scope of states’ general substantive obligations on climate change mitigation. Confusion often arises between the scope of two distinct obligations under the UNFCCC: the procedural obligation to communicate national GHG emissions inventories following methodologies agreed by the Conference of the Parties (COP)\(^43\) and the substantive obligation to implement ‘programmes containing measures to mitigate climate change’.\(^44\) With regard to the former, the COP has agreed to the use of inventory guidelines adopted by the Intergovernmental Panel on Climate Change (IPCC),\(^45\) which build on the assumption that each party should generally report the emissions that are generated within its territory, or, when this would not be practical, from the combustion of fuel sold within its territory.\(^46\) As an exception, these guidelines suggest that international aviation and shipping emissions ‘are to be excluded … from national totals’ and ‘should be reported separately’.\(^47\) On the other hand, nothing in the UNFCCC implies that the latter, substantive obligation on climate change mitigation would be limited to the emissions that the party must inventory and report.

The Kyoto Protocol imposed quantified emissions limitation and reduction commitments on Annex I parties for two commitment periods from 2008 to 2020.\(^48\) For the purpose of accounting for this quantified commitment, the Protocol relied on the IPCC inventory guidelines,\(^49\) excluding emissions from international bunker fuels. The Protocol sought to address this gap by requiring each Annex I party to pursue regulation of international civil aviation through the ICAO.\(^50\) The exclusion of international civil aviation from the scope of quantified commitments under the Kyoto Protocol does not necessarily imply that these emissions are excluded from the scope of the general mitigation obligation under the UNFCCC, nor does the commitment of Annex I parties to pursue an arrangement at the ICAO exclude international civil aviation from the scope of UNFCCC negotiations. Nothing in the UNFCCC or the Kyoto

\(^42\) By contrast, road vehicle emissions are attributed to the state in which fuel is purchased, even though the fuel may be consumed abroad, on the ground that the difference ‘is expected to be small’: J.T. Houghton et al. (eds), Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (vol. 1, 1996), ‘Overview’, p. 5.

\(^43\) UNFCCC, n. 1 above, Art. 12(1)(a).

\(^44\) Ibid., Art. 4(1)(b).


\(^47\) Houghton et al., n. 42 above, ‘Understanding the Common Reporting Framework’ s. 1.4. See also C.D. Waldron et al., ‘Mobile Combustion’, in Eggleston et al., n. 46 above, vol. 2, s. 3.6.


\(^49\) Kyoto Protocol, n. 10 above, Art. 5(2).

\(^50\) Ibid., Art. 2(2).
Protocol creates or implies any obligation for states not to regulate emissions from international aviation.\textsuperscript{51}

In fact, the COP continued to express concern for international aviation emissions after the adoption of the Protocol. When the COP observed that the GHG emissions of Annex I parties had generally decreased during the 1990s, it also expressed concern that their international aviation emissions had increased by more than 40%.\textsuperscript{52} In 2011, the COP agreed ‘to continue its consideration of issues related to addressing emissions from international aviation’.\textsuperscript{53} No conclusion can be drawn from the absence of any mention of aviation in the Paris Agreement, as this treaty does not contain sector-specific provisions.\textsuperscript{54} The Agreement requires states to communicate and pursue nationally determined contributions (NDCs)\textsuperscript{55} involving ‘economy-wide’ action (at least for developed country parties),\textsuperscript{56} but it does not specify whether this includes international aviation. Consistently, some parties have expressly included international civil aviation within the scope of their successive commitments, pledges and strategies communicated under the UNFCCC and the Paris Agreement.\textsuperscript{57}

\section*{3. THE INTERNATIONAL STREAM}

This section explores the international initiatives negotiated under the aegis of the ICAO and assesses their limitations.

\subsection*{3.1. ICAO Initiatives}

Negotiations on mitigation in the aviation sector have been convened by the ICAO, an international organization created by the Chicago Convention on International Civil Aviation,\textsuperscript{58} which subsequently became a UN specialized agency.\textsuperscript{59} The two main

\begin{itemize}
\item \textsuperscript{52} Decision 1/CP.9, National Communications from Parties Included in Annex I to the Convention, UN Doc. FCCC/CP/2003/6/Add.1, 22 Apr. 2004, para. 2(c), available at: https://unfccc.int/documents/3606.
\item \textsuperscript{55} Paris Agreement, n. 3 above, Art. 4(2).
\item \textsuperscript{56} Ibid., Art. 4(4).
\item \textsuperscript{57} See references below nn. 109–112.
\item \textsuperscript{58} Chicago Convention, n. 8 above, Art. 43.
\end{itemize}
organs of the ICAO involved in the negotiations are the Assembly of all 193 member states and the Council of 36 elected member states. The Council may adopt and amend ‘international standards and recommended practices and procedures’ (SARPs) dealing with various aspects of international civil aviation, which are designated as Annexes to the Chicago Convention ‘for convenience’. While SARPs are not directly legally binding, a member state is obligated to notify the ICAO if it will not comply with a SARP.

Despite the absence of an express mandate on environmental protection in the Chicago Convention, the Assembly has long sought to ‘maintain the initiative in developing policy guidance’ on environmental matters in the aviation sector so as ‘not [to] leave such initiative to other organizations’, and the Council has adopted SARPs that address noise and local air pollution. Consistently, since climate change has been identified as a global concern, the Assembly has sought to keep sectorial mitigation initiatives under the organization’s purview. However, it was only in the late 1990s that the Assembly started to envisage the adoption of ‘policy options to limit or reduce’ GHG emissions from civil aviation (including ‘technical solutions’, ‘market-based measures’, and ‘operational measures’). Not before 2007 did it call upon the Council to ‘examine the potential for carbon offset mechanisms’. Since 2010, ICAO negotiations have led to the definition of aspirational goals, the adoption of technical standards, and the creation of a global market-based instrument.

Firstly, the Assembly defined two aspirational goals in 2010. One goal is to achieve 2% global fuel-efficiency improvement per year; the other is to ‘keep … the global net carbon emissions from international aviation from 2020 at the same level’. However, as the Assembly emphasized, these goals do not ‘attribute specific obligations to individual states’.

Secondly, following a 2013 Assembly Resolution, the Council adopted fuel-efficiency standards in 2017. Similar to Council standards on noise and local

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60 Chicago Convention, n. 8 above, Art. 50(a).
61 Ibid., Art. 37.
62 Ibid., Art. 54(1).
66 ICAO Assembly Resolution A29-12 (1992), para. 2.
68 ICAO Assembly Resolution A33-7 (2001), App. H para. 3(b)–(c).
70 ICAO Assembly Resolution A37-19 (2010), para. 4.
71 Ibid., para. 6.
72 Ibid., para. 5.
73 ICAO Assembly Resolution A38-18 (2013), para. 33(e).
air pollution, these SARPs apply to new types of aircraft (from 2020) and to new aeroplanes (from 2028), but not to aircraft the airworthiness of which has previously been approved. The 2019 Assembly asked the Council to consider updating these standards.\(^7^5\)

Thirdly, a 2016 Assembly Resolution led the Council to create a market-based mechanism in 2018.\(^7^6\) This mechanism – the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) – seeks to make up for any increase in international aviation emissions from 2020\(^7^7\) onwards by requiring airlines to acquire and cancel emission units from eligible emissions reduction projects. CORSIA starts with a ‘pilot phase’ (2021–23) and a ‘first phase’ (2024–26) to which states are invited to participate on a voluntary basis. It is only from its ‘second phase’ (2027–35) that CORSIA will be applicable to all member states other than least-developed countries, small-island developing states, and landlocked developing countries.\(^7^8\) In each phase, offsetting requirements apply only to international flights between participating states.\(^7^9\) The offsetting requirements are calculated initially on the basis of the evolution of global aviation emissions and allocated to each airline in proportion to its emissions. From 2030 onwards, some weight will gradually be given to the evolution of the airline’s emissions, creating a stronger marginal incentive for each airline to limit its emissions.\(^8^0\) The Council will review the implementation of CORSIA every three years from 2022.\(^8^1\)

The Assembly has taken note of – but not endorsed – the goal, promoted by some industrial associations, of reducing the CO\(_2\) emissions of international air transport by 50% by 2050, compared with 2005 levels.\(^8^2\) Instead, the Assembly has agreed only on a ‘global aspirational goal of keeping the global net CO\(_2\) emissions from international aviation from 2020 at the same level’,\(^8^3\) an objective that CORSIA seeks to achieve.

### 3.2. Limitations

The ICAO has played a limited role in addressing climate change. Throughout the 1990s member states raised doubts over ‘the extent to which civil aviation contributes to’ climate change; despite the growing recognition of the need for a precautionary

\(^{75}\) ICAO Assembly Resolution A40-18 (2019), para. 21(a).

\(^{76}\) ICAO Assembly Resolution A39-3 (2016), paras 5, 6; ICAO, *Annex 16 to the Convention on International Civil Aviation: Environmental Protection*, Vol. IV (2018). For a detailed account of the negotiations, see Ahmad, n. 7 above, Ch. 6.


\(^{78}\) ICAO Assembly Resolution A39-3 (2016), para. 9; ICAO *Annex 16 Vol. IV*, n. 76 above, s. II.3.1.3(b).

\(^{79}\) ICAO Assembly Resolution A39-3 (2016), para. 10.

\(^{80}\) ICAO *Annex 16 Vol. IV*, n. 76 above, s. II.3.2.

\(^{81}\) ICAO Assembly Resolution A40-19 (2019), para. 9 (g).

\(^{82}\) ICAO Assembly Resolution A37-19 (2010), Preamble para. 22.

\(^{83}\) ICAO Assembly Resolution A40-18 (2019), para. 6.
approach in international environmental law forums, they contended that the need for policymaking on climate change mitigation within the aviation regime had ‘to be based on information which is as complete and accurate as possible’. To date, the ICAO continues to ignore the non-CO2 impacts of aviation, presumably on the ground of lack of ‘complete’ information. While recognizing the importance of regulating aviation emissions in 2007, the Assembly also highlighted the need not to lose ‘sight of their proper context in assessing overall GHG emissions’ from other sectors. Six years later, the Assembly was still expressing concerns that international aviation could be unfairly ‘targeted’ as a source of climate finance. After the Copenhagen Accord and the Cancun Agreements defined the objective of holding global warming ‘below’ 2°C above pre-industrial temperatures, and suggested the need to consider the subsequent adoption of a 1.5°C target, the ICAO Assembly only noted a somewhat watered-down objective that global warming ‘ought not to exceed 2°C’.

From the early 1990s to the mid-2010s, the ICAO pre-empted sector-specific negotiations under the climate regime and opposed ‘unilateral’ measures, while defining no concrete commitments. On the contrary, the Assembly reaffirmed a policy recommendation for ‘the reciprocal exemption from all taxes levied on fuel taken on board by aircraft in connection with international air service’ and for the reduction or elimination of ‘taxes related to the sale or use of international air transport’. This recommendation was at odds with the growing expectation that states would phase out such fossil-fuel subsidies throughout the economy.

The measures that the ICAO did eventually take were immediately viewed as rather ineffective. The EU Member States and the European Civil Aviation Conference criticized the aspirational goals adopted by the Assembly in 2013 for failing to account for the non-CO2 impacts of aviation. In the same vein, the US and Canadian agencies concluded that the fuel-efficiency standards adopted by the Council were ‘technology

84 ICAO Assembly Resolution A29-12 (1992), Preamble para. 3. See also Resolution A31-11 (1998), App. F Preamble para. 3. But see UNFCCC, n. 1 above, Art. 3(3).
85 ICAO Assembly Resolution A40-18 (2019), Preamble para. 6; but see references at nn. 15–18 above.
87 ICAO Assembly Resolution A38-18 (2013), para. 30.
89 ICAO Assembly Resolutions A37-19 (2010), Preamble para. 9; A38-18 (2013), Preamble para. 9 (emphasis added).
93 See references at nn. 179–180 below.
following standards’ which would ‘not result in reductions in fuel burn and GHG emissions’.\footnote{Supplementary information on ‘Control of Air Pollution from Airplanes and Airplane Engines: GHG Emissions Standards and Test Procedures’ (2021) 86(6) Federal Register, p. 2136, at 2164, available at: https://www.govinfo.gov/content/pkg/FR-2021-01-11/pdf/2020-28882.pdf. See also Regulatory Impact Analysis Statement to the Regulation Amending the Canadian Aviation Regulation (CO2 Emissions), SOR/2020-251, (2020) II.154(25) Canada Gazette, p. 3348, available at: https://gazette.gc.ca/rp-pr/p2/2020/2020-12-09/pdf/g2-15425.pdf.}\footnote{See ICAO, ‘CORSIA States for Chapter 3 State Pairs’, Sept. 2021 (listing 107 states participating in the pilot phase, including the United States and most European states, but not China, India, and Russia).} CORSIA is the only ICAO initiative so far that could possibly achieve tangible mitigation outcomes. Yet, it has major limitations. Firstly, it is not intended to (and will not) lead to a deep decarbonization of the aviation sector. Secondly, it ignores aviation’s non-CO2 climate impacts. Thirdly, it does not aim to \textit{reduce or limit} international aviation CO2 emissions but only to \textit{offset} any increase. Fourthly, as at late 2021, several major players had not indicated their intention to participate in the pilot and first phases.\footnote{See D. Rosenbloom et al., ‘Why Carbon Pricing Is Not Sufficient to Mitigate Climate Change – and How “Sustainability Transition Policy” Can Help’ (2020) 117(16) Proceedings of the National Academy of Sciences of the United States of America (PNAS), pp. 8664–8; D. Cullenward & D.G. Victor, Making Climate Policy Work (Polity, 2020), p. 8.} Fifthly, state compliance remains uncertain, all the more given the last-minute adoption of essential modalities of implementation and the relatively convoluted, opaque, and altogether rather ‘ambiguous’ legal status of SARPs.\footnote{Additionality refers to the condition that emissions reduction units correspond to emissions reductions that would not have been achieved in a counter-factual business-as-usual scenario; see J.M. Allwood et al., ‘Glossary, Acronyms and Chemical Symbols’, in Edenhofer et al., n. 21 above, pp. 1249–79, at 1251.} Sixthly, the incremental incentive that CORSIA would ideally create for emissions reduction is – at least in some analyses – unlikely to induce technological innovation.\footnote{Additionality refers to the condition that emissions reduction units correspond to emissions reductions that would not have been achieved in a counter-factual business-as-usual scenario; see J.M. Allwood et al., ‘Glossary, Acronyms and Chemical Symbols’, in Edenhofer et al., n. 21 above, pp. 1249–79, at 1251.} Seventhly, experience with international transfers of mitigation outcomes, in particular as offset credits, suggests that the complete environmental integrity of emissions reduction projects is unachievable in practice as a result of difficulties in ensuring the additionality of such projects,\footnote{Double-counting occurs when a unique mitigation outcome is considered at the same time as an offset unit and as the implementation of a distinct mitigation commitment (e.g., an NDC); see L. Schneider et al., ‘Double Counting and the Paris Agreement Rulebook’ (2019) 366(6462) Science, pp. 180–3, at 181.} avoiding double-counting,\footnote{Double-counting occurs when a unique mitigation outcome is considered at the same time as an offset unit and as the implementation of a distinct mitigation commitment (e.g., an NDC); see L. Schneider et al., ‘Double Counting and the Paris Agreement Rulebook’ (2019) 366(6462) Science, pp. 180–3, at 181.} and preventing carbon leakage,\footnote{Carbon leakage occurs when emissions reduction in one place results in an increase in emissions somewhere else: Allwood et al., n. 99 above, p. 1265.} among other things.\footnote{See S. Becken & B. Mackey, ‘What Role for Offsetting Aviation Greenhouse Gas Emissions in a Deep-cut Carbon World?’ (2017) 63 Journal of Air Transport Management, pp. 71–83, at 75; C. Lyle, ‘Beyond the ICAO’s CORSIA: Towards a More Climatically Effective Strategy for Mitigation of Civil-Aviation Emissions’ (2018) 8(1–2) Climate Law, pp. 104–27, at 115; S. Maertens, W. Grimm & J. Scheelhaase, ‘ICAO’s New CORSIA Scheme at a Glance: A Milestone towards Greener Aviation’, in Fichert, Forsyth & Neimeier, n. 35 above, pp. 117–29, at 124. See also T.A.P. West et al., ‘Overstated Carbon Emission Reductions from Voluntary REDD+ Projects in the Brazilian Amazon’ (2020) 117(39) PNAS, pp. 24188–94; Cullenward & Victor, n. 98, p. 27.} Eighthly, by financing offsetting projects, CORSIA could create a perverse incentive for states to refrain from making ambitious commitments on climate change
mitigation in order to present ‘additional’ projects subsequently as income-generating offsetting.\textsuperscript{103}

In conclusion, the ICAO has patently failed to exercise leadership in mitigation action in international civil aviation over the last three decades. This lack of leadership is perhaps unsurprising given the ICAO objective of ensuring ‘the safe and orderly growth of international civil aviation’,\textsuperscript{104} which has limited its focus to ‘policy options that will reduce aircraft emissions without negatively impacting the growth of air transport’.\textsuperscript{105} Beyond some incremental cost-saving efficiency improvements (which need no or minimal policy incentives and, at any rate, could be counter-productive),\textsuperscript{106} effective action would inevitably impose some constraint on the sector. One may even argue that achieving substantial mitigation outcomes in international civil aviation implies the need to reconsider the objective of the sector’s continued growth.\textsuperscript{107}

4. THE DOMESTIC STREAM

Without waiting for the ICAO, many states have taken the initiative of adopting and implementing their own policies and measures. This section documents the six main types of initiative that they have taken.

4.1. National Targets

States have adopted various quantified pledges and commitments on climate change mitigation under climate treaties. These targets, especially those communicated by developed country parties, are increasingly expected or required to be ‘economy-wide’.\textsuperscript{108} While it is largely understood that domestic aviation ought to be included in such targets, some parties have extended them to international aviation. The EU 2020 pledge under the Cancun Agreements\textsuperscript{109} and its 2030 NDC under the Paris Agreement\textsuperscript{110} encompass emissions from the entire journey of any departing international flights.

In addition to NDCs, the Paris Agreement invites parties to communicate long-term low-GHG emissions-development strategies (LTS).\textsuperscript{111} Parties whose NDC does not address international civil aviation have sometimes considered taking a different

\textsuperscript{103} See Cullenward & Victor, n. 98 above, p. 27.
\textsuperscript{104} Chicago Convention, n. 8 above, Art. 44(a).
\textsuperscript{105} ICAO Assembly Resolution A36-22 (2007), App. K Preamble para. 6. See also Resolution A39-2 (2016), para. 3(b).
\textsuperscript{106} On the rebound effect, see n. 32 above.
\textsuperscript{108} See text at n. 56 above.
\textsuperscript{110} EU, First NDC, updated 17 Dec. 2020, p. 9; all NDCs are available at: https://www4.unfccc.int/sites/NDCStaging. See also EU, Fourth Biennial Report under the UNFCCC (2019), p. 43, available at: https://unfccc.int/documents/228427.
\textsuperscript{111} Paris Agreement, n. 3 above, Art. 4(19).
approach when devising their LTS. Switzerland decided that its 2050 net-zero emissions target would encompass emissions from departing international flights.\textsuperscript{112} New Zealand established a statutory process to consider, by 2024, the inclusion of international aviation in its LTS.\textsuperscript{113} After the United Kingdom (UK) communicated its LTS,\textsuperscript{114} the government announced its intention to review it to include international aviation. A formal commitment is yet to be made,\textsuperscript{115} but Scotland’s own net-zero carbon target already covers international aviation emissions.\textsuperscript{116} On the other hand, among the states whose LTS does not include international aviation, some have pledged to ‘keep emissions from [international aviation] in mind when assessing the achievement of climate targets’\textsuperscript{117} and affirmed a commitment to ‘international regulation’ in the sector.\textsuperscript{118} Regrettably, no LTS has outlined a realistic plan for the decarbonization of aviation; instead, those that discuss the evolution of aviation emissions tend to speculate on unproven technological fixes (such as biofuel,\textsuperscript{119} hydrogen,\textsuperscript{120} and electricity),\textsuperscript{121} or ‘other measures which will drastically reduce emissions’.\textsuperscript{122}

\section*{4.2. Technical Standards}

Various states have adopted technical standards on aircraft fuel efficiency and renewable-fuel content. National standards on fuel efficiency generally reflect the SARPs adopted by the ICAO Council in 2017.\textsuperscript{123} Whereas the Chicago Convention applies only to international civil aviation, national measures typically extend the same standards to domestic civil aviation, thus ensuring the interoperability of aircraft.


\textsuperscript{113} Climate Change Response (Zero Carbon) Amendment Act 2019, No. 61, s. 8 (New Zealand).

\textsuperscript{114} LTS of the UK (2018), p. 144.


\textsuperscript{116} Climate Change (Scotland) Act 2009, s. 16.


\textsuperscript{118} LTS of Denmark (2020), p. 139.


\textsuperscript{120} LTSs of Denmark (2020), p. 116; Portugal (2019), p. 36.


\textsuperscript{122} LTS of Fiji (2019), p. 35.

The adoption of national fuel efficiency standards has not always been a simple top-down process of implementing ICAO decisions. Several states were already considering the adoption of national standards before the Council 2017 decision.124 A US Court of Appeal held in 2011 that the Environmental Protection Agency (EPA) had to make ‘endangerment findings’ under the Clean Air Act with regard to GHG emissions from aircraft engines.125 As such, the EPA was bound to adopt national fuel-efficiency standards notwithstanding the ICAO’s ‘initiative’ (presumably an attempt of the ICAO to pre-empt national measures). While the ICAO standards imposed no additional efforts on airlines,126 one cannot exclude the possibility that home-grown standards could have been stringent.

By contrast, standards on renewable-fuel content are entirely home-grown, apply only to some countries, and vary significantly. For instance, Norway introduced in 2020 a 0.5% biofuel-content requirement for aviation fuels.127 To date, the EU has left it for each Member State to decide in which economic sector to promote the use of renewable energy (for instance, sustainable fuels), acknowledging ‘the current technological and regulatory constraints that prevent the commercial use of biofuels in aviation’.128 Several Member States are considering the adoption of a national biofuel-content standard or supporting the adoption of a pan-EU standard.129 Some biofuel-producing countries have also been actively supporting research and development on sustainable aviation fuels.130

In July 2021, the EU Commission proposed a Regulation which would impose a minimum sustainable-fuel content of 2% by 2025, increasing progressively to 63% by 2050.131 With this Regulation the EU is seeking to exercise global leadership by driving economies of scale on the production of ‘sustainable aviation fuel’. The Commission’s Explanatory Memorandum highlights both the likelihood of ‘[s]pill-over effects … whereby third countries may consider adopting similar

126 See references at n. 95 above.
measures and the need for ‘intensified efforts of the EU and its Member States’ to establish a global mandate for sustainable aviation fuel at the ICAO. However, many questions remain about the sustainability of such large-scale production of biofuels and synthetic fuel and, more generally, about the non-CO₂ climate impacts that these fuels would not avoid.

4.3. Carbon Pricing

Many jurisdictions have adopted multi-sectoral carbon-pricing instruments ranging from simple taxes to more complex cap-and-trade mechanisms. Some jurisdictions have extended the application of these instruments to domestic and, more rarely, international aviation. For instance, British Colombia’s carbon tax applies to the purchase of aviation fuel, while Canada imposes a federal carbon charge on the use of aviation fuels in provinces that lack their own carbon-pricing policy. Multi-sectoral cap-and-trade mechanisms have been applied to aviation emissions in the EU, South Korea, New Zealand, Switzerland and the UK. Half of China’s pilot emissions trading schemes (implemented by local governments) included some aviation emissions, and the national government has considered including domestic civil aviation in the scope of a national scheme, although not in its initial phase. By contrast, California (US) and Quebec (Canada) do not include aviation emissions within their cap-and-trade mechanisms.

Applicable carbon-pricing instruments are typically limited to intra-jurisdictional flights, for instance, within New Zealand or within South Korea. Similarly, the carbon tax of the Canadian province of British Colombia applies exclusively to flights.
within the province, whereas Canada’s federal charge applies only to flights that take place within or between listed provinces subject to the Pan-Canadian carbon-pricing regulation (for instance, Ontario). As such, flights between two jurisdictions that are individually subject to their own carbon-pricing instruments (such as from New Zealand to South Korea, or from British Columbia to Ontario) are not covered by any national carbon-pricing instrument. Given the prevalence of emissions from medium- to long-range flights, this observation highlights the limited effectiveness of national carbon-pricing instruments, especially those applicable to smaller jurisdictions.

The EU Emissions Trading Scheme (ETS), by contrast, applies directly to 30 countries and is integrated with two other national ETSs; it ‘prices’ emissions from international flights between any of the 32 participating countries. In addition, the EU initially decided to extend its ETS to all international flights which either depart from, or arrive at, an airport within the territory of a participating country (including flights originating from or destined for third countries). This measure proved to be politically contentious, and questions were raised about its compatibility with international aviation law. The EU eventually agreed to suspend the application of its ETS to flights to and from third countries in the light of the progress made, largely as a reaction to the EU initiatives, at the ICAO towards a global market-based mechanism. Following the adoption of CORSIA, the EU is likely to continue to apply the ETS to intra-regional flights, while applying CORSIA only to other international flights.
Notwithstanding their level of regulatory sophistication, carbon-pricing mechanisms are only as effective as the price they impose on GHG emissions. Taxes imposed on aviation fuel are relatively low, while cap-and-trade mechanisms often rely largely on free allocation of allowances (‘grandfathering’), which further reduces average prices. Like CORSIA, these national carbon-pricing mechanisms do not take into consideration the non-CO₂ impacts of aviation. The resulting price signal is a small fraction of fuel prices, creating little additional incentive for airlines to reduce emissions, or for passengers to fly less. For instance, the EU Commission estimates that the EU ETS imposes an increase in flight ticket prices of only 0.4 to 0.9%.

4.4. Ticket Taxes

Various jurisdictions have imposed taxes on flight tickets. These taxes may aim to cover the cost of running airports and civil aviation services, or they may be devised as carbon-pricing mechanisms, but in practice the distinction is not always obvious. France, Germany, the Netherlands, Sweden and the UK levy fixed-rate taxes on passengers of any domestic or international flight, with varying rates applicable to groups of countries for different distances and, sometimes, according to the flight class – thus reflecting, albeit approximately, the greater climate impact of long-haul flights and premium classes. For instance, a long-haul international passenger leaving the UK would need to pay £26 in economy, £176 in business or first class, or £528 on a private aircraft.

Ticket taxes do not always apply in the same way to domestic and international flights. For instance, the US imposes a small, fixed-rate tax on all domestic or international flights and an additional tax, proportional to the price of the ticket, on domestic flights. By contrast, Australia and South Africa impose only one, fixed-rate tax...
tax on outbound international flights perhaps because, unlike the US and many other jurisdictions, these two countries subject domestic flights to consumer taxes.

Ticket taxes could incentivize consumers to consider alternative modes of transportation or to travel less. On the other hand, unlike direct carbon pricing, ticket taxes do not incentivize efficiency gains, as the amount to be paid by a passenger does not depend on the flight’s actual per passenger emissions. The effectiveness of ticket taxes is also limited by the frequent exemption of transiting and transferring passengers (aimed at avoiding trade distortions),169 which often applies to high-emitting long-haul flights. Lastly, fewer jurisdictions levy equivalent taxes on cargo flights.170

4.5. Phasing Out Tax Exemptions

States have long supported aviation, sometimes through direct subsidies to airlines or airports and other infrastructures,171 but more often by exempting airlines and their passengers from various taxes to which they would otherwise be subject. Most jurisdictions exempt civil aviation from fuel excise duties172 or apply a discounted rate.173 In addition, airlines engaging in international transportation are often exempted from value-added tax (VAT) on the goods and services they purchase (including fuel),174 and passengers are not required to pay VAT on the purchase of tickets.175 A 2019 OECD survey of 44 OECD and G20 members concluded that fuels used in domestic aviation are ‘sometimes taxed but rarely reflect a low-end carbon benchmark’, while fuels used in international aviation are not taxed ‘at all’.176 Most states also provide for income tax exemptions,177 following here also ICAO policy recommendations.178

These tax exemptions go against a growing trend towards the phasing out of fossil-fuel subsidies. Following a series of declarations of the G20,179 states agreed at COP26

169 Finance Act 1994, s. 31(3) (UK); Code général des impôts, Art. 302bisK(VL.2) (France); Lag om skatt på flygresor (SFS 2017:1200), ss. 4(4)–(5) (Sweden). These exemptions have the aim of avoiding distortion of competition between airports.

170 For two notable exceptions, see Code général des impôts, Art. 302bisK(II.1) (France); 26 USC, §§ 4271–4272 (US).


173 E.g., 26 USC s. 4081(a)(2)(C).


that they should ‘accelerate[e] efforts towards the … phase-out of inefficient fossil fuel subsidies’. Both the EU and the US have engaged in comprehensive reviews of these subsidies, and the EU is considering a directive that would require phasing out the tax exemption on aviation fuels for intra-EU flights while allowing states to do the same for extra-EU flights ‘without prejudice to international obligations’.

The support that tax exemptions provide to civil aviation far outbalances the effect of even the most stringent carbon-pricing policies. For instance, an average airline flying within the EU in 2019 had to pay a marginal price of €0.062 per litre of kerosene for emissions allowances; this resulted (taking into account the free allocation of 85% allowances) in an average cost of €0.009 per litre. By contrast, were it not for their exemption of excise duties, airlines would need to pay at least the pan-EU minimal rate of €0.33 per litre of kerosene. Phasing out the exemption of EU excise duties would roughly double airlines’ fuel acquisition costs in this market, creating a clear incentive for airlines to reduce emissions or for passengers to fly less. A study commissioned by the EU Commission suggests that phasing out the exemption of fuel excise tax on airlines would increase ticket prices by 10% and reduce aviation CO2 emissions by 11%; which would be an order of magnitude more effective than the EU ETS.

Likewise, the benefits of VAT exemption on ticket sales often outbalances the costs imposed by ticket taxes. By contrast to VAT, ticket taxes rarely increase the overall price of the ticket by more than a single-digit percentage point. In one estimate,
imposing a 19% VAT rate on all flights departing from the EU could achieve an 18% reduction in CO₂ emissions from such flights.¹⁹⁰

4.6. Sectorial Governance

Beyond subsidies, states are often active partakers in the aviation sector: they influence the sector’s development, for instance, by approving airport construction and by regulating routes and traffic. Sectorial policies have relatively complex implications for the climate impacts of aviation. For instance, limited airport capacity, if ill-managed, can cause traffic congestion, resulting in additional CO₂ emissions,¹⁹¹ but a scarcity of landing and take-off slots could also incentivize airlines to maximize seat occupancy, hence improving carbon efficiency.¹⁹² In many jurisdictions the climate impacts of relevant projects are subject to environmental assessment procedures, although national authorities generally maintain considerable discretion in making the final decision.¹⁹³

Improving routing and traffic management could reduce aviation’s climate impact while also improving its economic efficiency. Accordingly, several jurisdictions have adopted or are considering measures to promote, for instance, more direct routes and continuous descent approaches.¹⁹⁴ In general, these measures apply indiscriminately to domestic and international aviation but, like other efficiency-driven measures, they run the risk of a rebound effect.¹⁹⁵

5. RELATIONS BETWEEN THE TWO STREAMS

This last section examines the interactions between national and international mitigation actions in the aviation sector. It shows that these two streams of mitigation action are generally compatible from a legal perspective and complementary from a policy perspective. In fact, the rapid decarbonization of the aviation sector is unlikely without a combination of national and international initiatives.

5.1. Compatibility

One could question whether national mitigation action in the aviation sector is compatible with states’ international law obligations. As far as international climate law is

¹⁹⁰ European Commission, n. 186 above, p. 114.
¹⁹⁵ See n. 32 above.
concerned, the question is relatively straightforward: notwithstanding whether international climate law requires states to implement mitigation action in international aviation, it certainly does not prevent such measures.196

A more complex question relates to the compatibility of national mitigation initiatives with international aviation law. It bears repeating that reducing air transport may be the only way to reduce its climate impact substantially:197 as such, there is an obvious tension, even possibly a contradiction, between the climate regime’s objective of carbon neutrality198 and the ICAO objective of a ‘safe and orderly growth of international civil aviation’.199 If a direct normative conflict is avoided on the international front between climate and aviation law, it is in large part as a result of the open-ended and bottom-up nature of commitments on climate change mitigation.200 However, the tension between these two policy objectives re-emerges when states seek to implement their obligations. Aviation pundits have interpreted the Chicago Convention as ‘placing strong legal constraints on unilateral action’.201 The ICAO’s attempt at keeping mitigation action under its purview202 reflects a distrust not only of initiatives adopted under the UNFCCC regime, but also of any national (‘unilateral’) measures ‘which would adversely affect the orderly development of international civil aviation’.203

There remains undoubtedly a regulatory space for national mitigation action in the aviation sector. Few, if any, observers have questioned the right of states to decide how to develop national infrastructure and manage air traffic within their territory, to adopt non-discriminatory technical standards on planes or fuel, or to define national mitigation targets applicable to all aviation activities under their control. Rather, legal controversies have centred on the legality of two types of national measure: the phasing out of tax exemptions and the imposition of a carbon price.204 As the following shows, some bilateral air service agreements require states to maintain some tax exemptions, but many other national mitigation measures in the aviation sector, including carbon-pricing mechanisms, appear to be consistent with international aviation law.

196 See Section 2.3.
197 See Section 2.2.
198 Paris Agreement, n. 3 above, Art. 4(1).
199 Chicago Convention, n. 8 above, Art. 44(a).
200 For instance, the Paris Agreement does not expressly require its parties to act consistently with its objective of achieving climate neutrality in the second half of the century: B. Mayer, ‘Temperature Targets and State Obligations on the Mitigation of Climate Change’ (2021) 33(3) Journal of Environmental Law, pp. 585–610, at 597.
201 Havel & Sanchez, n. 63 above, p. 235.
202 See Section 3.1.
5.1.1. Tax exemptions phase-out

Exemptions from excise duties and VAT impede climate change mitigation in the aviation sector. These exemptions are often presented as a legal requirement under international aviation law. Yet, such requirement arises not from any general norms reflected in multilateral treaties, but from ad hoc bilateral arrangements, which a state is more likely to be able to renegotiate.

The Chicago Convention does not require its contracting parties to exempt airlines from VAT or excise duties. The ICAO Council interpreted this treaty as making a distinction between ‘charges’, referring to ‘levies to defray the costs of providing facilities and services for civil aviation’, and ‘taxes’, which are ‘levies to raise general national and local government revenues that are applied for non-aviation purposes’. In that sense, VAT and excise duties are not ‘charges’ but ‘taxes’. Yet, while the Chicago Convention regulates the imposition of ‘charges’, it is silent on the issue of ‘taxes’. Article 15 is interested only in ‘airport and similar charges’. While Article 24 prohibits the imposition of ‘customs duty’ on any fuel on board an international flight on arrival and retained on board until departure, it does not preclude the imposition of excise duty on the purchase of additional fuel.

The ICAO Council has formulated ‘policies’ advocating an exemption for international civil aviation from excise duties and VAT, though these are not legally binding. The Assembly has recommended compliance with these policies but, since 1992, it has also noted that ‘taxes are increasingly being imposed by some states in respect of certain aspects of air transportation’. The latter observation rules out any argument based on the interpretation of the Chicago Convention in the light of subsequent practice of the parties, as it establishes that this practice lacks consistency. Since 2016, the Assembly has reflected the evolution of state practice by putting more emphasis on the need to avoid ‘discriminatory taxes’ (referring to discrimination between aviation and other modes of transport) and ‘double taxation’, rather than calling for a complete exemption. VAT or excise duties are unlikely to be imposed in ways that discriminate against aviation or result in double taxation.

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206 ICAO Council, Resolution on Taxation, n. 178 above, Preamble para. 3. See also ICAO Assembly Resolution A40-9 (2019), App. B Preamble para. 2.
208 Havel & Sanchez, n. 63 above, pp. 45–6.
209 ICAO Council, Resolution on Taxation, n. 178 above.
213 Other modes of international transportation are typically subject to VAT and excise duties.
214 The risk of double taxation arises in relation to the imposition of income tax; see ICAO Council, Resolution on Taxation, n. 178 above, para. 2(c).
Rather than the Chicago Convention, the main legal obstacle to imposing taxes on international civil aviation lies in the (mainly bilateral) air service agreements through which states allow one another’s airlines to operate flights between or within their territories.215 Some of these treaties provide for excise duty exemptions, on the basis of reciprocity, for the fuel used for these flights.216 By contrast to multilateral treaties, these bilateral agreements can more easily be modified through bilateral negotiations. The EU has already promoted air service agreements that allow the application of excise duties on fuel, at least, for intra-EU flights operated by foreign airlines.217 Overall, as far as the authors are aware, no air service agreement prevents VAT and ticket taxes, provided that such measures are applied in a fair and non-discriminatory manner to national and foreign airlines.

5.1.2. Carbon-pricing mechanisms

The unilateral application of carbon-pricing mechanisms to international aviation has also proved to be controversial.218 Yet, neither carbon taxes nor cap-and-trade mechanisms are among the charges and customs duties prohibited under the Chicago Convention. Even if one were to find that these instruments create ‘charges’ aimed at defraying ‘the costs of providing facilities and services for civil aviation’,219 these charges would not fall within the scope of the prohibition, under Article 15, of charges imposed ‘in respect solely of’ an aeroplane’s transit over, entry into, or exit from the state’s territory,220 as these mechanisms are imposed in respect of (and in proportion to) an aeroplane’s climate impacts. Nor do carbon-pricing mechanisms create customs duties levied for the importation of fuel ‘retained on board’, which would be prohibited under Article 24.221 Articles 15 and 24 do not prevent a state from requiring airlines to take responsibility for their environmental impact, at least in relation to activities taking place within the state’s own territory.222

A more probable legal obstacle to carbon-pricing mechanisms arises, here again, from bilateral air service agreements that prohibit the imposition of excise duties. For practical reasons, carbon taxes are typically levied on the purchase of fuel – in much the same way as excise duties – rather than directly on the combustion of fuel or on CO2 emissions.223 A distinction arguably could be made between carbon taxes and excise duties on the ground that the former apply only to non-sustainable fuels.

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215 See generally Havel & Sanchez, n. 63 above, p. 20.
218 See references at n. 203 above.
219 ICAO Council, Resolution on Taxation, n. 178 above, Preamble para. 3.
220 Chicago Convention, n. 8 above, Art. 15.
222 In this respect the (short-lived) application of the EU ETS to the entirety of every flight originating from or destined for an EU Member State is more problematic; see text at n. 153.
223 See, e.g., Carbon Tax Regulation, B.C. Reg.125/2008, s. 12(1) (British Columbia (Canada)).
and that revenues are often directed to climate-related funds rather than to the state’s general budget. At any rate, provisions on excise duties exemptions in bilateral air services agreements are less likely to affect cap-and-trade mechanisms that impose liabilities on fuel use rather than fuel purchase.\textsuperscript{224}

The ICAO Assembly and Council have appeared to recognize the lawfulness of national carbon-pricing mechanisms, in particular cap-and-trade mechanisms. This acceptance was implied, in 2010, when the Assembly adopted a set of guiding principles that states should follow when implementing ‘market-based mechanisms’.\textsuperscript{225} Subsequently, the Assembly noted that CORSIA ‘is the only global market-based measure applying to CO\textsubscript{2} emissions from international aviation’ and highlighted the need ‘to avoid a possible patchwork of duplicative State or regional MBMs’,\textsuperscript{226} but these observations do not outlaw national or regional market-based mechanisms. As China then observed, the ICAO Assembly ‘has no right to prohibit Member States from using other market measures for addressing aviation emission’.\textsuperscript{227}

The concern of the ICAO Assembly with national carbon-pricing mechanisms relates not to their legality but to their political opportunity, especially in conjunction with the adoption of CORSIA. Since 2010, the Assembly has expressed concern that market-based mechanisms could become ‘duplicative’, and it has suggested that ‘international aviation CO\textsubscript{2} emissions should be accounted for only once’.\textsuperscript{228} This concern was initially far-fetched, as no market-based mechanism applied to any international aviation emissions beyond the EU ETS, and it remains unfounded as most of aviation’s climate impact remains entirely unaccounted for. As CORSIA aims only to offset any increase in CO\textsubscript{2} emissions from international civil aviation, overlapping national or regional carbon-pricing mechanisms could be justified as addressing other aspects of aviation’s climate impact – including avoiding (rather than offsetting) an increase in CO\textsubscript{2} emissions, addressing pre-existing levels of CO\textsubscript{2} emissions, and limiting non-CO\textsubscript{2} impacts of international civil aviation.

5.2. Complementarity

From a policy perspective, the international and national streams are largely complementary. More specifically, the international stream has important shortcomings, which national action can help to address.

\textsuperscript{225} ICAO Assembly Resolution A37-19 (2010), paras 14, 17.
\textsuperscript{226} ICAO Assembly Resolution A40-19 (2019), para. 18.
\textsuperscript{227} ICAO 40\textsuperscript{th} Assembly, Statement of the Chinese Delegation, 8 Oct. 2019, Reservations s. II(14), available at: https://www.icao.int/Meetings/a40/Documents/Resolutions/china_EN.pdf; see also ICAO 37\textsuperscript{th} Assembly, Written Statement of Reservation by Belgium, n. 94 above.
\textsuperscript{228} See ICAO Assembly Resolution A37-19 (2010), Annex para. (f); A40-19 (2019), para. 18.
5.2.1. ICAO shortcomings

There are some obvious reasons to wish that states would reach an agreement on effective and ambitious mitigation action via multilateral negotiations convened by the ICAO, rather than taking separate initiatives. The very existence of the ICAO reflects state understanding that unilateral measures may seek to offer a competitive advantage for national airlines and airports or otherwise create a more complex regulatory environment. From a climate perspective, national initiatives run the risk of merely displacing emissions if, for instance, less efficient aeroplanes are redeployed on unregulated routes; they could even be counter-productive if passengers fly longer routes to evade carbon-pricing instruments.

Yet, the ICAO has a limited political capacity to initiate effective mitigation action. In line with the text of the 1944 Chicago Convention, the ICAO has clearly placed the growth of international civil aviation before any environmental or social concerns, such as climate change mitigation. The ICAO has considered measures aimed at improving aviation’s carbon intensity, but not measures intended to limit or reduce aviation activities altogether. It has not advanced a coherent, long-term vision of the sector’s decarbonization, nor has it questioned the need for, or the possibility of, continued growth in the sector. Arguably, the need to foster interaction and cooperation among nations through the growth of international civil aviation was far more obvious in the midst of the Second World War than in the age of globalization and virtual reality. Overall, the opacity of ICAO negotiations seems to benefit industrial lobbies far more than environmental advocates.

Altogether, the ICAO strategy on climate change mitigation appears to be mainly dilatory: the ICAO took ‘initiative’ (as it once admitted) only when and in so far as this was necessary to prevent other organizations, or states, from adopting more effective measures. It was only after the US EPA was mandated to define national fuel-efficiency standards that the Council adopted the first SARPs on CO₂ emissions.

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231 Chicago Convention, n. 8 above, Art. 44(a).

232 See Section 3.1.


235 See text at n. 64 above.
pre-empting the adoption of national standards that could have been more effective.\textsuperscript{236} Likewise, despite decades of negotiations, it was not until the EU applied its ETS to every international flight that the ICAO could agree to set up a global market-based mechanism.\textsuperscript{237} The subsequent implementation of CORSIA would lead the EU to reduce its efforts on mitigation in the aviation sector significantly if it does not decide to maintain its ETS for intra-EU international flights (thus applying CORSIA only to extra-EU international flights).\textsuperscript{238}

5.2.2. The need for national initiative

States have the capacity to implement various policies and measures that contribute to mitigating climate change in the aviation sector, including from international flights. Their NDCs and long-term strategies under the Paris Agreement could seek not only to improve aviation’s climate efficiency, but also to limit or reduce societies’ reliance on aviation, an approach that cannot easily be pursued under the ICAO. They can do so, for instance, by developing alternative modes of transportation (such as high-speed rail) as well as alternatives to transportation (such as local resorts and teleconferencing). The policy tools available to states in this respect range from fiscal policies, carbon pricing, and technical standards, to infrastructure development, land-use regulation, and subsidies.

The ICAO distrust of ‘unilateral’ measures\textsuperscript{239} is unwarranted: while a state’s initiative could always be considered ‘unilateral’,\textsuperscript{240} the national initiatives on climate change mitigation in the aviation sector are not usually promoting national interests at the expense of foreign and global interests.\textsuperscript{241} A state is typically not pursuing any uniquely national interest when implementing carbon-pricing measures, phasing out subsidies, or imposing technical standards on aircraft. Indeed, when these measures do distort international competition, it is almost always at the expense of the state’s own airlines and airports. Contrary to what the word ‘unilateral’ may suggest, these

\textsuperscript{236} See text at nn. 95 and 125 above.
\textsuperscript{239} See n. 203 above.
measures advance a global objective – climate change mitigation – which every ICAO member state has agreed to pursue.242

While there are legal constraints on the measures that states may impose, states retain significant regulatory space to implement measures aimed at addressing the climate impact of the aviation sector. The larger jurisdictions, in particular, have considerable market power to set de facto global standards, for instance, on aircraft efficiency,243 and they could even implement carbon-pricing mechanisms in cooperation with other parties interested in exercising global leadership. They also have diplomatic leverage to facilitate the adoption of a new generation of bilateral air service agreements allowing a systematic phase-out of tax exemptions. States would be able to give a clear signal to the ICAO and the aviation industry that, if no effective long-term strategy is formulated for the decarbonization of aviation, the world will have to find a long-term strategy without air transportation.

6. CONCLUSION

This article has shown the existence of two distinct streams of mitigation initiatives in the aviation sector. While the ICAO has claimed exclusive competence on the regulation of international civil aviation, neither climate nor aviation law prevents national initiatives aimed at reducing the impacts of aviation, including international civil aviation, on the climate system. In fact, while the ICAO is yet to achieve any significant mitigation outcomes, national initiatives have long resulted in the implementation of effective measures, including direct and indirect carbon pricing, infrastructure development, biofuel-content requirements, and air traffic management.

Overall, our analysis has shed critical light on ICAO initiatives on climate change, which too often have been aimed at forestalling the implementation of more effective national measures. CORSIA should be saluted as the first global market-based mechanism, but one must also keep in mind its limited aim (to offset increases in the sector’s CO₂ emissions, without addressing pre-existing emission levels and non-CO₂ impacts) and the foreseeable difficulties of ensuring the environmental integrity of offsetting units. There is a risk that, like previous ICAO initiatives,244 CORSIA could constitute a red herring, distracting the attention of regulators from the need for far more effective action – the type of action that, so far, has been undertaken only through national initiatives. As the ICAO has proved unable to exercise true leadership over the last three decades, it is in the national stream that lies the best hopes for the implementation of effective mitigation action and the definition of a long-term decarbonization strategy for the aviation sector.

242 Every ICAO member state is a party to the UNFCCC; see S. Truxal, Economic and Environmental Regulation of International Aviation (Routledge, 2018), pp. 151–5.
244 See Section 3.2 above.