TPCC
TOURISM PANEL
ON CLIMATE CHANGE

HORIZON PAPER

Climate Change Mitigation Policy of International Aviation

Chris Lyle

THE TPCC IDENTIFIES STRATEGIC KNOWLEDGE GAPS TO MEET THE SECTOR'S PARIS CLIMATE AGREEMENT OBLIGATIONS AND COMMISSION EXPERT REVIEWS OR NEW ANALYSIS TO SUPPORT RELATED POLICY AND DECISION-MAKING. THE PAPERS WILL BE STAND-ALONE AND REFLECT THE INTERPRETATION OF SCIENCE BY THE AUTHORS.

The TPCC welcomes collaboration with all tourism stakeholders to accelerate the low carbon transition and advance climate resilient tourism development. If you have questions about the TPCC or interests in our Horizon Paper series, Stocktake or Science Assessment.

CONTACT US

secretariat@tpcc.info

www.tpcc.info

Climate Change Mitigation Policy of International Aviation

– a Critical Assessment

Overview

The first Global Stocktake by the United Nations Framework Convention on Climate Change (UNFCCC) was concluded at the 28th Conference of its Parties (COP 28) in Dubai in December 2023. Coincident with that event the Tourism Panel on Climate Change (TPCC), an independent science-based collaboration (https://tpcc.info/), released its complementary first Tourism and Climate Change Stocktake. The latter Stocktake *inter alia* found that "Tourist transport emissions have increased by 65% between 1995 and 2019. Air travel was a key driver of this growth, now contributing 26% of all tourist trips (domestic and international), but 75% of tourist transport emissions" (Finding 3). For the international component aviation is the single increasingly dominant contributor to tourism emissions.

In that context, the present Horizon Paper for the TPCC takes a comprehensive look at the related efforts of the International Civil Aviation Organization (ICAO) through which international aviation emissions mitigation policy has up to now in effect been outsourced by the UNFCCC.

Aviation emissions are governed in a global, regional and national framework in which ICAO - prevailing for the 70 per cent generated by international operations - is a crucial but weak link, circumscribed by its regulatory dictate. Current mitigation measures are consequently by no means adequate to achieve global "net zero" of carbon or non-carbon emissions from air transport. This Paper reviews the relationship and mitigation activities amongst ICAO, the UNFCCC and the European Union (EU) against the backdrop of national regulation and proposes means of building on this structure towards fulfilling the Paris Climate Agreement goals.

Aviation decarbonization

Aviation is recognized as particularly difficult to decarbonise because it presently has a negligible quantity of potential technological alternatives to fossil fuelled power. Uniquely, air transport's greenhouse gases, particulate matter and condensation trails (contrails) are largely produced in the upper troposphere and lower stratosphere, which complicates the problem.

Aviation currently generates some 2.5% of global CO2 emissions and at least 3.5% of 'effective' radiative forcing of the climate, and efficiency improvements continue to be well exceeded by growth in traffic. It is currently unclear when air traffic will return consistently to pre-Covid 2019 levels worldwide and whether subsequent growth rates will be lower than in the past. But it remains a likely scenario that without markedly more effective climate policies, damaging emissions from air transport will at least double 2019 levels by 2050, the commonly recognized year in which greenhouse gas emissions are aimed at being "net zero" globally. Given developments in other sectors and absent further - intense - remedial action, aviation's share of global emissions is projected to rise to about 20%, with some sources indicating significantly higher proportions.

Over the past few years there has been a considerable shift in perception and recognition of aviation's contribution to climate change and in responses by governments and industry towards reducing the sector's emissions. A wide variety of mitigation measures has been taken or is being considered, with differing impacts, practicability, timing and cost. The fundamental achievement criterion is the reduction in emissions on a full life-cycle basis, that is including the creation and collateral effects of each measure.

ICAO regulatory policy to date

ICAO, a Specialized Agency of the United Nations, was established in 1944 through the Convention on International Civil Aviation, known as the Chicago Convention from its location of adoption. The initial and continuing focus of the Organization's work was air safety, air navigation and air traffic management, with the addition of security in the early 1970s. Standards and Recommended Practices (SARPs) on aircraft noise

were first adopted in 1971 and the first SARPSs on emissions - certification procedures for aircraft engines - followed in 1981. These SARPs are included in Volumes I and II respectively of *Annex 16, Environmental Protection* to the Chicago Convention and updated from time to time.

In 1997, the third Conference of the Parties (COP 3) of the UNFCCC first established emissions reduction targets through adoption of the *Kyoto Protocol*, which eventually entered into force in February 2005. The *Protocol* established targets for the 40 UNFCCC "Annex I" countries (Developed Nations and Nations with Economies in Transition) but excluded international aviation emissions from these targets because of the difficulty in allocating them to countries. Aircraft in international operations move from sovereign jurisdiction to jurisdiction, and often over the 'high seas' where no nation has sovereign responsibility. Such issues also apply in the case of international shipping.

Several options for allocation of international aviation to Parties were on the table in Kyoto in 1997 before the conference ran out of time. COP 3 consequently decided (Article 2(2) of the *Kyoto Protocol*): "The Parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime Organization, respectively".

States have been addressing the aviation remit through ICAO since 1998. A special report in 1999 by the Intergovernmental Panel on Climate Change (IPCC) on *Aviation and the Global Atmosphere*, requested by ICAO, was pivotal in framing ICAO action.

The ICAO remit has proved to have substantial constraints, particularly as far as market-based measures are concerned. ICAO's geographic and policy ambit reflects its membership (now 193 States), well beyond the UNFCCC's 40 Annex I countries. Moreover, there are significant barriers to applying an Annex I/non-Annex I industrialized/other-country concept in relation to 'equality of treatment' and certain other provisions in the Chicago Convention.

More than two decades after COP 3, in July 2017, a third Volume to Annex 16 to the Chicago Convention came into effect, on standards for aeroplane CO2 emissions. As with Volumes I and II, these apply to the manufacture of equipment and essentially reflect rather than drive technology. In June 2019 ICAO published a market-based Volume IV, on a *Carbon Offsetting and Reduction Scheme for International Aviation*. CORSIA is a complex form of offsetting but, despite including the word "Reduction" in its name, is not aimed at absolute reduction of emissions - it rather sets out to achieve a goal of "carbon neutral growth", currently above 2019 levels and from 2024 above 85% of those 2019 levels.

To put the effectiveness of ICAO emissions mitigation measures in context, CO2 emissions from international aviation doubled from 317Mt in 1997 to 641Mt in 2019, to match the total emissions of the 129 lowest emitting countries combined, about the same as the country-wide emissions of Australia.

Nevertheless, the Organization has undertaken a considerable amount of research and has raised the profile of the issue globally. A notable achievement has been the evolution of State Action Plans (SAPs) on aviation CO2 emissions reduction along with related assistance and capacity-building projects.

Through the SAP initiative, all ICAO member States are enabled to establish a long-term strategy on climate change for international aviation. They are encouraged to define a quantified baseline scenario, select appropriate emissions mitigation measures from ICAO's basket of measures, and calculate the expected results of implementing those measures. The level of detail submitted within a SAP is intended ultimately to enable ICAO to compile global progress towards meeting the goals set by ICAO Assembly Resolutions. The submission of SAPs is entirely voluntary

There is increasing evidence that aviation's non-CO2 emissions and contrails contribute to climate change, possibly even to a greater extent than CO2 (see for example Definitions and implications of climate-neutral aviation | Nature Climate Change and The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018 -

ScienceDirect). However, while their impact is under study by ICAO, the Organization has not as yet taken action with regard to their mitigation.

Mitigation outlook

The scientific consensus is that aviation's global CO2 emissions would have to peak by 2025, be reduced by 2030 to about half of 2019 levels and by 2050 to zero (not any "net" zero which includes out-of-sector carbon offsetting, or carbon capture and storage). ICAO, along with many airline and regulatory authorities now has an "aspirational" goal of "net zero" CO2 in 2050 - but with limited attention to intermediate targets (the European Union being an exception, with binding requirements for meeting both short- and long-term goals).

Drawing board concepts such as open rotor engines and blended wing body and truss braced wing aircraft may ultimately contribute significant reductions, but the key for all aircraft to reduce emissions will be changes in the power source away from fossil fuels. In this regard there are now numerous projects on the table or under development, notably including gaseous and liquid hydrogen powered aircraft. However, with the exception of electric (battery and fuel cell) for smaller aircraft at short- to medium-haul, none of these is expected to have a significant impact at the global level before mid-century. In the meantime, aircraft with current technology and a long lifespan (beyond 2050) continue to be brought into the market.

Thus, towards achieving "net zero" commitments industry and governments are relying heavily, particularly in the short- to medium-term, on measures external to the air transport sector rather than emissions reduction directly by air carriers: essentially in the forms of carbon offsetting and/or emissions trading. In the longer term the in-sector contribution of "Sustainable Aviation Fuel (SAF)", that is renewable or waste-derived aviation fuel that meets sustainability criteria (much lower carbon footprint than fossil-based fuel) is expected to play the substantial role.

Carbon offsetting is by no means a definitive solution. It shifts the moral responsibility for carbon reduction to someone else, the quality of offset units is heterogeneous and far from guaranteed, and studies have shown that the majority of even those of the highest standards simply do not work (see for example https://ec.europa.eu/clima/system/files/2017-04/clean_dev_mechanism_en.pdf). Eventually everyone has to reduce emissions and this is why offsetting is not a workable strategy to reach planetary net zero.

CORSIA in particular will not have any practical effect for a year or two to come and emissions below the baseline levels will even then continue to be churned out annually without redress. Given also a number of exempted routes, CORSIA will actually apply to less than half of international aviation CO2 emissions between now and 2035. The efficacy of CORSIA will also be impacted by the failure of successive meetings of the UNFCCC's COP to reach agreement on "operalization" of Article 6 of the Paris Agreement on carbon markets. While the first certification of SAF feedstocks (in contrast with out-of-sector offsetting) under CORSIA in June 2023 is a step in the right direction, CORSIA cannot currently be considered as a significant emissions mitigation measure.

SAF is the critical in-sector measure on which hopes are focused. The current volume contribution is very low (between 0.1 and 0.2% of kerosene) and the price high (varying from some 2.5 to 6 times kerosene). SAF comes in three forms: biobased, waste-based, and synthetic "e-fuels". Various biofuels have been proven to be technically viable and ICAO has set global standards for the sustainability of SAF. But there remain serious questions as to their full life-cycle benefits, their impact on direct and indirect land-use change, the high renewable energy inputs to produce them and the potential available volume of supply of raw materials, along with considerable barriers regarding the necessary investment, pricing, and scaling up to a commercial level. Waste-based fuels are a temporary, severely volume constrained, exception. Two recent studies by the United Kingdom's Royal Society (Net zero aviation fuels: resource requirements and environmental impacts | Royal Society) and by Becken, Mackey and Lee (Implications of preferential access to land and clean energy for Sustainable Aviation Fuels - ScienceDirect) have cast a dark shadow over the

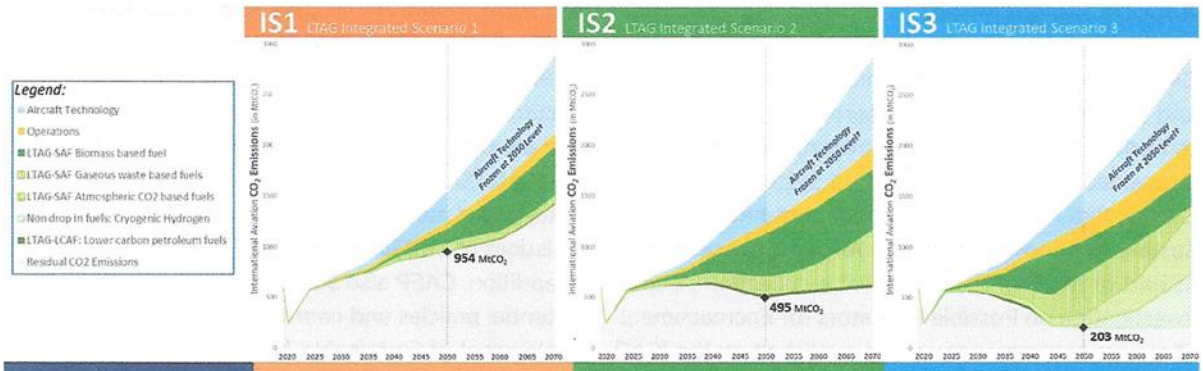
prospects for SAF as a primary contributor to reducing aviation emissions.o

An exception may be synthetic e-fuels (also known as "power-to-liquid"), which fall under the SAF umbrella and like biofuels have "drop in" capability, but they do not emit any greenhouse gas emissions at all in operation. Their cost is generally at least three times as high as that of conventional jet fuel - and likely to remain high. For the three technologies of fuel cell aircraft, gas turbine hydrogen jets and particularly e-fuels, hydrogen is a common denominator and there is already strong competition for "green" hydrogen, which requires a considerable volume of renewable energy to produce (see for example https://www.frontiersin.org/articles/10.3389/fenrg.2021.765360/full). These amounts are so large that a recent scenario study showed limitations on the potential SAF contribution to reducing aviation emissions, especially with the expectation of much larger volumes of traffic (Envision2030_SummaryFINAL.pdf).

ICAO has held three Conferences on Aviation and Alternative Fuels (CAAF) and the most recent one, in November 2023, agreed on a global framework for development of SAF, along with Lower Carbon Aviation Fuels (LCAF) and other "Aviation Cleaner Energies", aimed at reducing carbon intensity in international aviation by 5 per cent by 2030 - compared to zero cleaner energy use (ie while an noteworthy accomplishment not an absolute reduction and the vast bulk of unabated emissions will still grow as traffic does). As for the reference to LCAF, this is defined by ICAO as fossil-based aviation fuel that meets sustainability criteria including a 10% reduction in lifecycle emissions compared to the kerosene aviation fuel baseline. LCAF are essentially fossil fuels which are refined using renewable energy (notably solar). They are intended only as transitional (SAF can provide a reduction of 70% or more). However, the Conference did not address constraints on traditional jet fuel growth and the inclusion of LCAF means that suppliers are actually enabled to increase fossil fuel production for aviation subject only to the 10% (processing) criterion.

In its most ambitious of three scenarios, an ICAO Report on the Feasibility of a Long-Term Aspirational Goal for international aviation from its key Committee on Aviation Environmental Protection (CAEP) in 2022 showed a CO2 emissions reduction through in-sector measures for 2050 over 2019 of 87%, broken down into 21% from aircraft technologies, 11% from operations and 55% from fuels. The report did not cover out-of-sector measures such as carbon offsetting and even in this most ambitious scenario, residual CO2 emissions were anticipated to reach approximately 200 MtCO2 in 2050 (a third of the 2019 CO2 emissions level). The report did not consider cryogenic hydrogen to be a factor prior to 2050.

Main takeaways from the ICAO Long-Term Aspirational Goal Report



Metrics	IS1	IS2	IS3
CO_2 Emissions in 2050 after Reductions	≈950 $MtCO_2$ in 2050 *(160% of 2019 CO_2 emissions)*	≈500 $MtCO_2$ in 2050 *(80% of 2019 CO_2 emissions)*	≈200 $MtCO_2$ in 2050 *(35% of 2019 CO_2 emissions)*
Reduction in 2050 from the Baseline	**39% total** through: Technologies - 20%, Operations - 4%, Fuels - 15%	**68% total** through: Technologies - 21%, Operations - 6%, Fuels - 41%)	**87% total** through: Technologies - 21%, Operations - 11%, Fuels - 55%
Cumulative residual Emissions from 2020 to 2070	23 $GtCO_2$ (2020 to 2050) 23 $GtCO_2$ (2051 to 2070)	17 $GtCO_2$ (2020 to 2050) 11 $GtCO_2$ (2051 to 2070)	12 $GtCO_2$ (2020 to 2050) 4 $GtCO_2$ (2051 to 2070)

At its subsequent Assembly, in 2022, ICAO adopted a global "Long Term Aspirational Goal (LTAG)" of "net-zero carbon emissions" for 2050, with heavy reliance on SAF and CORSIA; but intermediate targets will only be set at its next Assembly in 2025 - the year of necessary CO2 peaking. The ICAO goal has no binding commitments and is again not directed specifically at in-sector emission reductions but rather at carbon neutral growth.

The EU has adopted binding legislation to reduce net greenhouse gas emissions from aviation by at least 55% over 1990 by 2030 and achieve "carbon neutrality" by 2050 (ReFuelEU Aviation). Under the mandate's rules, aviation fuel suppliers must provide all flights departing from an EU airport from 2025 with fuel containing a minimum share of 2% SAF, rising gradually to 6% in 2030, 34% in 2040 and to 70% by 2050. A specific proportion of the fuel mix must comprise e-fuels: 1.2% in 2030, 2% in 2032, 5% in 2035 and progressively rising to 35% in 2050 . As a market-based measure the EU prefers emissions trading to offsetting, since this has been shown to be a more effective tool for aviation, but the EU has yielded to application only of ICAO's CORSIA for most flights beyond its territories.

In the light of the inadequate contribution of offsetting and SAF, along with the minimal address of non-CO2 emissions and contrails, it is becoming increasingly evident that additional mitigation measures need to be taken. A survey by GE Aerospace prior to the Paris Air Show in June 2023 showed that even the aviation industry itself was split on whether its own net zero 2050 goal was achievable, with under half of the 325 executives surveyed believing the industry will meet its goal.

Amongst additional measures, demand management is coming to the fore. In its 2023 report the United Kingdom's Climate Change Committee specified the necessity, stating that "Demand management is the most effective way of reducing aviation CO2 and non-CO2 emissions", notably through airport capacity management. Some recent supporting consultancy and NGO views are A Realistic Path to Net-Zero Emissions for Commercial Aviation | Bain & Company and Paris Air Show 2023: Aircraft Sales Boom While the World Burns - Safe Landing (safe-landing.org).

ICAO and the UNFCCC

With the adoption of the Paris Agreement in 2015 and ongoing developments in the UNFCCC, the *Kyoto Protocol* has effectively lapsed. Specific text addressing international aviation and shipping emissions was cut out of the draft Paris Climate Agreement during COP 21 - with cursory consultation at most - and it proved too difficult to reintroduce such text in the pressures of the final hours. However, international aviation is implicitly encompassed by the Paris Agreement in the same way as any other sector (Article 4.1) and a legal analysis in 2021 confirmed that international aviation emissions are now to be included in the UNFCCC's Nationally Determined Contributions (NDCs). Most recently, the UNFCCC's COP28 in December 2023 encouraged "Parties to come forward in their next nationally determined contributions with ambitious, economy-wide emission reduction targets covering all greenhouse gases, sectors and categories….." (paragraph 39 of the Outcome).

Nevertheless, at the global level international aviation emissions continue to be treated separately and specifically through ICAO. The Organization reports at each biannual session of the UNFCCC's Subsidiary Body on Scientific and Technological Advice (SBSTA). In the past, SBSTA has habitually noted the views expressed by parties and invited the ICAO Secretariat to continue its reporting to sessions of the SBSTA on its ongoing work on relevant issues. However, at recent sessions the issue of revisiting the relationship between the UNFCCC and ICAO has been raised - although on each occasion discussion has been automatically postponed to the following session due to lack of agreement.

Relatively few parties currently incorporate international aviation emissions in their UNFCCC NDC filings, but the EU and its member States are doing so, and New Zealand, United Kingdom and California have declared their intention to include them. The calculation is generally based on emissions from the first outbound leg of flights that start in the territory concerned (and the EU only includes the above baseline CORSIA defined emissions for flights beyond its territories, Switzerland and the United Kingdom); domestic

aviation emissions have been covered directly by the UNFCCC provisions since at least 1997.

One drawback in the UNFCCC process is that all bunker fuels, both shipping and aviation, are considered together. The two transport sectors are very different from both regulatory and technical perspectives. Economic regulation of International shipping is largely governed by the multilateral rules of the World Trade Organization rather than the mainly bilateral air services agreements of international aviation. Freight traffic, comprising the vast bulk of shipping operations and unlike passenger traffic, is one way. Also, unlike air transport, where a flight goes out to one (mostly) or perhaps two or three destinations and returns, ships go on complex routes with stops in several destinations, often not returning "home" for quite some time - or from their first outbound destination. Shipping is also dominated by "flags of convenience", with massive registrations in places like Liberia, the Marshall Islands and Panama, while aviation has strictly regulated "principal place of business". Plus the role of China, with its massive contribution to trade, is a factor several times larger than in aviation.

While shipping is also a difficult sector to decarbonise, there are already alternative partly or fully fuelled ships around (electric at short-haul, gaseous and liquid hydrogen and natural gas, wind and solar assisted) with nuclear a possibility, and all ships are already required to use cleaner fuels when going into or out of EU ports. Perhaps the time has come for the UNFCCC to distinguish between shipping and aviation in its consideration of bunker fuels, which would provide a different perspective and the opportunity for a more effective role on international aviation by that body. This is being facilitated by the apparent political acceptance of Parties defining their international aviation emissions contribution as that from the first outbound leg of international flights.

NDCs vs SAPS. Parallelism of the activities of the two global institutions is illustrated by the key policy tools of UNFCCC's NDCs and the ICAO SAPs. As of December 2023, initial or updated NDCs had been submitted to the UNFCCC by 195 Parties, while SAPs had been reported to ICAO by 144 States (representing over 98% of global air traffic). NDCs are public; an SAP is considered confidential unless the State grants specific permission to make it accessible - 103 had done so.

While the UNFCCC NDCs relate to all types of greenhouse gas emissions, the ICAO SAPs refer only to CO2 (although some States mention non-CO2 emissions). There is no clearly definable link between the NDCs and the SAPs, but a number of States apparently consider their SAP as a surrogate for including international aviation in their NDC.

ICAO's current basket of emissions mitigation measures for international aviation - technology, operations, the CORSIA carbon offsetting scheme and SAF - will contribute *pro rata* much less than any one of the NDCs to which UNFCCC Parties have committed under the Paris Agreement.

Stocktaking. The "technical dialogue" synthesis report for the first Global Stocktake of the UNFCCC, issued in September 2023, is notable for recommending "transformations across all sectors and contexts, including scaling up renewable energy while phasing out all unabated fossil fuels". However, it includes only two specific references to aviation: "Rapidly reducing emissions from international shipping, aviation and freight transportation will require more effective international cooperation on sustainable fuels, energy-efficient design, data analytics and other solutions" and "the International Civil Aviation Organization has set a goal consistent with reaching net zero CO2 emissions by 2050. It remains important to understand whether and how these efforts are additional to action within NDCs, and rigorous accounting is needed to avoid potential overlaps across and within initiatives".

Since 2019 ICAO has held its own annual stocktaking event on progress on in-sector CO2 emissions reduction. The July 2023 stocktaking included the latest developments and innovations from technologies, operations, fuels and cleaner energies, with a focus on fuel-related measures. These stocktaking exercises by ICAO are essentially in the form of presentations by an extensive and diverse group of stakeholders, mostly from industry. There is no direct link to the UNFCCC stocktaking and no formal report but the

following were among broad conclusions elicited by the ICAO Secretariat from the 2023 event:

- a coordinated and inclusive approach is needed amongst all relevant stakeholders

- no one size fits all, and policy approaches need to consider local circumstances, and the need for stability of such policies in time, particularly in terms of coherence with the defined goals

- importance of harmonization on fuel sustainability criteria, certification and accounting methodologies at the global level under ICAO, as those already developed under CORSIA, with the need to further understand and discuss Book and Claim systems

- key role for States to shape financing programmes of development banks in view of de-risking capital investments for SAF projects, and the establishment of long-term harmonized regulatory frameworks is also key to provide certainty to investors

- need for blended-finance and the balance between public and private financing, and all stakeholders (ICAO, States, industry and financial institutions) should play respective roles to facilitate access to financing and investments for aviation cleaner energy projects.

Regulatory differences. Unlike the UNFCCC, the Chicago Convention would seem to proscribe nation-based discrimination. Article 1 of the Convention recognizes the complete and exclusive sovereignty of every State over the airspace above its territory; Article 11 declares that the laws and regulations of a State relating to the admission, departure, or operation, of aircraft are to be applied to the aircraft of all States without distinction as to nationality; and Article 15 (on 'Airport and similar charges') enunciates that 'conditions' (not further specified) applied by a State must be uniform as between national and foreign aircraft. The Convention is silent on sovereignty regarding airspace over the high seas, where it is recognized that no State should exercise sovereignty; however, Article 12 declares that in airspace above the high seas the rules in force are to be those established under the Convention, and ICAO has proceeded to establish such rules.

The equal application provisions in the Chicago Convention continue to dog climate change discussion in ICAO and agreed action tends to be "least common denominator" and diffuse, with no direct accountability to any individual country. ICAO's provisions, including those on environmental matters, are based on Standards and Recommended Practices, which are not themselves legally binding and under Article 38 of the Chicago Convention a State may "file a difference" to any ICAO Standard; in practice, even an ICAO Assembly Resolution is not legally binding.

One elemental weakness in the treatment of international aviation emissions through ICAO is that there is no directly identifiable national commitment, only a global 'sector determined' contribution. Not only is potential action diluted, but international aviation has been treated in a silo and not in the context of differing national circumstances and the relative contribution of aviation to the economy - notably for cases where tourism is critical. Moreover, while membership of the UNFCCC and ICAO is essentially the same, the UNFCCC's mandate is to reduce greenhouse gas concentrations in the atmosphere while the general motivation of ICAO is to protect and promote international aviation. This silo mentality is illustrated in the current *Transformation Strategy* of the ICAO Secretariat which has the circumscribed vision to "achieve the sustainable growth of the global aviation system".

Differences in economic regulation add to the intricacy. Efforts in Chicago in 1944 and on many occasions since have failed to produce a global multilateral air transport agreement (the 1944 *International Air Transport Agreement* has had a maximum acceptance of 12 States). With the exception of three ancillary elements falling under trade in services rules of the World Trade Organization (aircraft repair and maintenance, selling and marketing, and computer reservation services) international air transport is governed by around three thousand bilateral air services agreements and a few regional agreements, many of which include legally binding implications affecting the ability to use some emissions mitigation tools (for example on taxation).

This complex regulatory framework has to be accommodated when developing economic

measures for reduction of air transport emissions, particularly in the case of international operations.

Industry influence

One particularly significant outcome of the Chicago Conference in 1944 - due to differences regarding a proposed global multilateral agreement on economic governance - was a quasi-regulatory role emerging for the global airline body, IATA (the International Air Transport Association) which was established in 1945. IATA has ever since consistently been a driver of ICAO policy and standards, not least on environmental measures (see for example InfluenceMap Corporate Capture and the UN International Civil Aviation Organization). Industry influence on ICAO has been reinforced by global organizations of airports, air navigation service providers and airframe and engine manufacturers, each of which maintains an office adjacent to the ICAO Headquarters in Montreal and actively lobbies Representatives as well as participating in key activities. ICAO has an effective open-door policy on contributions by such bodies on virtually all matters but is much more restrictive regarding participation by environmental NGOs, which are permitted to be represented as a single umbrella organization, the International Coalition for Sustainable Aviation.

IATA's handwriting in particular may be seen in many ICAO policy statements. Primary examples of its precursive bearing on ICAO climate policy are: 1) the concept of 'carbon neutral growth', conceived by IATA in 2007, committed to application beyond 2020 at its AGM in 2009, and adopted by ICAO at its Assembly in 2010; and 2) the concept of 'net-zero 2050', adopted by IATA in 2021 and then by ICAO in 2022.

A related issue is the lack of transparency in ICAO's work on environmental protection. Members and Observers on the crucial Committee on Aviation Environmental Protection (CAEP) are required to sign strictly enforced non-disclosure agreements, and any output from the Committee is not released without the approval of ICAO's governing Council, which is not always forthcoming. Policy recommendations of major ICAO conferences and Assemblies are generally (even if perhaps necessarily in view of the large numbers of delegations) developed by behind-the-scenes consultation, often including industry (but not NGO) representatives, and presented as almost *fait accompli* to the delegations at large.

41st Session of the ICAO Assembly, 2022

The ICAO Assembly session in September/October 2022 is widely regarded as a global watershed on mitigation of aviation's climate change impact. Twenty-five years from the Kyoto mandate and - after 12 years of "exploring the feasibility" of a "long-term aspirational goal" - ICAO finally adopted one. The Assembly also agreed to expand the application of CORSIA from above 2019 emissions levels to above 85% of those levels from 2024 onward - if still leaving emissions below those levels untouched.

The outcome continues to reflect the fundamental issues between UNFCCC and ICAO governance regarding the UNFCCC principle of Common But Differentiated Responsibilities and Respective Capabilities (CBDR) and its "bottom up" process of NDCs against the ICAO provisions of equal application and its "top down" establishment of standards. While the next set of ICAO SAPs, due by June 2024, are expected to address net-zero specifically, relevant language in ICAO Resolution A41-21 (Resolutions (icao.int) is by no means precise.

The language of this Long Term Aspirational Goal Resolution recognizes that each country will decide its own contribution to the goal (cf the UNFCCC's NDCs), inevitably conflicting in some aspects with the equal application provisions of the Chicago Convention: "ICAO and its Member States are encouraged to work together to strive to achieve a collective long-term global aspirational goal for international aviation (LTAG) of net-zero carbon emissions by 2050, in support of the Paris Agreement's temperature goal, recognizing that each State's special circumstances and respective capabilities (e.g., the level of development, maturity of aviation markets, sustainable growth of its international aviation, just transition, and national priorities of air transport development) will inform the ability of each State to contribute to the LTAG within its own national timeframe". Given in particular the national economy-wide commitments to 'net-zero' of 2060 by China, Indonesia, the Russian Federation and Saudi Arabia, and 2070 by India,

this language leaves a wide door open, implying unspecified increased burdens on other States.

The Assembly Resolution did not establish intermediate targets towards the 2050 goal (for example for 2030 and 2040), leaving these to be addressed at the next triennial session (to be held in 2025, the date when the IPCC believes global CO2 emissions need to peak). Neither did it address the issue of non-CO2 emissions and contrails.

Further apparent conflict with “each country will provide its own contribution” continues in the Resolution (A41-22) on CORSIA: “CORSIA is the only global market-based measure applying to CO2 emissions from international aviation so as to avoid a possible patchwork of duplicative State or regional MBMs [Market-Based Measures]”.

Formal Reservations were made on the whole of the LTAG and CORSIA Resolutions by China and the Russian Federation, meaning that these countries have no obligation regarding them. China did not recognise a stated characterisation that the UNFCCC had given ICAO responsibility on international aviation and climate change and said that nothing granted ICAO exclusivity and that ICAO was secondary to wider global climate change governance in the UNFCCC.

There are in practice fundamental issues regarding participation in ICAO environmental programmes. ICAO carefully avoids use of the word ‘mandatory’ for the CORSIA full implementation phase from 2027 onward - and with good reason: the Organization has no direct authority over its member States, and so it will be up to each State to decide whether to stay in CORSIA right through to its present termination in 2035. CORSIA is based on ICAO Standards and a State may “file a difference” to any (or all) aspects of it. The Organization considered but dismissed at an early stage the idea of developing a legally binding convention on a global MBM (or more broadly on implementation of the ‘basket’ of measures) - but the approach was quickly abandoned as unwieldy, time-consuming, lacking in flexibility, and liable to induce disputes.

The global adoption by ICAO of a long-term emissions mitigation goal is perhaps symbolically important but it is fragile as well as lacking substance in some respects.

Regulatory and related needs

Climate Action Tracker, an independent scientific analysis that follows government climate action and measures it against the Paris Agreement, found in June 2020 and confirmed in September 2022 that current mitigation measures for international aviation are "Critically Insufficient", compatible with a 4°C+ world (International Aviation | Climate Action Tracker). And the World Meteorological Organization has stated that, under present trends and commitments, international aviation and shipping will be the world’s major source of CO2 emissions by 2050, with aviation playing the leading part.

Given the scientific consensus that aviation emissions need to peak by 2025, be reduced by 2030 to at least half 2019 levels and by 2050 to zero, development and application of more powerful mitigation measures is critical. A study published in November 2021 by an eminent group of scientists suggests aviation emissions produced must be reduced **each year** if they are not to increase warming further, otherwise the sector could consume one-sixth or more of the remaining budget to limit warming to 1.5°C by 2050.

From the analysis above it is clear that the ICAO programme will not be close to achieving any of these requirements and that its institutional framework will continue to limit the effectiveness of the Organization on emissions mitigation. While recognising and supporting ICAO’s contribution, there is therefore a pressing need to go beyond it. There is no single “silver bullet” for aviation emissions mitigation and all avenues need to be explored and acted upon, irrespective of the institution or mechanism. There follows a discussion on some key mitigation needs, some regulatory ways in which they might be addressed and how ICAO may or may not be able to play a role in them.

Scientific knowledge. While the fundamental knowledge is increasingly solid for decision taking, further work would assist in elaborating on policy. The 1999 IPCC special report on *Aviation and the Global Atmosphere* might be updated in the light of more advanced scientific knowledge, and

notably with regard to non-CO2 emissions and contrails. And while ICAO's Committee on Aviation Environmental Protection felt that the publication in 2022 of its report on the feasibility of a long-term aspirational goal concluded its work in the field, further study of non-CO2 emissions and contrails by the Committee may be warranted. It may also be policy productive for CAEP to develop a 'backcasting' type of scenario in which zero emissions are taken as a goal and calculating what volume of air travel would fit into such an assumption.

Defining the targets. An immediate fundamental need going forward is for target definitions such as 'carbon neutral', 'zero carbon', 'zero emissions' and 'carbon net-zero' to be clearly specified and consistently applied. 'Carbon net-zero' may or may not, for example, include airport and fuel and other supply chain activity, while ICAO, IATA and EU interpretations of it include out-of-sector carbon offsetting or removals. Proponents of hydrogen and electric power claim that they will be 'zero carbon' - however, this usually relates only to the flights themselves and excludes the manufacturing and distribution process of the power source, a factor which needs to be incorporated. The commitment needs to be to zero emissions, the climate change pledge that would result from setting anthropogenic emissions to zero. The aim should initially be real zero for aircraft operations and ultimately on the basis of full life cycle including Scope 2 emissions from suppliers. While the target definitions should ultimately come from the UNFCCC, ICAO might provide its clarifications applicable to aviation in the meantime.

Non-CO2 emissions and contrail-Induced cirrus. The mitigation focus is currently on CO2, on which there is now "unequivocal" (IPCC) scientific consensus regarding the anthropogenic contribution to climate change. But aviation non-CO2 climate effects are currently estimated to be about two-thirds of the total aviation 'effective' radiative forcing based on historical data. Their climate impact has recently been acknowledged by the European Union and the EU *Emissions Trading System* will require reporting of them within Europe from 2025 and application from 2027 - they should urgently be addressed by ICAO. On the specific issue of contrails, there is a controversial view that they are a low hanging fruit in that they can readily be reduced by minimal flight operational changes. Scientific research into the impact of contrails should be aggressively pursued - for each power source - and indicative results actioned in accordance with the precautionary principle.

Intermediate targets en route to 2050. "Visions" or "aspirational goals" for a date more than a quarter century in the future are meaningless unless they are associated with transparent and binding intermediate targets. Every effort should be made for ICAO to develop - as early as possible in its present triennium - waypoints to LTAG 2050 at a minimum of every five years apart.

Commitments by all Parties to the Paris Agreement to include international aviation in their NDCs. Jurisdictions which have not yet included international aviation in their NDCs will continue to have no international legal mandate to reduce their international aviation emissions and they should be strongly encouraged to take action accordingly. Bringing international aviation into the NDCs would give direct accountability and incentive for States (directly or through ICAO) to act on the related emissions, individually or through multilateral mechanisms such as CORSIA and the EU *Emissions Trading System*. It would place international aviation more squarely in each national emissions context and the influence of the air transport industry would be taken in a generic setting rather than a predominantly sectoral one. It would also improve transparency.

While they are presently treated separately by the UNFCCC and ICAO respectively, it can be very difficult to differentiate domestic from international air transport operations and emissions. The same aircraft types are used with the same emissions characteristics and in many cases, airlines offer both domestic and international flights. This makes current regulation unnecessarily complex to implement and enforce. Domestic and international aviation also share broader emissions generation aspects. For example, London's Heathrow Airport is the largest single source of CO2 emissions in the United Kingdom, but the majority of those emissions are from local ground transportation and business, not from the flights themselves.

Technology and operational improvements. Improvements in the efficiency of aircraft operation and air traffic management will continue, as will the evolution of electric and hydrogen powered aircraft. ICAO's role in the updating of standards and procedures will no doubt also continue.

Applying the Science Based Target initiative (SBTi). This important project, to which a number of airlines are now accredited, is organized by some environmental and international organisations including the UN (https://sciencebasedtargets.org/). The SBTi helps private-sector organisations to set climate targets in line with the Paris Agreement, based on what science tells them is necessary to honour the Agreement, and to give aid in the development of concrete short- and medium-term targets. The SBTi accredits only those companies which adopt high standards of measurement and disclosure data and have serious carbon mitigation plans - offsets of any kind do not count. The target evaluates not only the extent of the CO2 emissions reductions companies need to make but the speed at which they need to do it. Company-wide emissions and target progress are tracked annually. To keep the sector's decarbonisation pathway aligned with the Paris Agreement goals, the SBTi introduced guidelines specific to aviation for target development in August 2021. In February 2023 SBTi released a new technical report detailing an interim pathway for aviation companies to set 1.5°C-aligned targets, which will be integrated into the *SBTi Aviation Guidance* and accompanying target setting tool. There remain some reservations about the SBTi application to aviation (for example establishment of the base year, steep emissions reductions only after 2030, not taking non-CO2 effects into account, see A critical letter to the Science Based Target Initiative (gofossilfree.org)). But it is worth evaluation by ICAO as a mitigation tool.

Transition away from out-of-sector offsetting towards in-sector emissions reduction. CORSIA should be de-emphasized, and retained only as a temporary, "gap filling" expedient. The Scheme could be improved by moving to in-sector offsetting through more widespread funding or purchase of certified SAF products and by application to more operations including not just those above baseline emission levels. Application of exemptions from offsetting (for example any flight with an "Low Carbon Aviation Fuel" emissions reduction of greater than 10%) could be reduced or withdrawn. But in practice CORSIA is likely to remain substantially inadequate to address the "residual" emissions after technology, operations and fuel measures are applied.

At the same time, the Scheme is a comprehensively developed mechanism containing crucial elements such as Standards on Monitoring, Reporting and Verification. ICAO has established *CORSIA Sustainability Criteria* for CORSIA eligible fuels which are becoming an important feature, even raising quality of offsets in a more general context. The Organization also has a Tracker Tool on aviation CO2 emissions reduction initiatives. These are elements which should be retained.

But more generally, out-of-sector carbon offsetting for aviation needs to be strongly discouraged in favour of real in-sector reductions in emissions.

The EU's ETS has proven more effective than carbon offsetting but in December 2022 a "trilogue" of the Commission, the Parliament and the Council effectively confirmed a backwards step. In 2008 the EU had decided to incorporate aviation into its ETS from 2012 onward; however, after concerns raised by a number of non-EU countries regarding the inclusion of their carriers, the EU decided to exempt flights to and from (but not within) Europe. In 2022, a proposal by the European Parliament, backed by environmental groups and major European low-cost (and short haul) airlines, to include all international flights **departing** the European Economic Area (EEA) within the EU ETS was blocked by the Council (the main governing body of the EU).

The EU ETS will therefore continue to apply only for intra-European flights, including departing flights to the United Kingdom and Switzerland. But Europe's long-haul flights, which create the majority of EU aviation emissions, will be subject only to CORSIA and hence only to "carbon neutral growth" (even the option of applying the ETS only to emissions below the CNG baselines was declined). The EU agreement is incongruous given the bloc's decision to include international

aviation in NDCs (thereby making them much more difficult to fulfil), inconsistent with a decision to include international shipping in the ETS, and on the face of it weak. The subject will only be revisited after the ICAO Assembly in 2025, to "assess if CORSIA implementation is sufficient to reduce aviation emissions in line with Paris climate objectives" (which it is already patently not).

Development and application of high grade SAF. Aside perhaps from electricity and hydrogen fuel cell for small capacity aircraft at the short haul, and subject to the limitations discussed above, SAF is the most reliable tool already on hand for mitigating aviation emissions, and synthetic fuels have potential for the longer term. Scaling up and pricing down are key and considered feasible, and governments are promoting them in two distinct ways, blending mandates and financial incentives. The *Refuel Aviation* proposal has already been effectively mandated in some EU countries and Canada in its Aviation Climate Action Plan for 2022-2030 sets an aspirational goal of 10% SAF use by 2030.

Rather than imposing a mandate, the United States included tax credits for SAF production (as well as carbon capture) in the 2022 *Inflation Reduction Act*, also offering other SAF incentives.

Several other countries are acting along similar "carrot or stick" lines. The World Economic Forum has developed a Sustainable Aviation Fuel Policy Toolkit, which should help smaller States in particular to develop SAF. In June 2022 ICAO launched an *Assistance, Capacity-building and Training for Sustainable Aviation Fuels (ICAO ACT-SAF) programme* which will provide opportunities for States to develop their full potential in SAF development and deployment. However, ICAO is not able to mandate SAF contributions or financial incentives and surely issues such as life cycle and land use, or blending mandates in individual countries, should not be in the remit of ICAO? But ICAO could still be of help by issuing guidelines on introduction pathways and clear quality rules for SAF.

A number of countries, including for example small islands with high tourism and hence air traffic, are unlikely to have the capacity to produce SAF in adequate quantities - they may well require special treatment in global policy, perhaps through extension of "Book and Claim" (in which the SAF is not physically transported and entered into the specific aircraft of the entity covering the fuel premium but goes into the fuel system at an airport close to the SAF production facility). There will also be a need to address aspects of specifying and verifying SAF consumption given blending into regular kerosene at airport fuel farms or purchase based on "Book and Claim"; in such cases the contribution cannot usually be set against specific flights and hence is not currently compatible with CORSIA.

Some corporate bodies are seeking to reduce their Scope 3 (downstream) emissions through downgrading of class of travel and purchase of SAF. The Sustainable Aviation Buyers Alliance (SABA) which includes a number of large companies, is developing a rigorous, transparent SAF certificate system on the basis of Book and Claim.

Carbon labeling. Such labelling is becoming more widespread in travel and tourism, notably for the air transport component. ICAO and IATA both post carbon emissions calculators which have recently been upgraded and promoted. A number of travel entities now display flight emissions data. Carbon labelling initiatives, when made available at the outset of the booking process at point of purchase, may well have some influence on passenger choice of flight (even if the ones with the lowest emissions are often the cheapest) and perhaps, for the short haul, on their choice of travel mode. However, the methodologies are not standardized, few of them include the impact of non-CO2 emissions and contrails, and they can produce a variety of results for the same flight. There are now available some labelling products with high quality standards but until there is carbon labelling or budgeting that shows just how much of an individual's annual emissions overall is generated by each air journey it is unlikely to have much direct behavioural impact on reduction in air transport traffic or emissions.

Fiscal measures. ICAO and industry repeatedly express concern regarding international aviation as a potential source for the mobilization of climate finance to other sectors (aside from the application of CORSIA!), while international aviation is in practice favourably biased through

exemption from fuel, value added and some other taxes. Furthermore, air transport is subsidized at many airports through the "single till" approach, whereby some of the profits from non-aeronautical revenues, including duty-free sales, are set against landing charges. The time is ripe for a profound rethink.

Direct carbon levies are a potential policy vehicle. Tax exemptions for fossil fuels - which discriminate in favour of air transport and against SAF, electric and hydrogen powered aircraft alike - should be removed - but preferably with ring-fencing of revenues for alternative fuel and power source development. If expressed in terms of excise duties (cf the United Kingdom's Air Passenger Duty) or of cost-related charges this would not breach the provisions in air services agreements. It would also reduce the differential price with SAF. In pursuance of CBDR, a leaf might be taken from CORSIA where there is exemption from application for all operations on routes to and from Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (LDCs, LLDCs and SIDS).

But such measures fall within the remit of individual governments, beyond ICAO competency (and are another argument to have all aviation bunker fuels included in NDCs).

Turning to application of fiscal mitigation measures directly related to the passenger, options suggested from time to time have included a global departure tax and a frequent flyer tax. The vast majority of taxpayers fly rarely or never. But, while the global contribution of aviation to climate change may be considered relatively small, the contribution to an individual traveler's total greenhouse gas emissions is very much higher and very often the dominant element.

The idea of frequent flyer taxes has recently been encouraged by civil society and in September 2022 the International Council for Clean Transportation (ICCT) published a White Paper which concluded that a global frequent flyer levy could help implement a global net-zero target in an equitable way. But implementation challenges exist and were not addressed at this stage, including creating accurate flying frequency databases, distinguishing leisure from business trips, and governing the use of revenues collected.

Any such levy would be difficult and costly to administer. It would also be open to leakage, for example by purchase of onward travel in a neighbouring country which does not have such a tax (or has one at a lower level); if such a practice were to be countered by tracking using nationality or residency as a basis this would raise potential data and privacy concerns. And achieving multinational agreement on such a tax and on a common level is unrealistic given the sovereignty of national taxation jurisdictions. Even banning 'air miles' programmes would raise all sorts of discrimination issues amongst both airlines and passengers. and these 'points' programmes are now broadly integrated into the economy well beyond the aviation sector.

Other forms of fiscal measures are worth exploring (see TPCC Aviation Report). Most are likely to be of a national or bilateral nature, but perhaps the time has come to lay the groundwork for a minimum aviation environmental charge globally according to distance (cf the G7 decision on minimum corporate taxes), with revenues to be ring-fenced as desired by individual parties for aviation emissions mitigation. A national levy on each flight taken, the length of the flight, and the flight class would also seem to be a viable approach. On this, ICAO might have a research role.

Hypothecation of taxes and duties from aviation to aviation has frequently been proposed by industry but governments have continually resisted, with any revenues going to the public purse of the treasury. However, the time and case have become ripe for re-evaluation. One suggestion is that airlines themselves agree to charge a fee per tonne of CO_2 emissions and apply the revenues to mitigation - IATA could take a lead on this (although government antitrust approval would be required).

But as a disclaimer against tax-subsidy mechanisms to introduce more environmentally friendly technology or SAF, regulation is logically far more efficient. Take for instance a SAF mandate. When one taxes aviation and then uses the revenues for subsidising SAF, the incentive to produce SAF at the lowest possible cost will in

most tax systems be much lower than when a mandate forces producers to sell on a subsidy-free market - it would thus feel the full force of market forces rather than one diluted by large percentages of subsidies. Furthermore, the effect on the environment is guaranteed and the cost is borne directly by the polluter.

Demand management. Even with optimum application of all the above measures, demand management in the form of emissions capping is likely to become necessary sooner rather than later if the Paris Agreement targets are to be met, and early evaluation of options should help to minimise their economic and social impact. The airline industry studiously eschews any serious contemplation of demand management - even if well designed it could actually increase both yield and revenues (see for example The impact of airport capacity constraints on air fares - SEO Economisch Onderzoek). Thus it will be primarily up to governments - in some cases in conjunction with airports - to consider the capping of airline operations in some way related to fundamental connectivity requirements and in line with defined benefit criteria including emissions reduction targets.

Application only to national carriers would be in contradiction of the equal application provisions of the Chicago Convention. Avoidance of competitive disadvantage is key. But absent the effectiveness of other measures, capacity capping may ultimately be the only option. Climate Action 100+, an investor-led initiative targeting corporate greenhouse gas emitters, believes that to meet the 2050 1.5°C target, for aviation necessary action includes keeping business travel to 2019 levels, capping long-haul flights of more than 6 hours for leisure reasons at 2019 levels, and shifting demand to high-speed rail infrastructure where possible (see Report).

At the short haul the concept of shifting travel from air to rail is under consideration in several European countries and France has actually banned domestic flights for which destinations can be reached within two and a half hours by rail or bus. While most rail and bus travel has significantly lower CO2 emissions per passenger kilometre than air travel, the benefits of shifting depend very much on particular circumstances, and lack of availability of flights could shift some travel to cars which might actually increase emissions.

The need for specifically capping aviation operations is now on the radar. For example a comprehensive research report by the Travel Foundation (Envision2030_SummaryFINAL.pdf) found only one scenario for travel and tourism to achieve net zero by 2050 and that incorporates slowing the growth in aviation - including capping long-haul flights (over 3 500 km) to 2019 levels.

Irrespective of the "ownership" of flight emissions - generally attributed to passengers/shippers and particularly air carriers (to whom mitigation action is today predominantly addressed) - the best locus for capping the emissions may well be the airport. And the predominance of self-interest and privacy issues for passengers/shippers, airlines and other market players means that government regulation is necessary. Capping action with airport locus is feasible within the existing regulatory framework and could be most effective (different circumstances would apply from the 2023 Amsterdam Schiphol flight capping proposal, which was aimed essentially at noise and local air quality rather than emissions reduction *per se*).

A tailored climate-based approach could be to cap not simply the number of flights or total amount of fuel but rather the volume of emissions according to the first leg of departing flights. The necessary data regarding CO2 from international operations, in total and for individual routes, are now available through ICAO's Monitoring, Reporting and Verification system for CORSIA. Also taking a leaf from CORSIA, routes to and from certain countries (for example LDCs, LLDCs and SIDS) could be exempted. Such an approach is discussed more fully in Lyle2023-AviationDemandManagement.pdf (responsibletourismpartnership.org).

Airports could become key enablers in aviation emissions reduction if they were to move thus beyond their Scope 1 and 2 emissions to Scope 3 in the form of including emissions from the flights departing their runways to their first destination (with these emissions included in national NDCs). Stability could be added through some form of emissions trading amongst co-operating airports or integration into a broader system such as that of the EU ETS. Such an approach could also reduce

significantly the undue influence of air carriers on emissions reduction policy and practice. Context for such an approach is provided in a report in July 2023 by the Sustainable Tourism Global Center (STGC, Saudi Arabia) and the global airports body Airports Council International (ACI) with consultancy Oliver Wyman: Evolution Of Airports – Travel Trends In The Next 30 Years (oliverwymanforum.com).

Getting multilateral agreement on aviation demand management, beyond Europe, is unlikely and well beyond the remit of ICAO. However, one role ICAO might play, perhaps in co-operation with the World Economic Forum, the World Trade Organization and the UN World Tourism Organization, would be in developing criteria and providing guidance on defining grades of essential and less essential connectivity. Ultimately the global aviation network may well require redesign.

The bottom line

While ICAO's programme on aviation emissions mitigation should be fully supported, it will inevitably continue to be substantially inadequate in its contribution to achieving the Paris Agreement goals. In general terms there is a need not only to allow but strongly to encourage greater ambition by individual countries and groups of countries, complementary but in addition to the multilateral sectoral arrangements on aviation. States should not be constrained, as they have been in the past, from applying economic instruments. Individual Parties should rather be empowered to apply such vehicles as fossil fuel levies and related low-carbon fuel production incentives - or capacity capping - preferably in coordination to avoid potential allegations of discrimination.

As for ICAO's contribution to climate change mitigation, there is a need to select relevant input from the Organization's definitive activity in safety, security and facilitation, flight operations and air traffic management while recognising the Organization's statutory limitations in the field of regulatory economics and its narrow role in climate policy. More generally, there is a need to break away from the aviation silo, to take into account the downstream economic and social issues - while encompassing Scope 3 emissions - and generally to tie action more closely to trade and tourism (and to responses to "overtourism" and "degrowth"). ICAO should certainly no longer be sanctioned to continue as the sole regulatory policy framer for international aviation emissions globally. Individual countries should be free to add their own more ambitious action as promoted by the Paris Agreement. Comprehensive rethinking of policy and action is required as a matter of urgency. ICAO certainly has an important continuing role to play but it should not be the only one, every policy option should be explored.

Chris Lyle

January 2024

clyle@airtransporteconomics.ca

The author acknowledges with thanks the contribution and comments on a draft of this Horizon Paper by Susanne Becken (Griffith University, Australia), Geoffrey Lipman (SUNx Malta), Martin Cames (Oeko-Institut e.V., Germany), and Paul Peeters (Breda University of Applied Sciences, Netherlands).