Climate Change Mitigation Measures in Aviation Sector and Implication for Tourism Sector
航空分野における気候変動対策と観光分野への示唆

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Abstract

Recently the circumstances surrounding aviation sector have changed considerably from the environmental aspects. In 2015, UNFCCC parties agreed on Paris Agreement (PA) and set the long-term goal for climate change mitigation covering domestic aviation sector of each country. In 2016, International Civil Aviation Organization (ICAO) in charge of international aviation has set the first ever global sectoral market-based measure (MBM), the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) to achieve the global sector target of 2% annual fuel efficiency improvement and carbon-neutral growth from 2020 until 2050. The work is not completed yet. MBM is written also in PA but member states are still finalizing its exact content. ICAO members so far have not agreed on the long-term target (from 2050 onwards). Tourism sector as a whole has no cohesive sector target for climate change for either short/medium-term or long-term. This paper views that these policy target gaps should be filled quickly so that the truly global collaborative efforts would work for the effective mitigation of the very long-term problem, i.e., climate change.

I. Policy Developments in Aviation Sector

1. Introduction

Recently, the circumstances surrounding international aviation have changed considerably from the environmental aspects. International aviation sector is included in neither Kyoto Protocol (KP) (1997) nor Paris Agreement (PA) (2015) under the United Nations Framework Convention of Climate Change (UNFCCC), although domestic aviation is covered by both. In fact, the international aviation has been left to the deliberation at International Civil Aviation Organization (ICAO), a UN specialized agency.

The basic principle of climate change under the UNCCC, however, has changed significantly from the era of KP to PA. In KP, there was the principle of "common but differentiated responsibilities and capabilities (CBDR)." The principle basically means that the industrialized countries which have mainly provided emissions so far should bear more responsibilities of future reductions than developing countries that provided emissions less thus far. While the newly developed countries, such as China, continued to grow and the emission from such countries continued to increase, PA was finally agreed in 2015. In PA, both developed and developing countries share the common long-term temperature goal and efforts (for limiting global temperature increase from pre-industrial age to well below 2 degree Celsius, with efforts to limit the increase to 1.5 degree Celsius). The two sides share the same framework of responsibility to take mitigation measures such as a nationally determined contribution (NDC). Under these circumstances, ICAO has set the first ever global market-based measure for an entire sector (international aviation) in 2016, the Carbon Offsetting and Reduction Scheme for International Aviation – (CORSIA) in order to achieve the global sector target of 2% annual fuel efficiency improvement and carbon-neutral growth from 2020 until 2050 . Market based mechanism is also written in PA (Article 6) but member states continued to negotiate its details and they are not yet agreed upon as of October 2020.

In more general context, the perception by the general public of air travel has been significantly diversified. Traditionally, safety and efficiency are significant part as we observed numerous safety measures about aviation in ICAO and the economic advent of LCC models. Recently, more and more attentions are on environment and sustainability. Some people prefer using public transportation, such as railroad or sea liner, to aviation. We observe the terminology of "Fly Shame" in this context. It could be because there have been

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steadily growing concerns among the general public about environmentally negative aspects of aviation congestion at many air travel hubs, social and community levels of adverse effects of over-tourism, and occurrence of more and more severe natural disasters from powerful typhoons or huge wildfires. Many suspect that such natural disasters could be caused by climate change stemming from GHGs emission from sources including autos or aircrafts. UN Climate Change Annual Report 2019 call this situation, "A Planetary Emergency." Then came the COVID-19 from 2019. Its imminent effects are overwhelming world-wide on many aspects of our lives. Although the medium- or longer-term effects are yet to be seen, COVID-19 could fundamentally change the way of traveling, working and even communicating in the direction of touchless, remote, or virtual relationships for many years to come.

We have now common global target and the basket of measures to achieve it in international aviation sector at ICAO. In the domestic aviation sector, which is covered in PA, parties also agreed on the common global target and started constructing details of the measures to achieve the target, such as market-based mechanism. But the long-term global target for international aviation has yet to come. As for tourism sector, even the short/medium-term global target is not yet set, let alone the long-term global target. With the urgency of setting up the proper measures and actually implementing them, these policy target gaps should be filled fairly soon.

2. Aviation Sector Growth and Impact of COVD-19

Aviation is growing steadily over the past decades. Compound annual growth rate (CAGR) of revenue passenger kilometers (RPKs), which is metric of the sector's output, in both domestic and international aviation, is 5.4% from 1995 to 2015 and is estimated to be 4.3% from 2015 to 2035, and 4.1% from 2015 to 2045 by ICAO (World Civil Aviation Report 2018, before the outbreak of COVID-19), which is shown in the following Figure 1. According to the latest ICAO's forecasts (also using 2018 baseline before the outbreak of COVID-19), global passenger traffic will grow at about 4.2% annually from 2018 to 2048.

Staring from December 2019 in Wuhan, China, the outbreak of new infectious disease called COVID-19 has quickly spread into other countries, resulting in worldwide pandemic by March 2020. It is caused by the novel coronavirus,

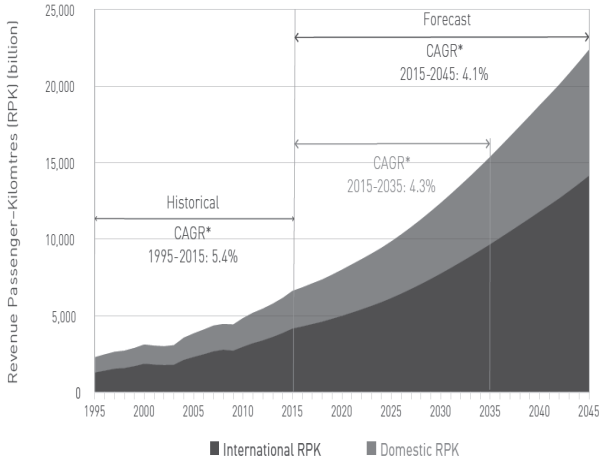

Figure 1 Aviation Growth and Projection (1995-2045) (ICAO 2019)

SARS-COV2, which is categorized in the same corona-virus family causing diseases such as SARS or MERS. Medical researches revealed that COVID-19 would be transmitted from person to person by close physical contacts. The human movement is a major contributor to contagion of COVID-19. So, most countries started international travel restrictions by midst of April 2020, and many countries restricted domestic travel, too. These travel restrictions had unprecedented and devastating effect on international air travel in 2020. The actual impacts will depend on duration and magnitude of the outbreak, containment measures including vaccines, the degree of consumer confidence for air/sea/land travel, economic conditions, and so on.

The overall world passenger traffic is estimated to decline by more than -57% as compared to the year before as of September 2020 by ICAO. Below is the Figure 2 for the historic record of total number of passengers carried and impact estimation of 2020. we can see that both international and domestic passengers are receiving similarly historic damping impact in 2020. ICAO estimates that the number of passengers carried would be as much as - 60% decline from the 2019 level for both domestic and international aviation. This would push back the number of air passenger carried as far as 20 years or so.

The aviation industry association, International Air Transport Association (IATA) had made public the forecast (Figure 3 below) for the recovery trajectory estimations of RPKs under the COVID-19. In the forecast, "we expect RPKs to decline by a little more than 60% in 2020 compared to 2019, with a return to pre-COVID levels not occurring before

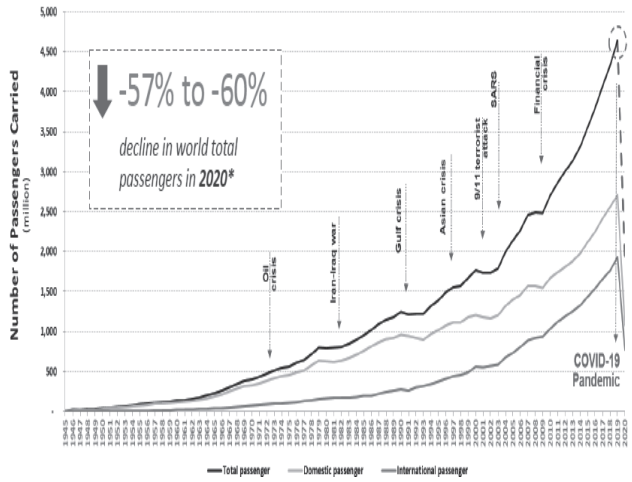

Figure 2 World Passenger Traffic 1945-2020 (ICAO 2020)

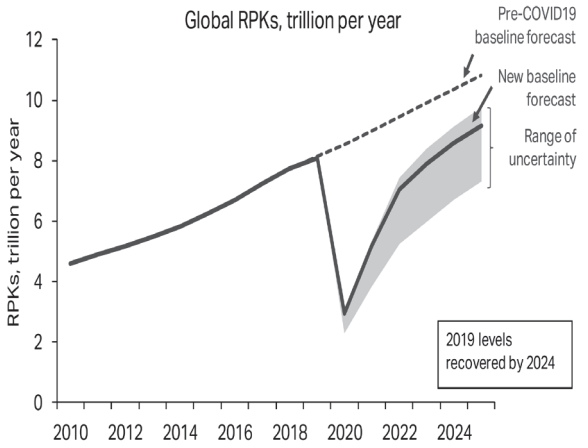

Figure 3 Revenue Passenger Kilometers (RPKs) Forecasts (IATA 2020)

2024." This means that we may have to wait for at least four years to regain the passenger traffic level in 2019.

Also, UNWTO, a UN specialized agency about tourism sector, estimates that the world tourist arrivals would decline more than 70% by monthly year on year comparison between 2019 and 2020. This means that more than 850 million international tourist arrivals would be lost, more than 910 billion USD export revenues from tourism would be lost, and more than 100 million tourism jobs would be at risk. Also, UNWTO made public the estimates that it will take two and half to four years for world tourist arrivals to recover to the 2019 level.

3. Air Cargo Growth

The noticeable record during the first half of COVID-19 struck 2020 is the growth of air cargo. According to ICAO data, the global air cargo almost steadily kept growing over the result of 2019. Except for February (- 4.1% from the February 2019), the results from March through August showed the increase over the result of each month 2019; March (+6.9%), April (+2.1%), May (+4.5%), June (+10.1%), July (+7.9%), and August (+4.7%). These results show the elevated need for high-speed transportation of such goods that are in urgent need during COVID-19 pandemic as facial masks, medical gowns, medicines, testing samples, ventilators, and other materials.

4.Recent Policy Developments about Climate Change Mitigation at International Aviation Sector

4.1 Mitigation Measures

The scientific researches about the impact of aviation on climate change are still underway. The aviation is a complex system comprising various subsystems such as the process of fuel burning in a single engine of a single aircraft to the accumulation of thousands of flights of many aircrafts. The scientific impact on the climate of simple phenomenon, such as contrail entailing aircraft in the sky for a while after the aircraft passes, is still very much the main research topic according to the pioneering work of the IPCC special report (1999) and ICAO (2010). The schematic illustration of aviation and its climate impact are shown in Figure 4 below. Out of many greenhouse gases (GHGs), CO2 have politically special importance, since it is not toxic in itself, from very wide range of human activities, and its effects probably is no smaller than other GHGs.

Under demand projections, the emission level of CO2 from international aviation are estimated by ICAO as in Figure 5 below. If no action is taken, the emission will grow based on the growth trajectory of RPKs. Figure 5 shows results for global full-flight (i.e., from departure gate to arrival gate) fuel burn for international aviation from 2005 to 2045, and then extrapolated to 2050. Uppermost line is the baseline, which is the case for business as usual.

As we stated, both KP and PA confide the emission reduction measures of international aviation sector to ICAO. Since the two mechanisms are based on each contracting country and its commitments within its jurisdiction, mitigation from

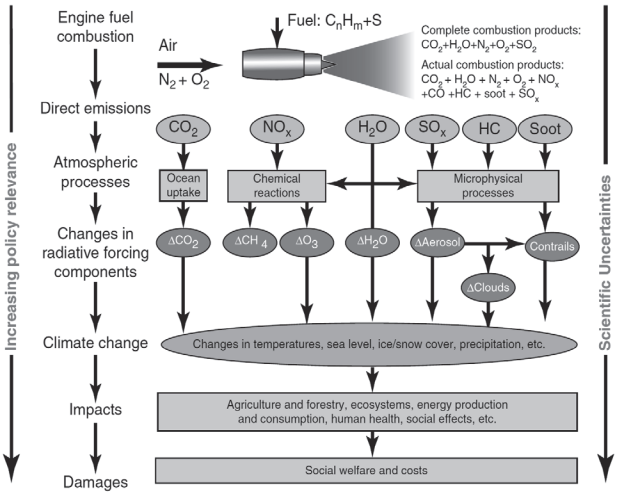

Figure 4 Schematic representation of aircraft emissions and their causal linkage with potential climate and social welfare impacts (ICAO 2010)

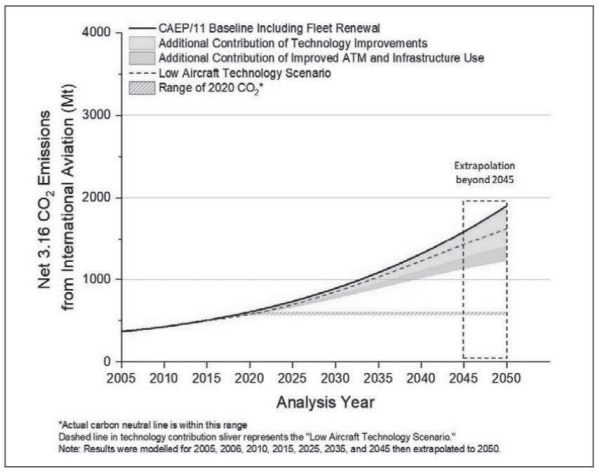

Figure 5 CO2 Emissions from International Aviation (2005-2050) (ICAO 2019)

international aviation with the inherent nature of cross-border operation would be better addressed with the global sector specialized body, ICAO.

Then ICAO made the CO2 reduction estimation from that baseline by utilizing so-called basket of measures. ICAO had set up the first ever global sectoral (international aviation) aspirational goals for CO2 emissions back in 2010. The goal is two percent annual fuel efficiency improvement and carbon neutral growth from 2020 until 2050. ICAO's basket of measures was set to meet these goals. The contents of basket of measures are listed below.

[Basket of Measures at ICAO]

① aircraft technology and standards;
② development of sustainable aviation fuels;
③ operational improvements;
④ the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

The first reduction measure is technology improvement (①). This is about the improvement of aircrafts and engines. Development of more efficient aircraft type design and more efficient aircraft engine can contribute to the fuel burn efficiency. ICAO estimates that aircraft technology improvement can be annual fuel burn improvement from 0.57% through 1.5% into 2050.

The development of sustainable aviation fuel (SAF) (②) is the new development of bio-based fuel[1] and blending it into the traditional carbon-based jet fuel. A SAF must achieve at least 10% GHG emission reduction on a life cycle basis. Compliance with those criteria will be confirmed by Sustainability Certification Schemes (SCSs).

Although the impact of introducing SAF is significant, the reduction is not enough to completely cancel the CO2 emission form international aviation, and in fact the emission level will grow from about 2040 even with 100% replacement. The high percentage of replacement of conventional jet fuel with SAF would require high availability of bioenergy feedstock. The production of such volume of bioenergy feedstock would be significantly affected by its price or other policy mechanism. Also, 100% replacement of alternative jet fuel would require a complete shift in aviation consumption, from petroleum to bio-based fuels, and a significant expansion of the agricultural sector. These transitions would require substantial policy support.

[1] Between 2011 and 2015, 22 airlines performed over 2,500 commercial passenger flights with blends of up to 50% bio-based fuel from feedstock including used cooking oil, jatropha, camelina, algae and sugarcane. In June 2019, more than 180,000 commercial flights using SAF have been performed and greater than 40 different commercial airlines have gained experience using SAT according to ICAO (2019). Some additional research and development of new bio-based fuel is underway. Euglena, for example, is micro-algae categorized as both plant and animal, and is known for its high level of photo-synthetic efficiency and reproduction speed. Euglena based-jet fuel has been produced based on ASTM (American Society of Testing and Materials) standard and is approved for commercial airline use by Japan Civil Aviation Bureau February 2020.

Figure 6 illustrates the basket of measures makes the carbon neutral growth from 2020 possible.

Operational improvement (③) is the next measure. This is about airlines' aircraft operation improvement, the improvement of Air Traffic Management and infrastructure use improvement. Operational improvement come also from more efficient aircraft operations including continuous climbing and descending operation (CCO and CDO) around airports. In addition, it comes from the implementation of new technologies, concepts and procedures developed under the auspices of the regional air traffic management (ATM) improvement programs such as SESAR (Europe), NextGen (US) and CARATS (Japan).

These programs are aligned at the ICAO level under the Aviation System Block Upgrades (ASBU) framework that is detailed in the Global Air Navigation Plan (GANP).

CORSIA (④) is the first global sectoral market-based measure, the framework of which was established in 2016. CORSIA is the scheme to off-set the carbon emission growth above baseline (2019-2020 average) for each aeroplane operator within the system by purchasing carbon offsetting units and/or using CORSIA eligible alternative fuel to reduce offsetting requirements. It is contrasted with similar but different mechanism such as the European Union Emissions Trading Scheme (EU-ETS). The latter is so-called cap and trade mechanism, which is administered in EU area and covers domestic flight within EU area.

4.2 CORSIA

As was just stated, CORSIA is the scheme to off-set the carbon emission growth above baseline (2019-2020 average) calculated for each aeroplane operator within the CORSIA system by purchasing carbon offsetting units outside aviation sector and/or using CORSIA compatible alternative fuel to reduce off- setting requirements[2].

As the Figure 6 shows, the largest part of reduction estimation is sustainable aviation fuel (SAF) and CORSIA. Then comes the reduction form aircraft technology, and the reduction from operational improvement. Combined with all these three measures, ICAO estimates to achieve carbon neutral growth from 2020.

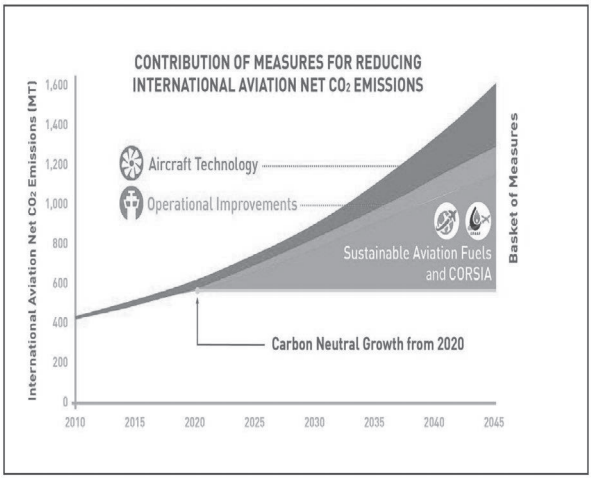

Figure 6 Contribution of Basket of Measures for Reducing CO2 Emission from International Aviation (ICAO 2019)

CORSIA is the latest measures set up at ICAO, and together with utilizing SAF, it assumes the large part of reduction estimation in order to achieve the carbon neutral growth goal from 2020 set by ICAO.

Under CORSIA, aeroplane operators will be required to purchase and cancel "emissions units" to offset the increase in CO2 emissions from their operations, which is calculated, reported, verified under the CORSIA scheme. Also, CORSIA has the mechanism to account for verifying the use of low emission aviation fuel to be used as offsets to the CO2 increase if such low emission fuel meets CORSIA standards. So CORSIA is actually not only market base mechanism but also encouraging aeroplane operators to switch for low emission aviation fuel that meet the standards set by CORSIA.

As ICAO (2019) report states, experts have recommended for many decades using emissions units, also known as carbon credits, as part of a market-based approach to address climate change. UNFCCC KP included a mechanism for some States to meet their emissions reductions commitments using emissions units. Similarly, EU ETS has used emissions units for over a decade to achieve the European Union's greenhouse gas reduction goals.

Emissions units are generated when emissions from a specific project or program are reduced, compared to a baseline (or

[2] About CORSIA, ICAO provides several official documents, including ICAO Assembly Resolution A39-3 (2016) and following related materials, such as ICAO International Standards and Recommended Practices (SARPS) Annex 16, Volume IV (2018), Environmental Technical Manual (Doc 9501), Volume IV (2019). Also, the ICAO Environmental Report 2019 has a detailed explanation about ICAO CORSIA and other basket of measures. The section 4 is based on these documents.

business-as-usual scenario), through the implementation of emission reductions techniques/technologies. These projects or programs can be implemented in various sectors, such as electricity generation, industrial processes, agriculture, forestry, and/or waste management.

In general, emissions units are issued, or created, in a program registry. A program registry is akin to an online bank for emissions units. Emissions units can only exist within a registry, where they are also traded, tracked, and cancelled.

While emissions units exist within a registry, their owner may change. For example, a project developer may sell them to a compliance buyer, such as an airline registered in a State which participates in CORSIA. This transaction can occur through an exchange, a broker, or a direct bilateral contract between the seller and the buyer.

The compliance buyer will then use the emissions units to meet its obligations. In the context of CORSIA, this means that the airline will cancel the required number of emissions units in the registry.

Importantly, the emissions units which are cancelled must not be counted elsewhere, such as for compliance with another program or Nationally Determined Contribution (NDC) under the UNFCCC PA.

If the emissions units are counted for another emissions reduction program, then they cannot also count for CORSIA. An emissions unit can only be counted once as a reduction.

In 2019, ICAO approved the Emissions Units Criteria (EUC), which will be used to undertake the assessment of emissions unit programs and to determine eligible emissions units for use by airlines under CORSIA. The approved EUC is available at the ICAO CORSIA website[3].

Emissions coverage under CORSIA is based on a route-based approach. This means that emissions from all aeroplane operators performing international flights between two States where both the origin and destination States participate in CORSIA are covered by the offsetting requirements of the Scheme. The route-based approach ensures that all aeroplane operators with flights on the same international routes are treated equally irrespective of whether the States to which they are attributed participate in CORSIA. Exemptions also apply to aeroplane operators with less than 10, 000 tons of annual CO2 emissions, to aeroplanes with less than 5, 700kg take-off weight, and to humanitarian, medical and firefighting operations.

4.3 Timeline of CORSIA

CORSIA will be implemented in three phases: a pilot phase from 2021 through 2023, a first phase from 2024 through 2026, and a second phase from 2027 through 2035. This time line is illustrated in Table 1[4].

Table 1 CORSIA Period and Participation

Period	2021-2023	2024-2026	2027-2035
	Pilot Phase	First Phase	Second Phase
Participation	Voluntary		Mandatory except for small countries and LDCs
Annual Offsetting Requirements to be Purchased by Airlines	Requirements to be allocated for each operator based on the calculations of emission level above the aviation sector baseline (2019-2020 average)*		

*: ICAO announced the baseline should be 2019 level, instead of 2019-2020 average, during pilot phase (2021-2023).

For the first two phases (2021 to 2026), participation is voluntary. As of June 2019, 80 States – representing 76.63% of international aviation Revenue Ton-Kilometers (RTKs) – have announced their intention to participate in the CORSIA from its outset. From 2027 onwards, participation will be determined based on 2018 RTK data. Specifically, CORSIA will cover all States with an individual share of 2018 RTKs higher than 0.5 per cent of total RTKs or whose cumulative share in the list of States from the highest to the lowest amount of RTKs reaches 90 per cent of total RTKs. According to Assembly Resolution A39-3, Least Developed Countries (LDCs), Small Island Developing States (SIDS) and Landlocked Developing Countries (LLDCs) are exempt from

[3] https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Emissions-Units.aspx

[4] According to a certain case study by Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan, the rough average cost estimates for a typical Japanese airline range from several million US$ in 2021 to ten to several million US$ in 2035 within CORSIA scheme.

participation (even if they fulfill these RTK conditions), but they can participate in the Scheme on a voluntary basis.

4.4 CO2 Offsetting Requirements Calculations

Once participating States and routes covered by the CORSIA are defined (starting in 2021), the amount of CO2 offsetting requirements for individual aeroplane operators is calculated in such ways as follows (shown also in Figure 7):

1) from 2021 through 2029, the amount of CO2 offsetting requirements is calculated by multiplying the operators' annual emissions with the international aviation sector's growth factor every year, following a so-called 100 per cent sectoral approach; and
2) from 2030 onwards, the amount of CO2 offsetting requirements is calculated by considering both the sector's growth factor and the growth factor of an individual operator; the individual factor's contribution to the calculation will be at least 20 per cent from 2030 to 2032; and at least 70 per cent from 2033 to 2035.

The sector's growth factor is obtained by dividing the aggregated increase in total CO2 emissions above the baseline from all operators by the total CO2 emissions from international civil aviation in a given year. The growth factor of individual operator corresponds to the difference between an operator's CO2 emissions in a given compliance year and its emissions in the baseline (average of 2019-2020).

In either case, only the emissions from state-pairs subject to offsetting requirements are taken into account in the determination of the sector's growth factor.

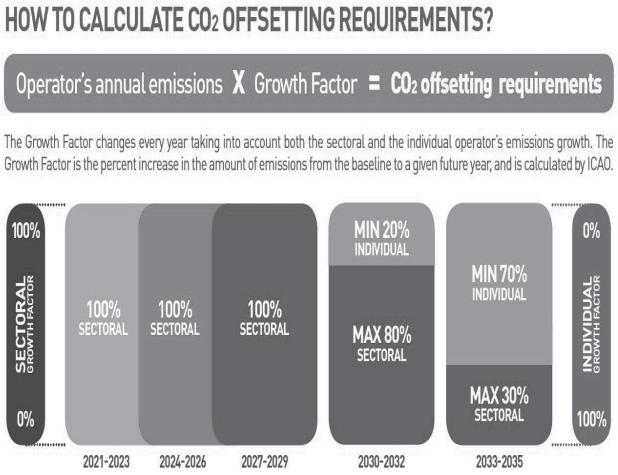

Figure 7 CORSIA How to Calculate CO2 Offsetting Requirement (ICAO 2019)

As already mentioned, CORSIA includes the emission reduction scheme for each aeroplane operator to switch its fuel from traditional fossil-based fuel to low emission aviation fuel, CORSIA eligible fuel (CEF) in sustainable aviation fuel (SAF) based on CORSIA emission reduction formula. The use of CEF can reduce aviation CO2 emissions on a life cycle basis (i.e., from production to combustion). The reduction of CO2 emissions from CEF depends on a variety of factors, for example, the feedstock used, how the feedstock was produced, the fuel conversion process used, etc. These factors combine to provide a fuel's life cycle emissions value (LSf).

An aeroplane operator can reduce its CORSIA offsetting requirements by claiming emissions reductions from the use of CEF through the following process:

1) The operator obtains the life cycle emissions value (LSf) of the CEF. This is determined during the CEF sustainability certification process, defined in CORSIA.
2) The operator calculates the CEF emissions reductions (ERt) according to CEF emission reduction formula[5].

Starting in 2022, CORSIA will be periodically reviewed, every three years, by the ICAO Council. The review will

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[5] $ER_t = FCF \times [\sum_f MS_{f,t} \times (1 - \frac{LS_f}{LC})]$

ER_t : CEF fuel emission reduction in year t

FCF : fuel conversion factor, fixed value, e.g., 3.16 [$kgCO_2$ / kg fuel] for jet-A fuel

$MS_{f,t}$: total mass of CEF claimed in year t by fuel type f

LS_f : life cycle emission values by fuel type f

LC : baseline life cycle emission values, e.g., 89 [gCO_2/MJ] for jet-A fuel

include, among other features, the assessment of its impact on the growth of international aviation, and the results of this assessment will serve as an important basis for the Council to recommend, as appropriate, adjustments to the scheme for the consideration by the ICAO Assembly.

4.5 Impact of COVID-19 on CORSIA

COVID-19 has posed unprecedented negative impact on aviation demand. This huge negative impact has forced ICAO to change several implementation-related items. ICAO has set up the website [6] in order to provide up-to-date information about various impacts of the ongoing situation on the implementation of CORSIA, as well as the remedial measures and decisions being taken by ICAO.

Mainly two items are in focus at present in connection with the pandemic of COVID-19.

1) Deadline for reporting and verification on CORSIA Implementation

Since the outset of the COVID-19 pandemic, several States and aeroplane operators alike have expressed concerns regarding their capacity to meet the CORSIA reporting timelines starting from 2020. A frequent cause of the concern is the difficulty to conduct the verification of the aeroplane operators' Emissions Reports, due to the fact that mobility restrictions pose a challenge to the organization of verification bodies' site visits to the operators' facilities. In the context of the verification of aeroplane operators' Emissions Reports, site visits are not a requirement, although they are recommended in the guidance provided in technical manual. The decision to undertake a site visit as part of the verification of the aeroplane operator's Emissions Report is to be taken by the verification body on the basis of a risk analysis during the preparatory stage of the verification. ICAO has made clear that alternative approach (e.g. remote verification) with risk analysis and coordination is possible for the concerned parties and continue to supply support in capacity building seminars and websites. ICAO encouraged States to make all the efforts to meet the deadline of 31 August 2020 to report on their respective CO2 emissions data corresponding to year 2019.

At the same time, ICAO, cognizant of the challenges posed by the current situation, invited those States that have difficulty in meeting this deadline of 31 August 2020 to inform ICAO and they will work flexibly to accommodate late submissions by States, as appropriate.

2) Baseline calculation for 2020 on CORSIA design measure.

CORSIA's sectoral baseline is defined as the average of total CO2 emissions for the years 2019 and 2020 on the routes covered by CORSIA offsetting scheme in a given year from 2021 onwards. Therefore, the expected reduction of the 2020 CO2 emissions from international aviation due to the COVID-19 pandemic will lead to a decrease of the CORSIA baseline, compared to the non-COVID-19 scenario and could mean significant increase of the offsetting requirement for each operator.

For example, CORSIA calculates annual offsetting requirements for individual aeroplane operators every year from 2022 based on an annual Sector's Growth Factor (SGF), which represents the CO2 emissions growth of international aviation in a given year from 2021, compared to CORSIA's sectoral baseline (average of 2019 and 2020). The impact of COVID-19 on a given year's SGF will be reflected through: the impact on CORSIA's sectoral baseline; and the impact on the given year's CO2 emissions from international aviation, which will depend on the aviation sector's recovery pattern from 2021 onwards. The compounded effect on the year's SGF will determine the magnitude and nature of the impact on the total CORSIA offsetting requirements for that year, as well as the associated costs for the industry. Industry body expressed the concern for the possibility of significant increased burden on aeroplane operators.

Any adjustment to CORSIA's design features is a matter that requires careful consideration by the relevant ICAO bodies about the economic and legal aspects.

ICAO had to assess various aspects, including the importance of maintaining the originally agreed balance between the scheme's economic impacts and environmental benefits together with its simplicity and practicality, whilst responding to this unprecedented crisis. After the careful deliberations, ICAO agreed that, in order to safeguard against inappropriate economic burden on aeroplane operators, 2020 emissions

[6] https://www.icao.int/covid/Pages/default.aspx

should not be used for CORSIA during pilot phase (2021-2023). In this regard, during the pilot phase, ICAO decided that 2019 emissions shall be used for 2020 emissions and published this in all relevant ICAO documents. ICAO will conduct a periodic review of the CORSIA every three years from 2022. In this regard, ICAO highlighted the importance of undertaking the 2022 periodic review, which will offer an opportunity to examine the impact of COVID-19 on CORSIA on various issues, including the impact on the baseline beyond the pilot phase.

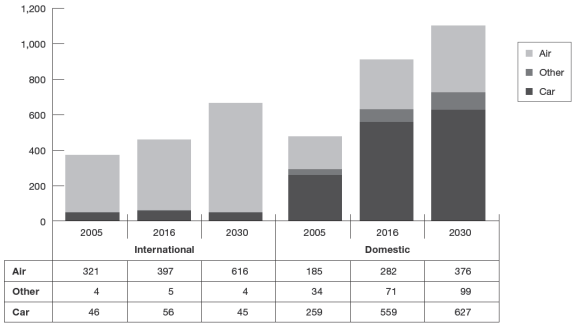
II. ICAO's Policy Measures in Perspective and Implication for Tourism Sector

Under the COVID-19 pandemic, air cargo market shows the steady increase, since the medical supply, high-quality masks, personal protective equipments, and ventilators are needed to be quickly transported by aircrafts. Also, the supply chain in our globalization era is reevaluated as the vital material and energy supply networks. For example, many seamen in cargo ships under the global supply chain are kept in their ships for months because of quarantine issues, and their work rotations for the fresh workers needed quick air transport. In essence, the air transport has its vital needs for its high-speed function even after the fly-shame era and at the time of COVID-19. In order to keep the air transport continue to live up to the societies' vital needs in the foreseeable future, aviation sector must transform itself as truly sustainable functional pillar in our world.

Aviation sector had set the medium-term target and ICAO constructed the basket of measures by 2016. In hindsight, aviation industry group (IATA) and Maritime sector (UN Specialized agency, IMO) have already set the long-term goal for 2050 and later. Aviation industry group in 2009 set the next goal to cut net emissions to half of 2005 levels by 2050. International Energy Agency (IEA) estimates that emissions from the aviation sector should decline to a certain level (0.3 GtCO2-eq) by 2060 under their "Beyond 2°C Scenario." The IEA notes that this is consistent with the industry's long-term target to halve its net emissions by 2050, compared to 2005. ICAO itself is still considering the long-term goal from 2050 onwards and has not yet set the concrete target as of October 2020.

Although aviation sector had cut the carbon footprint of an individual flyer by 50% since 1990 and ICAO has set the first global sectorial target back in 2010, in terms of the short/medium-term goal, maritime sector (IMO) and PA has already gone further than ICAO about the long-term goals. Aviation sector's public body's long-term goal after 2050 for climate change mitigation and sustainability is a pressing issue yet to be addressed.

In the tourism sector, there is no cohesive climate target so far by UN specialized agency World Tourism Organization (UNWTO). Domestic tourism sector is covered in PA and international tourism movement in aviation and maritime sectors is technically covered by ICAO and IMO. UNWTO jointly with International Transport Forum (ITF) made public a report about CO2 emission estimation from transport-related tourism sector in 2019 (Figure 8 below).



	International			Domestic		
	2005	2016	2030	2005	2016	2030
Air	321	397	616	185	282	376
Other	4	5	4	34	71	99
Car	46	56	45	259	559	627

Figure 8 Transport-related Emissions from Domestic and International Tourist Arrivals by Mode of Transport:(2005, 2016 and 2030) (Mt of CO2) (UNWTO 2019)

The report's estimation methods are, however, not in line with those of ICAO or IMO on international movements. We need more inter-agency collaborations over the issue for comparability on the highly technical issues such as CO2 emissions and climate change. Since PA, ICAO, and IMO have all the medium-term target for 2050 as shown in table 2 below and COVID-19 could be fundamentally resetting growth path until 2019, now is the huge opportunity for UNWTO to speed up to form at least the medium-term target until 2050. This would enable tourism sector systematically pursuit its officially announced goal of disconnecting growth form emission in tourism sector and to play its share of significant role in attaining SDGs.

UNWTO (2019) states, "in 2016 transport-related emissions

Table 2 The Comparison of Climate Change Mitigation Objectives among Major Sectors

Period	Short,/Medium-term (-2050)	Long-term (2050-)
Paris Agreement	-Keeping a global temperature rise this century well below 2℃ above pre-industrial levels (pursue efforts to limit it to 1.5℃) -Carbon Neurral Growth in latter half of this century	
Aviation Industry	- Average Annual Fuel Efficiency Improvement by 1.5% from 2020 - No increase of total Emission from 2020	- Total Emission should be decreased by more than 50% from 2005 level.
ICAO (Aviation Sector)	- Average Annual Fuel Efficiency Improvement by 2% from 2020 - No increase of total Emission from 2020	Not Yet Decided
IMO (Maritime Sector)	- Fuel Efficiency Improvement by at least 40%From 2008 level by 2030 - Fuel Efficiency Improvement by at least 50%From 2008 level by 2050	- GHG zero as earliest as possible within this century
UNWTO (Tourism Sector)	Not Yet Decided	Not Yet Decided

from tourism contributed to 5% of all man-made emissions and are to increase to 5.3 % by 2030 against a current ambition scenario. The projected increase represents 25% growth, from 1,597 million tons of transport-related CO2 attributable to tourism in 2016 to 1,998 million tons in 2030.In view of these findings, it is urgent for the tourism sector to define a "*high ambition scenario*" that would allow the sector to transform and advance towards significantly decoupling growth from emissions, in order to ensure its contribution to the PA and SDG13 on Climate Action."

In our view, UNWTO has only started the basic research about CO2 emission level from transport-related tourism sectors on this matter. The quick green recovery action with medium-term goal is craved in this historic testing time.

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