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Global Civil Aviation Emissions Standards - from Noise to Greener Fuels

by

Md. Tanveer Ahmad

Occasional Paper Series: *Sustainable International Civil Aviation*

The attached Occasional Papers have been prepared by a group of scholars associated with the Institute of Air and Space Law (IASL) at McGill University. They are the result of a collaborative effort between the IASL and the Centre for International Sustainable Development Law and are designed to be part of a book prepared by authors from both groups which will eventually be published by the Cambridge University Press under the title *Sustainable International Civil Aviation*.

As the title of the book suggests, bringing together these various scholars and papers is the central theme of the sustainable development of international aviation. In particular, the work of the International Civil Aviation Organization (ICAO), the primary United Nations body tasked with regulating the environmental aspects of international aviation, and the provisions of the Chicago Convention which lays down powers of the Organization and the fundamental rules of international air law, form the primary focus of this collection. At the next ICAO Assembly in September-October of 2016, ICAO has the ambitious mandate to finalise a global scheme to limit CO2 emissions from international aviation. As many of the articles contained in the book are of immediate relevance to the discussions due to take place at ICAO, publishing and disseminating these draft chapters will contribute to the growing interest and debates on the issue of the environmental impact of aviation. It is hoped that these papers will contribute to the work of the Assembly and that informed readers and delegates participating at the ICAO Assembly will have constructive comments to share with the authors.

Readers are invited to send their comments to the authors whose e-mail addresses are set out on the title page of each paper as well as a copy to the following address: edannals.law@mcgill.ca

The authors and the Editors of this collection of papers thank all readers for their attention and their comments.

Professor Armand de Mestral, Emeritus Professor, *McGill University, Canada*
Dr. Paul Fitzgerald, *McGill University, Canada*
Dr. Tanveer Ahmad, *North South University, Bangladesh*

SUMMARY

Current global civil aviation emissions standards: Are the current emissions standards sufficient to ensure sustainable development in the aviation industry?

The issue:

- Whether a legally binding emissions standard for international civil aviation is in place?
- Whether the current emissions standards are sufficient to cover all greenhouse gases?
- Whether ICAO's basket of mitigation measures to address environmental concerns of aviation, at their current state, can effectively curb emissions from international civil aviation?

Its importance:

- Securing sustainable development of aviation requires initiatives from the aviation industry to lessen environmental impacts of aviation while ensuring smooth growth of the industry
- Emissions from civil aviation is a great environmental concern since such emissions pollute the environment, exacerbate climate change and global warming, occur at upper atmosphere, and are rapidly increasing with the rapid growth of aviation industry

The treaty law:

- Article 2(2) of the Kyoto Protocol
- Annex 16 to the Chicago Convention

The analysis:

- The Kyoto Protocol includes emissions from domestic civil aviation requiring developed State Parties under its Annex I to regulate those but excludes emissions from international civil aviation, leaving such responsibility to ICAO.
- Annex 16 to the Chicago Convention, which sets out environmental provisions, is not legally binding. Any State, who finds it impracticable to comply, can provide immediate notification to ICAO of the discrepancy between its own

practice and the respective standard or procedure. The Chicago Convention is silent on the definition of “immediate”.

- Annex 16 suffers from lack of modern effective provisions dealing with emissions from aviation. ICAO has not yet added all the GHGs emitted by aircraft, which are required to be controlled under the Kyoto Protocol, in the list of controlled gases in Annex 16, Volume II.
- ICAO’s basket of four mitigation measures, namely, technological improvements, operational improvements, sustainable alternative fuels, and market-based measures (MBMs), at its present condition, is fraught with difficulty and, hence, cannot sufficiently reduce emissions from civil aviation.
- The existing and envisaged global civil aviation emissions standards are incapable of significantly reducing emissions from aviation at their current condition. Hence, the current global aviation emissions standards are not sufficient to ensure sustainable development in the aviation industry.

Options for decision-makers:

- 1) Amendment of Annex 16 to the Chicago Convention so as to ensure its effectiveness in reducing emissions from aviation.
- 2) Adoption of a global MBM for international civil aviation, which is considered as an important gap filler.
- 3) No action on the part of decision-makers that may result in the unrestrained growth of emissions.

GLOBAL CIVIL AVIATION EMISSIONS STANDARDS - FROM NOISE TO GREENER FUELS

by

Md Tanveer Ahmad*

I. INTRODUCTION

The protection of the environment is one of the main components of sustainability. Therefore, securing sustainable development of aviation requires initiatives from the aviation industry to lessen environmental impacts of aviation while ensuring smooth growth of the industry. Emissions from civil aviation have become a great environmental concern today since such emissions pollute the environment, exacerbate climate change and global warming, and are rapidly increasing with the rapid growth of the aviation industry. Hence, emissions from aviation have to be reduced to protect the environment. This chapter addresses the question whether or not the current global civil aviation emissions standards are sufficient to ensure sustainable development in the aviation industry. The author argues that the current global aviation emissions standards are not sufficient to ensure sustainable development in the aviation industry.

II. CURRENT STATE OF THE GLOBAL CIVIL AVIATION EMISSIONS STANDARDS

In international law, the only legally binding instrument that specifically addresses emissions from civil aviation is the *Kyoto Protocol*.¹ Article 2, paragraph 2 of the Protocol provides that the Annex I developed State Parties shall pursue limitation or reduction of emissions of greenhouse gases [GHGs] not controlled by the *Montreal Protocol*² from aviation bunker fuels working through the International Civil Aviation Organization [ICAO],³ the global forum for cooperation among its 191 Member States in all fields of civil aviation.⁴ However, the Protocol has not further elaborated the provision and, hence, has not set any emissions standard for aviation. It is unsurprising since it is not the *Kyoto Protocol* but the *Chicago Convention* that governs the area of law in the field of international civil aviation.⁵

* The author can be contacted at: md.ahmad@mail.mcgill.ca.

¹ *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 11 December 1997, 2303 UNTS 162 (entered into force 16 February 2005) [*Kyoto Protocol*].

² *Montreal Protocol on Substances that Deplete the Ozone Layer*, 16 September 1987, 1522 UNTS 3, Can TS 1989 No 42 (entered into force 1 January 1989) [*Montreal Protocol*].

³ *Kyoto Protocol*, *supra* note 1, art 2(2).

⁴ See ICAO, "Vision & Mission", online: ICAO <www.icao.int/about-icao/Pages/vision-and-mission.aspx> (visited May 28, 2016).

⁵ *Convention on International Civil Aviation*, 7 December 1944, 15 UNTS 295, Can TS 1944 No 36, ICAO Doc 7300/9 [*Chicago Convention*].

The *Chicago Convention* is the primary source of public international air law,⁶ has established ICAO,⁷ and is often regarded as the “Constitution”⁸ of international civil aviation. However, the Convention was signed in 1944 when international environmental law was at its first stage of development.⁹ Thus, the need to protect the environment was not envisaged at the time of negotiation and drafting of the Convention in 1944 and, hence, no explicit provisions on environmental protection were incorporated therein.¹⁰

Nonetheless, the Convention tacitly confers responsibility on ICAO to address aviation environmental issues. According to Article 44, one of the aims and objectives of ICAO is “to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport so as to... promote generally the development of all aspects of international civil aeronautics”.¹¹ Since reducing environmental impacts of aviation for the protection of the environment is one of the aspects of international civil aeronautics,¹² it follows that ICAO has a duty to regulate emissions from international civil aviation thus ensuring sustainable development of aviation.¹³ To discharge this duty, ICAO has adopted Annex 16 to the *Chicago Convention* to address aviation environmental issues.¹⁴

The Convention facilitates the adoption of international standards and recommended practices [SARPs] as Annexes to the Convention by the ICAO Council, in accordance with Article 90,¹⁵ to address new issues to meet the current

⁶ Michael Milde, *International Air Law and ICAO* in Marietta Benkö, ed, *Essential Air and Space Law*, vol 4 (Utrecht: Eleven International Publishing, 2008) at 17 [Milde, *International*]. See also Elmar M Giemulla, “Chapter 1: Chicago System: Genesis and Main Characteristics” in Elmar M Giemulla & Ludwig Weber, eds, *International and EU Aviation Law: Selected Issues* (AH Alphen aan den Rijn: Kluwer Law International, 2011) 3 at 5.

⁷ Paul Stephen Dempsey, *Public International Air Law* (Montreal: McGill University, Institute and Center for Research in Air & Space Law, 2008) at 49.

⁸ See Dempsey, *supra* note 7 at 69; Pablo Mendes de Leon, “Enforcement of the EU ETS: The EU’s Convulsive Efforts to Export its Environmental Values” (2012) 37 *Air & Space L* 287 at 289 (Kluwer Law Online).

⁹ Catherine Redgwell, “International Environmental Law” in Malcolm D Evans, ed, *International Law*, 3rd ed (New York: Oxford University Press, 2010) 687 at 687, 690.

¹⁰ See also ICAO, *The Convention on International Civil Aviation: Annexes 1 to 18*, online: ICAO <www.icao.int/safety/airnavigation/NationalityMarks/annexes_booklet_en.pdf> [ICAO, *Annexes 1 to 18*].

¹¹ *Chicago Convention*, *supra* note 5, art 44(i).

¹² In fact, environmental protection is one of the five strategic objectives of ICAO for the 2014-2016 triennium. See ICAO, “ICAO Strategic Objectives 2014-2016”, online: ICAO <www.icao.int/about-icao/Pages/Strategic-Objectives.aspx> (visited May 28, 2016).

¹³ See Armand de Mestral & Md Tanveer Ahmad, “A Pre-Analysis of Canada-EU Aviation Relations post-ICAO Assembly Meeting Concerning Emissions Trading System”, Policy Brief, Carleton University Canada-Europe Transatlantic Dialogue (April 2013) at 7, online: Carleton University <labs.carleton.ca/canadaeurope/wp-content/uploads/sites/9/2013-04-brief-demestral-ahmad-mcgill-aviation-emissions.pdf>.

¹⁴ For a brief discussion on Annex 16, see ICAO, *Annexes 1 to 18*, *supra* note 10.

¹⁵ *Chicago Convention*, *supra* note 5, art 90. According to Article 90, the adoption of annexes requires the vote of two-thirds of the ICAO Council at a meeting called for that purpose and shall then be submitted by the ICAO Council to each Contracting State, and that Annex or any amendment thereto shall become effective within 3 months after its submission to the Contracting States or at the end of such longer period of time as the ICAO Council may prescribe, unless in the meantime majority of the Contracting States register their disapproval with the ICAO Council. *Ibid*.

global need.¹⁶ The ICAO Council is bound to adopt SARPs in accordance with the provisions of Chapter VI of the Convention,¹⁷ i.e. Articles 37 - 42. Among these provisions, Article 37 provides guidelines regarding such adoption:

Each contracting State undertakes to collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organization in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation.

To this end the International Civil Aviation Organization shall adopt and amend from time to time, as may be necessary, international standards and recommended practices and procedures dealing with:

...

...such...matters concerned with the safety, regularity, and efficiency of air navigation as may from time to time appear appropriate.¹⁸

The ICAO Council made good use of this authority by adopting Annex 16. The SARPs are designated as Annexes to the *Chicago Convention* for convenience.¹⁹ However, Annexes do not actually become part of the Convention.²⁰

Since “[a]ircraft noise was the first major environmental issue raised with respect [to] aviation”,²¹ noise emissions from aircraft engines were addressed by ICAO before addressing gaseous emissions.²² Hence, initially, Annex 16, adopted by the ICAO Council on April 2, 1971, only dealt with aircraft noise.²³ In international civil aviation, emissions from aircraft engines emerged as an environmental issue in the 1970s.²⁴ In May 1980, at the second meeting of the Committee on Aircraft Engine Emissions - which was established in 1977 to pursue a number of aspects of the subject of aircraft engine emissions - proposals were made for material to be included in an Annex. After amendment of the proposed material, the ICAO Council adopted the material to form the text of Annex.²⁵ The ICAO Council agreed that it was desirable to include all environmental provisions in one Annex and, hence, Annex 16 was renamed “Environmental Protection” and divided into two volumes.²⁶ The then existing text of the Annex became Volume I exclusively dealing with aircraft noise, and the amended material became Volume II devoted to addressing the issue of aircraft engine emissions other than noise emissions.²⁷ Therefore,

¹⁶ See *ibid*, art 37.

¹⁷ *Ibid*, art 54(l).

¹⁸ *Ibid*, art 37.

¹⁹ *Ibid*, art 54(l).

²⁰ See Dempsey, *supra* note 7 at 75; Michael Milde, “Aviation Safety Oversight: Audits and the Law” (2001) XXVI Ann Air & Sp L 165 at 168 [Milde, “Aviation”].

²¹ Dempsey, *supra* note 7 at 415.

²² See *ibid*.

²³ ICAO, (2008) 5 International Standards and Recommended Practices: Annex 16 to the Convention on International Civil Aviation: Volume 1, Aircraft Noise at xi [*Annex 16: Volume 1*].

²⁴ Dempsey, *supra* note 7 at 444.

²⁵ ICAO, (2008) 3 International Standards and Recommended Practices: Annex 16 to the Convention on International Civil Aviation: Volume 2, Aircraft Engine Emissions at ix [*Annex 16: Volume 2*].

²⁶ *Ibid*.

²⁷ *Ibid*.

Volume II of Annex 16 contains the global civil aviation emissions standards currently in force.

Part II of Volume II contains standards relating to vented fuel with regard to all turbine engine powered aircraft intended for operation in international civil aviation manufactured after February 18, 1982.²⁸ This Part requires that the design and construction of an aircraft shall be such as to prevent the intentional discharge into the atmosphere of liquid fuel from the fuel nozzle manifolds resulting from the process of engine shutdown following normal flight or ground operations.²⁹

Part III contains standards relating to emissions certification applicable to the types of aircraft engines specified in the individual chapters of the Part, “where such engines are fitted to aircraft engaged in international civil aviation”.³⁰ Emissions certification shall be granted on the basis of satisfactory evidence that the engine complies with the minimum requirements set by the provisions of Volume II.³¹

Chapter 2 of Part III deals with turbojet and turbofan engines intended for propulsion only at subsonic speeds. Chapter 3 concerns turbojet and turbofan engines intended for propulsion at supersonic speeds. For the emissions certification for all types of engines, the following emissions shall be controlled: smoke and three gases, namely, unburned hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x).³² Smoke emissions are measured and reported in terms of Smoke Number (SN).³³ The mass (D_P) of the gaseous pollutant – HC, CO or NO_x – emitted during the reference emissions landing and take-off [LTO] cycle are measured and reported in grams.³⁴ Regulatory Smoke Number and regulatory gaseous emissions levels for different engines are specifically defined.³⁵ A certificate of compliance is issued if the mean of the values measured and corrected for all the engines tested does not exceed the regulatory level.³⁶

A new volume, namely Volume III, that will provide for a new aircraft carbon dioxide (CO₂) emissions standard is under development and will be added to Annex 16.³⁷ On July 10, 2012, the ICAO’s Committee on Aviation Environmental Protection [CAEP] unanimously agreed on a CO₂ metric system that characterizes the CO₂ emissions for aircraft types with varying technologies.³⁸ In 2013, the development of CO₂ certification requirement, including a CO₂ metric system and procedures, was

²⁸ *Ibid* at ix, II-1-1.

²⁹ *Ibid* at II-2-1.

³⁰ *Ibid* at ix.

³¹ *Ibid* at III-1-1.

³² *Ibid* at III-2-1, III-3-1.

³³ *Ibid* at III-2-1, III-3-1.

³⁴ *Ibid*.

³⁵ See *ibid* at III-2-3ff, III-3-3.

³⁶ See *ibid* at App 6-1.

³⁷ Jane Hupe, “Aviation and Environment: Developments Since the Last Assembly” (Presentation delivered at the ICAO Symposium on Aviation and Climate Change, “Destination Green”, Montreal, 14 - 16 May 2013) [unpublished].

³⁸ ICAO, Press Release, COM 15/12, “New Progress on Aircraft CO₂ Standard” (11 July 2012), online: ICAO <www.icao.int/Newsroom/Pages/new-progress-on-aircraft-CO2-standard.aspx>.

accomplished,³⁹ and the CAEP delivered agreement on the certification procedures.⁴⁰ On February 2016, the 170 international experts on the CAEP unanimously recommended a new aircraft CO₂ emissions standard “paving the way for its ultimate adoption” by the ICAO Council.⁴¹

III. THE CAPABILITY OF THE CURRENT EMISSIONS STANDARDS TO ENSURE SUSTAINABILITY: AN ENVIRONMENTAL PERSPECTIVE

It appears that no legally binding emissions standard for international civil aviation is in place now. Outside the *Chicago Convention* regime, the *Kyoto Protocol* provides a clear mandate for ICAO to limit or reduce emissions of GHGs not controlled by the *Montreal Protocol* from international civil aviation.⁴² It appears, however, that such emissions are kept outside the purview of the *Kyoto Protocol*,⁴³ since Article 2(2) refers to “aviation”, not “international civil aviation” specifically.⁴⁴ Therefore, it is argued that the *Kyoto Protocol* includes emissions from domestic civil aviation requiring Annex I developed State Parties to regulate those but excludes emissions from international civil aviation, leaving such responsibility to ICAO.⁴⁵ According to the Guidelines of the Intergovernmental Panel on Climate Change [IPCC] and of the *United Nations Framework Convention on Climate Change* [UNFCCC],⁴⁶ emissions from both national and international civil aviation should be calculated as part of the national GHG inventories of Parties, but emissions from international civil aviation “should be excluded from national totals and reported separately”.⁴⁷

³⁹ See Hupe, *supra* note 37.

⁴⁰ See ICAO, Press Release, COM 4/13, “ICAO Environmental Protection Committee Delivers Progress on New Aircraft CO₂ and Noise Standards” (14 February 2013), online: ICAO <www.icao.int/Newsroom/Pages/ICAO-environmental-protection-committee-delivers-progress-on-new-aircraft-CO2-and-noise-standards.aspx>.

⁴¹ ICAO, News, “New ICAO Aircraft CO₂ Standard One Step Closer To Final Adoption” (8 February 2016), online: ICAO <www.icao.int/Newsroom/Pages/New-ICAO-Aircraft-CO2-Standard-One-Step-Closer-To-Final-Adoption.aspx> [ICAO, “New ICAO Aircraft”].

⁴² See *Kyoto Protocol*, *supra* note 1, art 2(2); Dempsey, *supra* note 7 at 450.

⁴³ See also Dempsey, *supra* note 7 at 450.

⁴⁴ See *ibid.*

⁴⁵ See *ibid.*; Michael Milde, “The EU Emissions Trading Scheme: Confrontation or Compromise?: A Unilateral Action Outside the Framework of ICAO” (2012) 61:2 ZLW 173 at 175; Jane Barton, “Including aviation in the EU Emissions Trading Scheme: prepare for take-off” (2008) 5:2 J Eur Env'tl & Plan L 183 at 184 (HeinOnline); Matthew D Kasper, “The Air Transport Association's Challenge to the European Union's Extension of Its Emissions Trading Scheme to International Aviation: A Legal Analysis” (2010) 10:1 Issues in Aviation L & Policy 145 at 153–54 (HeinOnline); Daniel B Reagan, “Putting International Aviation into the European Union Emissions Trading Scheme: Can Europe Do It Flying Solo?” (2008) 35:2 BC Env'tl Aff L Rev 349 at 364 (HeinOnline).

⁴⁶ *United Nations Framework Convention on Climate Change*, 9 May 1992, 1771 UNTS 107, Can TS 1994 No 7 (entered into force 21 March 1994) [UNFCCC]; Simon Eggleston et al, eds, *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (Hayama, Japan: Institute for Global Environmental Strategies, 2006).

⁴⁷ UNFCCC, “Emissions from fuel used for international aviation and maritime transport (international bunker fuels)”, online: UNFCCC <unfccc.int/methods/emissions_from_intl_transport/items/1057.php>; Amit Garg et al, “Volume 2: Energy” in Simon Eggleston et al, eds, *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (Hayama, Japan: Institute for Global Environmental Strategies, 2006) at 3.57.

Certainly, a question arises whether or not Annex 16, Volume II can resolve the difficulty of absence of legally binding instrument dealing with emissions from international civil aviation. The answer will be in negative for various reasons. First and foremost, Annexes to the *Chicago Convention* are not mandatory like the provisions of the Convention since, as noted above, Annexes do not become part of the Convention.⁴⁸ In reality, the adoption and legal force of Annexes are not “subject to the general international law of treaties”.⁴⁹

The Contracting States to the *Chicago Convention* are required to adopt measures to ensure that all aircraft flying over or maneuvering within its territory or carrying their nationality mark shall comply with the rules and regulations relating to the flight and maneuver of aircraft there in force.⁵⁰ In these respects, all Contracting States undertake to keep their own regulations “uniform, to the greatest possible extent, with those established from time to time under this Convention”,⁵¹ i.e. with Annexes. Nevertheless, Articles 37 and 38 weaken the binding nature of the Annexes.⁵² Both articles allow any Contracting State to the Convention to avoid implementing the Annexes.⁵³ Although Article 37 invites all Contracting States “to collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organization”,⁵⁴ any State can refrain from doing everything possible by it since the phrase “highest practicable degree of uniformity”⁵⁵ has not been defined.⁵⁶ Article 38 allows deviation from any standard or procedure of any Annexes or any amendments thereto by any Contracting State.⁵⁷ If any State finds it “impracticable to comply in all respects” with any of those standards or procedures, it merely has to notify ICAO of the discrepancy between its own practice and the respective standard or procedure.⁵⁸ What is meant by the term “impracticable”?⁵⁹ The Convention provides no guidance.⁶⁰ Again, although the deviating Contracting State must give “immediate notification”⁶¹ to ICAO of such “differences between its own practice and that established by the international

⁴⁸ See Milde, “Aviation”, *supra* note 20 at 168. See also *New Zealand Airline Pilots’ Association v Attorney General*, [1997] 3 NZLR 269 (CA). Milde, *International*, *supra* note 6 at 18 [footnote omitted], observes:

The provisions of [the Chicago] Convention are mandatory since there is no provision permitting any reservations to the Convention. The mandatory nature of the Convention is underlined by Article 82 in which contracting states committed themselves to abrogate any inconsistent obligations and understandings and not to enter into any such obligations or understanding.

⁴⁹ Milde, “Aviation”, *supra* note 20 at 168.

⁵⁰ *Chicago Convention*, *supra* note 5, art 12.

⁵¹ *Ibid* [emphasis added].

⁵² *Ibid*, arts 37, 38.

⁵³ See Md Tanveer Ahmad, “Achieving Global Safety in Civil Aviation: A Critical Analysis of Contemporary Safety Oversight Mechanisms” (2012) 37 *Ann Air & Sp L* 81 at 86 [Ahmad, “Achieving”].

⁵⁴ *Chicago Convention*, *supra* note 5, art 37 [emphasis added].

⁵⁵ *Ibid*.

⁵⁶ See Ahmad, “Achieving”, *supra* note 53 at 86; Milde, “Aviation”, *supra* note 20 at 168 – 169.

⁵⁷ See *ibid*; *Chicago Convention*, *supra* note 5, art 38.

⁵⁸ See *Chicago Convention*, *supra* note 5, art 38.

⁵⁹ Ahmad, “Achieving”, *supra* note 53 at 86.

⁶⁰ *Ibid*.

⁶¹ *Chicago Convention*, *supra* note 5, art 38.

standard”,⁶² the concerned State can avoid notifying since no defined time limit is set for that purpose.⁶³ The Convention is silent on the definition of the term “immediate”.⁶⁴ Professor Dempsey has observed that, “[i]n practice, States have notified ICAO of impracticality of compliance with [Annexes] at any time, or indeed not at all, thereby violating the plain meaning of the phrase “immediate notification”.”⁶⁵ Interestingly, a sixty-day notification requirement is established for filing of differences with regard to any amendment to the Annexes.⁶⁶

Twelve States, including the United States [US], already have notified ICAO of differences which exist between their national regulations and practices and the SARPs of Annex 16, Volume II, while a large number of States remains silent.⁶⁷ It cannot be stated with sufficient certainty that only those twelve States are not complying with Volume II. In fact, the overwhelming majority of States do not discharge their obligation to notify ICAO of such differences.⁶⁸ ICAO itself admitted this unexpected fact.⁶⁹ Most importantly, “[t]here is no explicit sanction in the [Chicago] Convention for failing to notify”.⁷⁰ Regarding the obligatory nature of the Annexes, Judge Buergenthal notes:⁷¹

With some exceptions..., the Contracting States have no legal obligation to implement or to comply with the provisions of the duly promulgated Annex or amendment thereto, unless they find it ‘practicable’ to do so. This conclusion is supported both by the language of the Convention as well as by the practice of the [ICAO].⁷²

Nevertheless, Professor Dempsey argues that “whatever *de jure* “soft law” attributes SARPs may have, they appear to have corresponding *de facto* “hard law” attributes as well”.⁷³ This is due to the authority granted to the Contracting States by Article 33 to refuse to recognize certificates of airworthiness, and certificates of competency and licenses issued or rendered valid by another Contracting State if they do not meet the minimum standards established from time to time pursuant to

⁶² See *ibid.*

⁶³ See *ibid.*; Ahmad, “Achieving”, *supra* note 53 at 86.

⁶⁴ See *Chicago Convention*, *supra* note 5, art 38.

⁶⁵ Dempsey, *supra* note 7 at 77 [footnote omitted].

⁶⁶ *Chicago Convention*, *supra* note 5, art 38.

⁶⁷ See ICAO, “Supplement to Annex 16, Volume II (Second Edition)” in *Annex 16: Volume 2*, *supra* note 25.

⁶⁸ See Dempsey, *supra* note 7 at 78.

⁶⁹ See Milde, “Aviation”, *supra* note 20 at 170.

⁷⁰ Dempsey, *supra* note 7 at 79 [footnote omitted].

⁷¹ Thomas Buergenthal, *Law-making in the International Civil Aviation Organization*, 1st ed (Syracuse, New York: Syracuse University Press, 1969) at 76.

⁷² *Ibid.*

⁷³ Dempsey, *supra* note 7 at 79–80 [footnote omitted]. Similarly, Milde, “Aviation”, *supra* note 20 at 169, argues:

However, in practice there is a powerful motivation for all States wishing to participate in international air transport to comply with such standards as closely as possible. The fact remains that these standards cannot be disregarded with impunity, and a phrase has been coined that their force can be compared with that of the “law of gravity”: compliance is simply unavoidable in practice.

the *Chicago Convention*.⁷⁴ If economically powerful States, like the US and the European Union [EU] Member States, elect to wield their authority under Article 33, States that fail to comply with annexes will lose their right to fly to those economically powerful States.⁷⁵ As a consequence, those non-compliant States will be isolated from the global economy that can gravely affect their economic development.⁷⁶

It is apparent that annexes are *de facto* “hard law” and, hence, Annex 16, Volume II or any amendments thereto will force the Contracting States to comply with that. However, annexes should be made *de jure* “hard law” to ensure more effectiveness, given the fact that, in the case of Annex 16, Volume II, the US itself has notified ICAO of differences. This requires amending the *Chicago Convention*, a difficult and time-consuming process.⁷⁷ Therefore, amending Annex 16 so as to ensure its effectiveness in reducing emissions from aviation may be easier, faster, and more flexible process than amending the Convention.⁷⁸

Besides not being legally binding, Annex 16 suffers from lack of modern effective provisions dealing with emissions from aviation.⁷⁹ ICAO has not yet included all the GHGs emitted by aircraft, which are required to be controlled under the *Kyoto Protocol*, in the list of controlled gases in Annex 16, Volume II.⁸⁰ Most importantly, two major GHGs emitted by aircraft, namely, carbon dioxide (CO₂) and water vapor (H₂O), are not being regulated by Annex 16. The fact that Volume II is only concerned with aircraft engine emissions, not with the entire aircraft design of which engine is only a part, further limits the effectiveness of this volume.⁸¹ Addressing engines is significant in terms of fuel efficiency. It is, nonetheless, insufficient “to determine how clean the aircraft is in terms of controlling emissions.

⁷⁴ See *Chicago Convention*, *supra* note 5, art 33.

⁷⁵ Dempsey, *supra* note 7 at 79.

⁷⁶ *Ibid.* See also Milde, “Aviation”, *supra* note 20 at 169.

⁷⁷ See also Jin Liu, “The Role of ICAO in Regulating the Greenhouse Gas Emissions of Aircraft” (2011) 5:4 Carbon & Climate L Rev 417 at 422 (Academic Search Complete); Gilbert Guillaume, “ICAO at the Beginning of the 21st Century: The 8th Beaumont Memorial Lecture, 5 February 2008” (2008) 33:4/5 Air & Space L 313 at 317 (Kluwer Law Online). To learn about the procedure, see *Chicago Convention*, *supra* note 5, arts 49(j), 94(a).

⁷⁸ Liu, *supra* note 77 at 425.

⁷⁹ See also Dempsey, *supra* note 7 at 455–58.

⁸⁰ Aircraft emissions of relevance to climate change and global warming include:

- carbon dioxide (CO₂),
- water vapor (H₂O),
- nitric oxide (NO),
- nitrogen dioxide (NO₂),
- sulfur oxides (SO_xO), and
- soot.

See World Bank, *Air Transport and Energy Efficiency*, Transport Papers, TP – 38 (February 2012) at 31, online: World Bank <siteresources.worldbank.org/INTAIRTRANSPORT/Resources/TP38.pdf>; David H Lister et al, “Summary for Policymakers: Aviation and the Global Atmosphere” in Joyce E Penner et al, eds, *Aviation and the Global Atmosphere: A Special Report of IPCC Working Groups I and III in collaboration with the Scientific Assessment Panel to the Montreal Protocol on Substances that Deplete the Ozone Layer* (Cambridge: Cambridge University Press, 1999) 1 at 3. See also ICAO, “Contaminants”, online: ICAO <www.icao.int/environmental-protection/Pages/Contaminants.aspx>.

⁸¹ See Liu, *supra* note 77 at 421.

For example, the weight of an aircraft also matters for its emissions level”.⁸² Hopefully, Annex 16, Volume III, which will provide for a new aircraft CO₂ emissions standard, will overhaul at least two flaws of Annex 16, i.e. its failure to address aircraft CO₂ emissions in Volume II, and its concern with aircraft engines only. Unlike Volume II, Volume III will not deal only with engines; the new standard will be applicable to aircraft type designs:

Under the CAEP recommendation, the new CO₂ emissions standard would not only be applicable to new aircraft type designs as of 2020, but also to new deliveries of current in-production aircraft types from 2023. A cut-off date of 2028 for production of aircraft that do not comply with the standard was also recommended. In its current form the standard equitably acknowledges CO₂ reductions arising from a range of possible technology innovations, whether structural, aerodynamic or propulsion-based.⁸³

Apart from Annex 16, ICAO adopted several other legal measures dealing with emissions from civil aviation to fill in the gaps left by the *Chicago Convention* and Annex 16. These include: Assembly Resolutions A38-18 and A37-19,⁸⁴ Declaration and Recommendations of High-level Meeting on International Aviation and Climate Change,⁸⁵ and Programme of Action on International Aviation and Climate Change.⁸⁶ Nonetheless, none of these measures has any legally binding effect since these are considered “soft law”.⁸⁷ Resolutions, declarations or programs of action are non-binding soft law, and are not law *per se*;⁸⁸ these instruments are a type of social rather than legal norms.⁸⁹ Hence, due to their non-binding nature, these measures will not succeed in effectively arresting emissions from aviation.

⁸² *Ibid* [footnote omitted]. ICAO's Carbon Emissions Calculator Methodology provides an insight into some of the variables that impact emissions levels. See ICAO, *ICAO Carbon Emissions Calculator Methodology*, 7th version (June 2014), online: ICAO <www.icao.int/environmental-protection/CarbonOffset/Documents/Methodology%20ICAO%20Carbon%20Calculator_v7-2014.pdf>.

⁸³ ICAO, “New ICAO Aircraft”, *supra* note 41.

⁸⁴ See *Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change*, ICAO Assembly Res A38-18, 38th Sess, ICAO Doc 10022, I-68, online: ICAO <www.icao.int/publications/Documents/10022_en.pdf> [ICAO Res A38-18]; *Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change*, ICAO Assembly Res A37-19, 37th Sess, ICAO Doc 9958, I-67, online: ICAO <http://www.icao.int/publications/Documents/9958_en.pdf>.

⁸⁵ *Declaration by the High-level Meeting on International Aviation and Climate Change (HLM-ENV/09) in October 2009*, in ICAO, “Climate Change: Programme of Action”, online: ICAO <www.icao.int/environmental-protection/Pages/programme-of-action.aspx>.

⁸⁶ ICAO Secretariat, “ICAO Programme Of Action On International Aviation and Climate Change” in ICAO, *ICAO Environmental Report 2010: Aviation and Climate Change* (Montreal: ICAO, 2010) 8 at 9, online: ICAO <www.icao.int/environmental-protection/Documents/Publications/ENV_Report_2010.pdf>.

⁸⁷ See e.g. Alan Boyle, “Soft Law in International Law Making” in Malcolm D Evans, *International Law*, 2nd ed (Oxford: Oxford University Press, 2006) 141 at 141–43; Alina Kaczorowska, *Public International Law*, 4th ed (Oxford: Routledge, 2010) at 64–65; Dinah Shelton, “Soft Law” in David Armstrong, ed, *Routledge Handbook of International Law* (Oxford: Routledge, 2009) 68 at 68–71.

⁸⁸ See e.g. Shelton, *supra* note 87 at 68–71; Boyle, *supra* note 87 at 141–43; Milde, *International Law*, *supra* note 6 at 169; Mark Weston Janis, *International Law*, 6th ed (New York: Wolters Kluwer Law & Business, 2012) at 55.

⁸⁹ Shelton, *supra* note 87 at 69.

IV. OPTIONS UNDER CONSIDERATION: ICAO'S BASKET OF MEASURES

To address environmental concerns of aviation, ICAO has initiated to develop and employ a basket of four mitigation measures, namely, technological improvements, operational improvements, sustainable alternative fuels, and market-based measures [MBMs]. However, the basket at its present condition is fraught with difficulty and, hence, cannot sufficiently reduce emissions from civil aviation.

With respect to technological improvements, no commercially viable aviation technology is in place that can ensure either zero emissions or even zero growth in emissions. Moreover, we cannot expect to see drastic technology advances in the near-future to secure that solution since technological improvement, especially in the field of aviation, is a very expensive and time-consuming process.⁹⁰ Concerning operational improvements, such improvements cannot largely reduce emissions from international civil aviation, as shown in Figure 1 below, and new concepts for the purpose of improving operations suffer from several difficulties including lack of implementation.⁹¹ Although sustainable alternative fuels for civil aviation, where kerosene is the primary energy source,⁹² are essential as both a near-term and long-term solution,⁹³ as demonstrated by Figure 1 below, several challenges ranging from production to deployment still remain. Alternative fuels are still commercially unviable mainly because of high and uncertain costs of such fuels and of lack of availability in sufficient amount to meet the demand of commercial aviation industry.⁹⁴ Even the former ICAO Council President González asserted that “there is

⁹⁰ See Terry Barker et al, “Technical Summary” in Bert Metz et al, eds, *Climate Change 2007: Mitigation: Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (New York: Cambridge University Press, 2007) 25 at 36; Suzana Kahn Ribeiro et al, “Transport and its infrastructure” in Bert Metz et al, eds, *Climate Change 2007: Mitigation: Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (New York: Cambridge University Press, 2007) 323 at 353–54; Paul Stephen Dempsey & Laurence E Gesell, *Airline Management: Strategies for the 21st Century*, 2nd ed (Chandler, Ariz: Coast Aire Publications, 2006) at 314; Rob Corp, “Dreamliner trouble: A brief history of airliner problems” *BBC News* (17 January 2013), online: BBC News <www.bbc.co.uk/news/uk-21059525>.

⁹¹ See e.g. Shane Sumner, “Regional Forum: “Creating More Lift”: ICAO Asia/Pacific Region” (Presentation delivered at the ICAO Performance-based Navigation (PBN) Symposium and Workshops, Montreal, 16 – 19 October 2012) [unpublished]; Alan Stealey, Address (Presentation delivered at the ICAO Performance-based Navigation (PBN) Symposium and Workshops, Montreal, 16 – 19 October 2012) [unpublished]; Carlos Cirilo, “PBN: Global Implementation Situation” (Presentation delivered at the ICAO Performance-based Navigation (PBN) Symposium and Workshops, Montreal, 16 – 19 October 2012) [unpublished]; Angela Gittens, “Airports and PBN, will it make a difference?” (Presentation delivered at the ICAO Performance-based Navigation (PBN) Symposium and Workshops, Montreal, 16 – 19 October 2012) [unpublished]. For an insight into the legal challenges in reducing GHG emissions through more efficient ATM practices, see c 7, *above*.

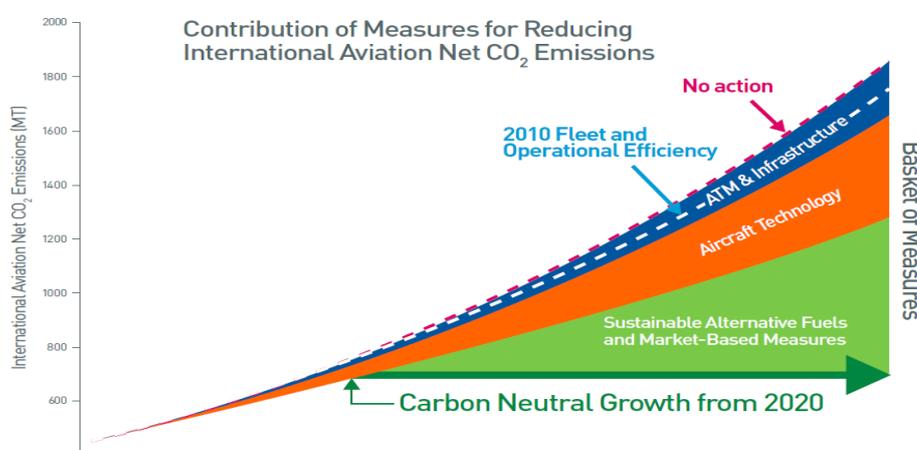
⁹² See also Ribeiro et al, *supra* note 90 at 334, 354; ICAO Sustainable Alternative Fuels (SUSTAF) Experts Group, “Sustainable Alternative Fuels: Challenges for the Development and Deployment of Sustainable Alternative Fuels in Aviation: Outcomes of ICAO’s SUSTAF Experts Group” in ICAO, *ICAO Environmental Report 2013: Aviation and Climate Change* (Montreal: ICAO, 2013) 126 at 126, online: ICAO <cfapp.icao.int/Environmental-Report-2013/>.

⁹³ ICAO Secretariat, “Overview – Sustainable Alternative Fuels: Sustainable Alternative Fuels for Aviation” in ICAO, *ICAO Environmental Report 2013: Aviation and Climate Change* (Montreal: ICAO, 2013) 122 at 122.

⁹⁴ See generally ICAO, “Alternative Fuels: Questions and Answers 5. What are the Challenges for the Development and Deployment of Alternative Fuels?”, online: ICAO <www.icao.int/environmental-protection/Pages/AltFuels-Challenges.aspx>. See also Barker et al, *supra* note 90 at 51; Ribeiro et al,

no alternative to current aviation fuel in the foreseeable future.”⁹⁵ Regarding MBMs, no global MBM for international civil aviation is currently in operation. To date, an agreement to develop a global MBM was reached at the 38th session of the ICAO Assembly. However, no global MBM for aviation will be implemented before 2020.⁹⁶ MBMs are considered “to be an important gap filler”⁹⁷ to complement technological, operational, and infrastructure measures.⁹⁸ The forecasts by ICAO’s CAEP show that, even after the implementation of technology and operational improvements and assuming 3 per cent use of alternative fuels, “the emissions gap from carbon neutral growth in 2020 would be on the order of 500 Mt by 2040.”⁹⁹ See Figure 1 below. Thus, a global MBM for civil aviation has to be quickly developed and implemented.

Figure 1: Contribution of Measures for Reducing International Civil Aviation



Source: ICAO, *Environment: Market-based Measures and Climate Change* (August 2013), online: ICAO <cfapp.icao.int/tools/38thAssyikit/story_content/external_files/Flyer_US-Letter_ENV_MBM_s_2013-08-30.pdf>.

supra note 90 at 355.

⁹⁵ Roberto Kobeh González, “Towards a Transformed ATM environment – Working together” (Opening address by the President of the ICAO Council to the World ATM Congress 2013, Madrid, 12 – 14 February 2013) at 2 [unpublished].

⁹⁶ See ICAO Res A38-18, *supra* note 84; ICAO, Press Release, “Dramatic MBM Agreement and Solid Global Plan Endorsements Help Deliver Landmark ICAO 38th Assembly” (4 October 2013), online: ICAO <www.icao.int/Newsroom/Pages/mbm-agreement-solid-global-plan-endorsements.aspx>.

⁹⁷ ICAO Secretariat, “Overview – Market-Based Measures: Market-Based Measures” in ICAO, *ICAO Environmental Report 2013: Aviation and Climate Change* (Montreal: ICAO, 2013) 138 at 138. See also International Coalition for Sustainable Aviation, “Effective Market-Based Measures to Address Greenhouse Gas Emissions from International Aviation”, ICAO Assembly, 38th Sess, Agenda Item 17, Working Paper No 288, Doc A38-WP/288/Ex/100 (12 September 2013), online: ICAO <www.icao.int/Meetings/a38/Documents/WP/wp288_en.pdf>.

⁹⁸ IATA, Press Release, 34, “Historic Agreement on Carbon-Neutral Growth” (3 June 2013), online: International Air Transport Association <www.iata.org/pressroom/pr/Pages/2013-06-03-05.aspx>; Paul Steele, “Aviation – Benefits Beyond Borders – ICAO Destination Green” (Presentation delivered at the ICAO Symposium on Aviation and Climate Change, “Destination Green”, Montreal, 14 – 16 May 2013) [unpublished]; Annie Petsonk, “A Global MBM for Aviation and Climate Change: The Time is Now!”, (Presentation delivered at the ICAO Symposium on Aviation and Climate Change, “Destination Green”, Montreal, 14 – 16 May 2013) [unpublished].

⁹⁹ ICAO, *Environment: Market-based Measures and Climate Change* (August 2013), online: ICAO <cfapp.icao.int/tools/38thAssyikit/story_content/external_files/Flyer_US-Letter_ENV_MBM_s_2013-08-30.pdf>.

V. CONCLUSION

It appears that the existing and envisaged global civil aviation emissions standards are incapable of significantly reducing emissions from aviation at their current condition. Hence, the current global aviation emissions standards are not sufficient to ensure sustainable development in the aviation industry. Annex 16, Volume II, which provides for emissions standards, is not binding and suffers from lack of modern effective provisions dealing with emissions from aviation. ICAO's basket of measures at their current state cannot effectively curb emissions from international civil aviation. The difficulties that are hindering effective implementation of this basket have to be immediately addressed and solved. Most importantly, a global MBM has to be developed and implemented as soon as possible to contain emissions from international civil aviation. Unless the growth in emissions is restrained, sustainable development of aviation cannot be ensured.

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Centre for Research in Air and Space Law
Centre de recherche en droit aérien et spatial
McGill University
3690 Peel
H3A 1W9
Quebec, Canada
514 398 5095

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