Taking Flight: Federal Action to Mitigate Canada's GHG Emissions from Aviation

Nathalie J. Chalifour & Laurel Besco

THE 2015 *PARIS AGREEMENT* represents a significant step forward in international cooperation to mitigate greenhouse gas (GHG) emissions. Aviation emissions represent approximately 2 percent of global GHG emissions, a percentage that is predicted to grow rapidly over the next few decades. In spite of their importance, aviation emissions have been essentially left out of the *UNFCCC* processes, including the recent *Paris Agreement*. Responsibility for negotiating a plan to mitigate global aviation emissions has been left to the UN International Civil Aviation Organization (ICAO). After years of challenging negotiations, ICAO members recently agreed to establish a global offsetting mechanism. While this is an important step, the program will not begin its voluntary pilot phase until 2021 and its first mandatory phase in 2024. Further, the program only covers international emissions. Given the projected growth in this industry, some jurisdictions are taking steps domestically to mitigate aviation emissions. For instance, the countries of the European Union (EU) included aviation in the EU Emissions Trading Program in 2012, although they offered international flights a hiatus while awaiting the outcome of ICAO negotiations on a market-based mechanism. In the wake of ICAO's decision to implement an offsetting program, states now need to determine whether and how they will regulate emissions from aviation.

L'*ACCORD DE PARIS* DE 2015 représente une avancée importante dans le cadre de la coopération internationale visant à réduire les émissions de gaz à effet de serre (GES). Les émissions provenant de l'aviation comptent pour environ 2 pour cent des émissions de GES mondiales, un pourcentage qui, selon les prévisions, risque de de croître rapidement au cours des prochaines décennies. Malgré leur importance, les émissions provenant de l'aviation ont été dans une large mesure laissées pour compte lors des procédures de la *CCNUCC* (*Convention-cadre des Nations unies sur les changements climatiques*), notamment le récent Accord de Paris. La responsabilité de négocier un plan destiné à atténuer les émissions provenant de l'aviation à l'échelle mondiale a été confiée à l'Organisation de l'aviation civile internationale (OACI), un organisme de l'ONU. Après des années de négociations ardues, les membres de l'OACI ont récemment convenu d'adopter un mécanisme de compensation mondial. Bien qu'il s'agisse d'une étape importante, le programme n'entamera toutefois pas sa phase pilote volontaire avant 2021 et sa première étape obligatoire avant 2024. Qui plus est, ce programme ne couvre que les émissions internationales. Étant donné la croissance prévue dans cette industrie, certains ressorts prennent déjà des mesures à leur échelle nationale afin d'atténuer les émissions provenant de

This paper examines Canada's options for mitigating aviation emissions. Under Canada's division of legislative powers, aviation falls squarely within federal jurisdiction. As such, most provincial climate change policies exclude domestic aviation. We examine the potential for federal action on GHG emissions from domestic aviation as a first step in the broader climate change action program, as well as the possibility of further action on international flights. Since the majority of aviation emissions are a consequence of burning fuel, we first survey the ways in which aviation fuels are currently regulated and then we consider the potential for carbon pricing and other regulations to be applied. We argue that addressing GHG aviation emissions would not only show leadership, but could also ultimately set Canada up to cooperate with the EU in the event it once again includes international flights in the EU ETS. Taking steps to implement a carbon price on international aviation in Canada could ensure that the considerable revenue that would be raised by such a carbon price stays in Canada.

l'aviation. Les pays de l'Union européenne (UE) ont, par exemple, inclus l'aviation au Système d'échange de quotas d'émissions de l'UE en 2012, quoiqu'ils aient accordé un hiatus aux vols internationaux en attendant l'issue des négociations de l'OACI entourant l'adoption d'un mécanisme fondé sur le marché. Dans le sillage de la décision de l'OACI en vue de mettre en œuvre le programme de compensation, les États doivent à présent déterminer dans quelle mesure et de quelle manière ils vont réglementer les émissions provenant de l'aviation.

Cet article examine les options dont dispose le Canada en matière de réduction des émissions provenant de l'aviation. En vertu du partage des compétences législatives au Canada, l'aviation relève entièrement de la compétence du gouvernement fédéral. Dans cette optique, la plupart des politiques provinciales relatives aux changements climatiques excluent l'aviation nationale. Nous examinons les mesures que le fédéral pourrait prendre en matière de GES émis par l'aviation nationale comme première étape d'un programme d'action élargi à l'égard des changements climatiques, ainsi que la possibilité de mesures additionnelles visant les vols internationaux. Puisque la majorité des émissions provenant de l'aviation découlent de la combustion de carburants, nous sondons en premier lieu la manière dont les combustibles d'aviation sont actuellement réglementés et examinerons ensuite la possibilité de fixation du prix du carbone et les modalités d'application des règlements en la matière. Nous soutenons que le fait de traiter les GES provenant de l'aviation démontrerait non seulement notre leadership dans ce domaine, mais pourrait en outre

finir par paver la voie d'une coopération entre le Canada et l'UE advenant que les vols internationaux soient de nouveau inclus au Système d'échange de quotas d'émission de l'UE. Prendre des mesures en vue de fixer le prix du carbone en matière d'aviation internationale au Canada pourrait faire en sorte que les revenus considérables engrangés par le prix du carbone demeurent au Canada.

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INTRODUCTION

Aviation, or air transport, is a global industry that is estimated to contribute some 2,960 billion dollars to the world's economy.[1] The sector provides an estimated 63 million jobs[2] and is a key component of many industries as it enables the transport of goods and people. Importantly, the sector is growing rapidly—it is expected to double its revenue passenger kilometres (RPKs)[3] in the next 15 years and continue to grow well beyond that, with an estimated RPK growth of 145 percent by 2034.[4] Although it provides important social and economic benefits, aviation is a significant

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1 Aviation will contribute to the world's economy through direct, indirect, induced, and catalytic economic impacts. See Air Transport Action Group, *The Economic & Social Benefits of Air Transport*, (Geneva: Air Transport Action Group, 2005) at 2, online: <www.icao.int/Meetings/wrdss2011/Documents/JointWorkshop2005/ATAG_SocialBenefitsAirTransport.pdf>. See also Michael Gill, "Aviation and the Climate: an ATAG Perspective" (2016) 10:2 Carbon & Climate L Rev 118 at 118.

2 Gill, *supra* note 1 at 118.

3 See David S Lee, "Aviation and Climate Change: The Science" in Stefan Gössling & Paul Upham, eds, *Climate Change and Aviation: Issues, Challenges and Solutions* (London: Earthscan, 2009) 27 at 29 (revenue passenger kilometers represent "the number of seats flown and occupied").

4 Airbus, *Flying by Numbers: 2015–2034,* (Blagnac Cedex, France: Airbus SAS, 2015) at 8, online: ORBIS <espas.eu/orbis/document/flying-numbers-global-market-forecast-2015-2034>.

contributor to greenhouse gas (GHG)[5] emissions and therefore to climate change. Currently, aviation contributes an estimated 781 million tonnes of carbon dioxide (CO_2), which represents approximately two percent of global CO_2 emissions, and this is expected to more than double by 2050.[6] If the global aviation industry were a country, it would be among the top ten global emitters.[7] Air transport is part of the broader transportation sector, which was recently flagged by the Intergovernmental Panel on Climate Change (IPCC) as a sector requiring attention: "[w]ithout aggressive and sustained mitigation policies…emissions could increase at a faster rate than emissions from other energy end-use sectors."[8] It is clear that aviation's rapidly growing CO_2 emissions are sharply at odds with the nearly universal call to tackle climate change.

To date, emissions from international aviation have been left out of the *United Nations Framework Convention on Climate Change* (*UNFCCC*) agreements, including the most recent *Paris Agreement*.[9] In 1997, the global community in the *Kyoto Protocol*[10] tasked the United Nations' International Civil Aviation Organization (ICAO) with managing international emissions from civil aviation. In response to this mandate, ICAO established certain goals for the sector, including improving fuel efficiency by one and a half percent annually between 2009 and 2020 and capping net

5 We use both CO_2 and GHG emissions in this article. Our focus is on reducing the impact of climate change from aviation and therefore we are concerned, generally, with reducing all GHG emissions, but much of the research on climate change and aviation (and ICAO's emphasis) focuses on CO_2.

6 Ipek Gençsü & Miyuki Hino, "Raising Ambition to Reduce International Aviation and Maritime Emissions" (2015) New Climate Economy Working Paper at 3, 9, online: <newclimateeconomy.report/2015/wp-content/uploads/sites/3/2015/09/NCE-Aviation-Maritime_final.pdf>. See Parth Vaishnav, "ICAO's Market Based Mechanism: Keep it Simple" (2016) 10:2 Carbon & Climate L Rev 120 at 120 (some estimates suggest that CO_2 aviation emissions could grow up to 300 percent between now and 2050).

7 International Coalition for Sustainable Aviation, "Flightpath 1.5°: International Aviation's Link to Climate Change" (2016), online: <www.flightpath1point5.org>.

8 Ralph Sims et al, "Transport" in Ottmar Edenhofer et al, eds, *Climate Change 2014: Mitigation of Climate Change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2014) 599 at 603.

9 *Report of the Conference of the Parties on its Twenty-First Session, Held in Paris from 30 November to 13 December 2015 Addendum Part Two: Action Taken by the Conference of the Parties at its Twenty-First Session*, UNFCCCOR, 21st Sess, Annex, Paris Agreement, UN Doc FCCC/CP/2015/10/Add.1 (2016) at 21–36 (entered into force 4 November 2016) [*Paris Agreement*].

10 *Kyoto Protocol to the UN Framework Convention on Climate Change*, 11 December 1997, 2303 UNTS 30822 art 2.2 (entered into force 16 February 2005) [*Kyoto Protocol*].

CO_2 emissions through a global market-based measure.[11] In 2016, ICAO States adopted the first global standard for aircraft CO_2 emissions, as well as a standard for non-volatile Particulate Matter (nvPM).[12] Although ICAO members debated options for implementing a market-based measure, including taxation and an emissions trading scheme, they ultimately opted, at the 2016 Assembly, to pursue a global offsetting scheme.[13] The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) requires international carriers to have carbon-neutral growth after 2020, which means they will need to purchase credits to offset any emissions that go beyond the 2020 baseline. While CORSIA is a step in the right direction, neither it nor the fuel efficiency standard established by ICAO will be sufficient to stem the rising tide of CO_2 emissions from the aviation sector.[14] There is no commitment to absolute emissions reductions (only carbon-neutral growth), and CORSIA's success will depend on its implementation and the quality of offsets. It is therefore imperative for nations—especially wealthy ones—to lead the way in not only supporting ICAO's efforts but also finding ways to move beyond CORSIA and reduce international aviation emissions and mitigate domestic aviation emissions.

Action at the domestic level is complicated by the global nature of the industry and the trans-boundary component of many flights. In this paper, we examine the potential for Canada to regulate aviation CO_2 emissions, taking into account the recent ICAO offsetting mechanism. The paper is structured as follows: Part I (Background and Context) offers an overview of aviation CO_2 emissions globally and the key strategies for mitigation; Part II (International Dimensions) describes the efforts undertaken internationally to address emissions from international civil aviation; Part III (Aviation in Canada) provides context for aviation in Canada, and describes how aviation emissions from are currently regulated in Canada; and, Part IV (Options for Moving Forward in Canada) analyzes options for the Canadian

11 See International Civil Aviation Organization, *Assembly Resolutions in Force (as of 4 October 2013)*, (Montréal: ICAO, 2014), Resolution A38-18 at I-68–I-70, online: ICAO <www.icao.int/publications/documents/10022_en.pdf> [ICAO, *Resolutions*] (ICAO states initially agreed in 2010 to an aspirational goal of carbon neutral growth post 2020, which morphed into that of developing a market-based mechanism).

12 See International Civil Aviation Association, News Release, "ICAO Environment Committee Wraps up Landmark 10th Meeting" (12 February 2016), online: ICAO <www.icao.int>.

13 International Civil Aviation Association, *Report to the Executive Committee on Agenda Item 22*, 39th Session (2016) at 22.3.4.

14 See Part II, A, below, for a detailed discussion of CORSIA.

federal government to reduce aviation CO_2 emissions, including how domestic approaches can integrate with CORSIA. Our recommendations for Canada involve a mix of policy tools, including regulation, carbon pricing, and modal shifts for short-haul transit. We believe these would be flexible enough to allow for regional variability (*e.g.* communities that rely on air transport for subsistence purposes), as well as integration with CORSIA and potentially also the European Union (EU) Emission Trading System (ETS), should flights to and from the EU be covered.

I. BACKGROUND AND CONTEXT

Determining and managing aviation's contribution to climate change is difficult for many reasons. One challenge is that the climate impact of aircraft emissions is greater because of the altitude at which they are emitted. Aviation CO_2 emissions come principally from the burning of jet fuels, such as kerosene. When those fuels are burned at high altitudes (8–12 km), the resulting GHG emissions are compounded by water vapour and contrails, which trap heat that would otherwise dissipate.[15] While the technical details of radiative forcing are beyond the scope of this paper, the key point is that aviation emissions contribute more to climate change (some estimate two to four times more) than the fuels burned at ground level.[16] This factor is not reflected in international policy discussions about aviation. Emissions from airport operations (the definition of which varies)[17] are an additional consideration in evaluating aviation's contribution to climate change. However, the focus of this paper is on emissions from flights themselves.

The fact that aviation and its associated CO_2 emissions are projected to continue growing has not gone unnoticed in policy fora. The Subsidiary Body for Scientific and Technological Advice (SBSTA) under the *UNFCCC* flagged the problem of growing aviation emissions in 1996.[18] Indeed, there have been many different proposals for reducing aviation emissions over

15 Olivier Dessens et al, "Aviation and Climate Change" (2014) 34 Transport Policy 14 at 14; David S Lee et al, "Aviation and Global Climate Change in the 21st Century" (2009) 43 Atmospheric Environment 3520.

16 Dessens et al, *supra* note 15; Lee et al, *supra* note 15; Joyce E Penner et al, *Aviation and the Global Atmosphere* (Cambridge: Cambridge University Press, 1999).

17 Ben Daley & Holly Preston, "Aviation and Climate Change: Assessment of Policy Options" in Gössling & Upham, *supra* note 3, 347 at 363.

18 UNFCCC, Subsidiary Body for Scientific and Technological Advice, *National Communications*, 4th Sess, FCCC/SBSTA/1996/9/Add.1, October 1996, at para 26 [UNFCCC (1996)].

the years. Strategies for reducing GHG aviation emissions fall into three general categories: improving aircraft efficiency (*e.g.* through fleet renewals), using alternative fuels (*e.g.* biofuels), and increasing the efficiency of operations (*e.g.* through changes in route networks and cruising altitude). Given that fuel represents approximately one-third of an airline's costs,[19] the fuel savings associated with reducing GHG emissions are an important motivator for airlines as well.

Aircraft efficiency: Individual airlines[20] and international organizations often use fleet renewal strategies to improve aircraft fuel efficiency.[21] The types of technological improvements applied include "aerodynamic changes, weight reductions, more fuel efficient engines, and increased operational efficiency."[22] While these changes have contributed to improved efficiency, there are sometimes trade-offs that have to be made between emissions reduction and noise.[23] Further, there are safety rules that must be complied with that take priority over improvements in efficiency. Aircraft today are significantly more efficient (60–70 percent) than 40 years ago,[24] largely due to "step changes in technology," such as shifting from propeller planes to jet planes.[25] Further efficiency increases will likely require the use of more lightweight materials or additional functional changes in aircraft design, such as blended wing-body aircraft.[26] The reality is that in the short term, at least, additional meaningful emissions reductions through fleet renewal will be difficult since most currently feasible fleet renewal has already been completed.[27]

Alternative fuels: The use of alternative fuels offers another strategy for reducing the impact of aviation emissions on the climate. Two main types

19 Vaishnav, *supra* note 6 at 121.

20 For a discussion of Air Canada and WestJet's focus on fleet renewal as a sustainability strategy, see Michael Chapman, "Sustaining Reductions in Aircraft Emissions for Canada's Major Airlines" in Oliver Mack et al, eds, *Managing in a VUCA World* (New York: Springer, 2016) 175 at 181–82.

21 ICAO, *Resolutions*, *supra* note 11 at I-74.

22 Lee et al, *supra* note 15 at 3531.

23 *Ibid*.

24 *Ibid*; Burt Metz et al, eds, *Climate Change 2007: Mitigation* (Cambridge: Cambridge University Press, 2007) at 326.

25 Lee et al, *supra* note 15 at 3531.

26 Metz et al, *supra* note 24 at 354.

27 Belinda Gan, *Aviation: The Wings of (Climate) Change* (Schroders, 2016) at 7, 10, online: <www.schroders.com/en/SysGlobalAssets/email/international/2016/2016-08-aviation-the-wings-of-climate-change.pdf>.

of fuel have been the focus of research: liquid hydrogen and biofuels.[28] Both have their challenges, key amongst them being how they are produced. For liquid hydrogen, the question is whether its production can be carbon neutral—if not, what it offers in terms of mitigation potential, as compared to kerosene, is much less clear.[29] Another challenge with hydrogen production is that its development may be some years down the road (a decade or more), and even then, perhaps only if the economy moves more generally towards hydrogen fuel.[30] Biofuels are compatible with existing aircraft engines and can be blended with conventional kerosene fuel.[31] The first test flight using biojet fuel was in 2008, and now the fuel is in increasing use, with some airports (*e.g.* Oslo and Los Angeles) offering biojet fuel in regular refuelling operations.[32] Further, Qatar is investing heavily in a research program on biofuels for aviation—Qatar Airways is a partner in this project.[33] There are, however, ongoing debates about the use of agricultural and/or Indigenous lands for the production of biofuels for a variety of reasons, including the displacement of communities, food security, and the risk that associated deforestation could counter any potential efficiency gains. There are also concerns about the use of biodiesel,[34] the costs of production,[35] and the freezing point of both alternative fuels.[36]

Operations efficiency: Changes in operations can contribute to efficiency gains. One such strategy involves changes in air traffic management. Reducing flight speeds to increase fuel savings thereby reducing emissions

28 For a very detailed description of alternative fuels, see Bob Saynor, Ausilio Bauen & Matthew Leach, *The Potential for Renewable Energy Sources in Aviation* (London: Imperial College Centre for Energy Policy and Technology, 2003).

29 Lee et al, *supra* note 15 at 3531.

30 *Ibid*.

31 Metz et al, *supra* note 24 at 341.

32 International Air Transportation Association, *Fact Sheet: Alternative Fuels* (November 2016), online: IATA <www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-alternative-fuels.pdf>.

33 International Civil Aviation Organization, "Qatar University Biofuels Project", online: <www.icao.int>.

34 DA Wardle, "Global Sale of Green Air Travel Supported Using Biodiesel" (2003) 7:1 Renewable & Sustainable Energy Rev 1 at 34.

35 Darren A Prum & Kathryn Kisska-Schulze, "The Environmentally Conscious Skies: Did the European Union's Game of Brinksmanship Lead to a Viable Global Plan for Emissions Trading in Aviation?" (2015) 14:1 Wash U Global Stud L Rev 1 at 44.

36 Wardle, *supra* note 34 at 10–12.

is another strategy.[37] While changes in operations may reduce emissions,[38] the marginal gains may decrease over time as operations become increasingly efficient. Analysis conducted by the EU concluded that operational and technical improvements in aviation would be insufficient to achieve the targets required to meet the goal of maintaining average temperature increase to below two degrees.[39]

In sum, while all three strategies hold some potential for reducing the impact of aviation emissions on climate change, alone, they are insufficient. In spite of positive steps forward, such as CORSIA and modest efficiency gains, reducing GHG emissions from the aviation sector is a major challenge. ICAO themselves identify a significant component of meeting the goal of carbon neutral growth from 2020 onwards must be filled by a combination of sustainable alternative fuels and market-based measures.[40] As already noted there are significant issues with the current generation of alternative fuels. Further, the use of low-carbon biofuels, though typically included in assumptions for scenarios of emissions growth, has not yet been sufficiently supported by government mandates or policies to make their use feasible on a large scale.[41] Therefore, a significant proportion of CO_2 reductions will need to come from market-based measures. While market-based measures can take many different forms, from carbon taxes to cap and trade programs, they all involve imposing some kind of price (direct or indirect) on aviation emissions. As noted earlier, ICAO States have opted for an offsetting program, which will require airlines to purchase credits for growth in CO_2 emissions when the system takes effect. We turn to this next.

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37 Lee et al, *supra* note 15 at 3532.

38 See e.g. Frank Jelinek et al, *The EUR RVSM Implementation Project—Environmental Benefit Analysis* (Brussels: EUROCONTROL, 2002) (for a study about one type of air traffic management procedure).

39 See Policy Department A: Economic and Scientific Policy, *Emission Reduction Targets for International Aviation and Shipping*, by Martin Cames et al (Brussels: European Union, 2015) at 41, online: <www.europarl.europa.eu/RegData/etudes/STUD/2015/569964/IPOL_STU(2015)569964_EN.pdf>; Lee et al, *supra* note 15 at 3532 (noting that some changes can occur in steps, offering a significant "a one-off savings").

40 International Civil Aviation Organization, "Environmental Trends", online: ICAO <www.icao.int>.

41 Metz et al, *supra* note 23 at 643ff; Sustainable Aviation, *CO_2 Road-Map* (Sustainable Aviation, 2012) at 39, online: <www.sustainableaviation.co.uk/wp-content/uploads/2015/09/SA-Carbon-Roadmap-full-report.pdf>.

II. INTERNATIONAL DIMENSIONS

A. *UNFCCC* and ICAO

Adopted by 195 countries at the 21st *UNFCCC* conference (COP 21), in December 2015 in Paris, the *Paris Agreement* opened for signature in April 2016 and entered into force on November 4, 2016.[42] The *Paris Agreement* represents a critical milestone in the global effort to address climate change and keep global average temperatures from rising more than two degrees Celsius (or the more ambitious one and a half degrees Celsius goal).[43] While emissions from domestic aviation are captured as part of a Party's overall GHGs, emissions from international aviation were omitted from the *Paris Agreement*, as they were from the *Kyoto Protocol*. The *UNFCCC* and its associated working groups, Conferences of the Parties, and subsidiary bodies have been discussing the impact and management of aviation emissions since 1995, but to-date, the result has been to underline the importance of the subject, but not allocate emissions reduction targets to individual countries.[44] The final text of the *Kyoto Protocol* states that "[t]he 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."[45] Some Parties, such as the EU, lobbied for aviation to be included in the *Paris Agreement*.[46] The initial draft agreement for Paris

42 United Nations Framework Convention on Climate Change (UNFCCC), "Paris Agreement — Status of Ratification, online: <unfccc.int>; see *Paris Agreement*, *supra* note 9, art 21 (the *Paris Agreement* came into force 30 days after at least 55 Parties to the Convention, which account for at least 55 percent of global emissions, ratified the *Agreement*).

43 *Paris Agreement*, *supra* note 9, art 2.

44 The 1996 document produced by SBSTA on possible revisions to guidelines for the preparation of national communications by Parties included in Annex 1 to the *UNFCCC* provided eight allocation options for emissions from the use of bunker fuels (marine and aviation). These options ranged from "no allocation" to "allocation to parties according to the countries where the bunker fuel is sold," and "allocation to the party of all emissions generated in its national space" (amongst others). The document proceeds to indicate that if the Parties do not allocate these emissions to specific Parties, the International Civil Aviation Organization and the International Maritime Organization may be helpful in working towards reductions. As article 2.2 of the *Kyoto Protocol*, *supra* note 10, illustrates, this is, in fact, the direction chosen by the international community. See UNFCCC (1996), *supra* note 18 at paras 27–30.

45 *Kyoto Protocol*, *supra* note 10, art 2.2

46 Amongst other things, the European Parliament presented the side event (IISD, Meeting Reports, "Global Market-Based Mechanisms for Reducing Emissions from Aviation and

did have text on international aviation and maritime shipping emissions (something carried over from the Bonn negotiations in October of 2015),[47] but this text was ultimately deleted.[48] As a result, the *Paris Agreement* is silent on these growing sources of emissions.

One of the reasons why aviation has not been included in these international agreements is that the bulk of international aviation emissions are released outside jurisdictional boundaries, often during transnational flights. As such, it is difficult to get states to agree on how emissions reductions should be allocated. While agreements under the *UNFCCC* are international in scope, the agreements target reductions of domestic emissions by individual nations. Given the significant and growing impact that international aviation has on global CO_2 emissions, this approach has led some countries and regions, particularly the EU, to move forward unilaterally.

Over the years, SBSTA has discussed options for reporting and mitigating emissions from international aviation fuels. From the beginning, IPCC Guidelines (those used by nation-states to report their GHG emissions to the *UNFCCC*)[49] recommended countries report emissions related to "fuel sold to any air or marine vessel engaged in international transport"[50] separately from other national inventory sectors. The same recommendations remain relevant today, with the 2006 IPCC Guidelines noting that "[a]n exception to emissions from fuel use [is] ships and aircraft engaged in international transport which is not included in national totals, but

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Shipping" (9 December 2015), online: IISD <www.iisd.ca>) and attempted to insert aviation and shipping emissions in to the "Workstream 2" discussion, which dealt with actions that needed to happen pre-2020 (Air Transport Action Group, *Aviation Report: COP21 Climate Talks, Paris* (December 2015) at 2) [Air Transport Action Group, *Aviation Report*].

47 United Nations Framework Convention on Climate Change, Ad Hoc Working Group on the Durban Platform for Enhanced Action, *Draft Agreement and Draft Decision on Workstreams 1 and 2 of the Ad Hoc Working Group on the Durban Platform for Enhanced Action*, 2nd Sess, Part 11, 2015, online: UNFCCC <unfccc.int/files/bodies/application/pdf/ws1and2@2330.pdf> (article 3, section 19 had as one option (the other being "no text"): "[p]arties [shall][should][other] pursue limitation or reduction of greenhouse gas emissions from international aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime Organization, respectively, with a view to agreeing concrete measures addressing these emissions, including developing procedures for incorporating emissions from international aviation and marine bunker fuels into low-emission development strategies").

48 Air Transport Action Group, *Aviation Report*, *supra* note 46 at 1.

49 *Revision of the UNFCCC Reporting Guidelines on Annual Inventories for Parties Included in Annex I to the Convention*, FCCC Dec 24/CP.19, UNFCCCOR, 2014, UN Doc FCCC/CP/2013/10/Add.3, 2 at 2 online: UNFCCC <unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf>.

50 UNFCCC (1996), *supra* note 18 at para 21.

is reported separately."[51] This is perhaps in recognition of the fact that allocating responsibility for international flight emissions is complicated, but also facilitates the exclusion of international aviation from domestic commitments to reduce emissions within the *UNFCCC* framework.

As noted earlier, mitigation of international aviation emissions has been left in the hands of individual nations through ICAO. ICAO is a United Nations Specialized Agency created by the *Convention on International Civil Aviation* (*Chicago Convention*).[52] Although the original focus of ICAO was to "develop the principles and techniques of international air navigation and to foster the planning and development of international air transport,"[53] its mission has expanded significantly over the years. As already noted, the international community mandated ICAO to help countries reduce CO_2 aviation emissions. Indeed, ICAO continues to report to SBSTA on the outcomes of its work,[54] and the *UNFCCC* "recogniz[es] the important role of ICAO…in limiting and reducing GHG emissions from fuel used in international aviation."[55]

Although ICAO has expressed support for its role in mitigating global GHG aviation emissions,[56] it was initially reluctant to take on this mandate, and many have criticized the organization for its slow progress on mitigating international aviation emissions.[57] Despite Assembly Resolution 35-5 in 2004—which highlighted various approaches to reducing GHG emissions from aviation, including voluntary action, price-based initiatives, or trading schemes—ICAO has, until very recently, relied on voluntary measures

51 Kristin Rydpal et al, "Introduction to the 2006 Guidelines" in Simon Eggleston et al, eds, *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, vol 1 (Japan: IGES, 2006) 1.1 at 1.5.

52 7 December 1944, 15 UNTS 295 art 43 (entered into force 4 April 1947) [*Chicago Convention*].

53 *Ibid*, art 44.

54 United Nations Framework Convention on Climate Change, "Emissions from Fuel Used for International Aviation and Maritime Transport (International Bunker Fuels)" (2014), online: UNFCCC <unfccc.int>.

55 *Ibid*.

56 International Civil Aviation Organization, News Release, "ICAO Welcomes COP21 Agreement, Will Continue to Provide Leadership and Coordinate Actions on International Aviation's Environmental Goals" (15 December 2015), online: ICAO <www.icao.int/Newsroom/NewsDoc2015/COM.71.15.EN.pdf>.

57 For example, in 2007, the European Federation for Transport and Environment released a report summarizing the ways in which ICAO has stalled on acting on climate change, see European Federation for Transport and Environment, *No Flight Plan: How the International Civil Aviation Organization (ICAO) has Blocked Progress on Climate Change for a Decade* (Brussels: Transport and Environment, 2007).

implemented by mutual agreement between states.[58] However, ICAO has recently moved forward on emissions standards and CORSIA, discussed next.

1. Aircraft Emissions Standards

ICAO recently agreed to two standards: (1) standards for nvPM, which are the ultrafine soot particles released by aircraft engines, and (2) global CO_2 emissions design standards.[59] The Aircraft CO_2 Emissions Standard is aimed at encouraging the integration of fuel-efficient technologies into aircraft design and development.[60] The level of the standard is set using ICAO criteria of technical feasibility, environmental benefit, and cost-effectiveness,[61] with the ultimate goal of "mandat[ing] improvements in fuel efficiency and reduction in CO_2 emissions"[62] through technological improvements in the sector.

As such, the CO_2 standard will apply to new aircraft type designs as of 2020 and deliveries of current in-production aircraft types from 2023 onwards. The standard will not likely be fully operational until 2028, as this is the date recommended as a cut-off for producing aircraft that are not in compliance with the standard.[63] It is predicted to decrease fuel consumption of aircraft by four percent. While companies will need to make minor changes in design to improve efficiency, the standard is agnostic about the type of technological innovation used to generate the reductions. Reaction to the standard has been mixed, with some praising the establishment of global standards for the industry.[64] Others have criticized the CO_2

58 Prum & Kisska-Schulze, *supra* note 35 at 7–8.

59 See International Civil Aviation Organization, News Release, "New ICAO Aircraft CO_2 Standard One Step Closer to Adoption" (8 February 2016), online: ICAO <www.icao.int> [ICAO, "New ICAO CO_2 Standard"].

60 International Civil Aviation Organization, Fact Sheet AN 1/17, *Aircraft CO_2 Emissions Standard Metric System* at 1, online: ICAO <www.icao.int/environmental-protection/Documents/CO2%20Metric%20System%20-%20Information%20Sheet.pdf>.

61 *Ibid* at 2.

62 Dan Rutherford & Anastasia Kharina, "International Civil Aviation Organization CO_2 Standard for New Aircraft", (9 February 2016), online: ICCT-ICAO <www.theicct.org>.

63 Air Cargo World, "ICAO CO2 Emission Standards Closer to Adoption" (10 February 2016), *Air Cargo World* (blog), online: <aircargoworld.com/allposts/icao-co2-emission-standards-closer-to-adoption>.

64 See e.g. Air Transport Action Group, "Q&A: The ICAO CO_2 Standard for Aircraft" (February 2016), online: ATAG <www.enviro.aero> (concluding the standard is "ambitious and realistic").

standard for being insufficiently stringent,[65] suggesting that the standard reflects current industry practice, and thus, will not require changes to the existing fleet, nor create incentives to reduce empty weight.[66] Others have pointed to the long time frame for adoption (the standards will only be fully operational in 2028, at which point they may be obsolete).

The nvPM standard currently under discussion is a work in progress, using the current ICAO standards for smoke with an additional nvPM certification requirement.[67] The goal is for a more stringent standard by 2019.[68]

2. *Carbon Offset and Reduction Scheme for International Aviation (CORSIA)*

At the ICAO's 39th General Assembly, held in September and October of 2016, members voted in favour of implementing CORSIA.[69] The system requires international carriers to purchase credits to offset growth in emissions beyond 2020 levels. The system will begin in 2021 and run to 2035. As of August 2017, 73 states have volunteered to join CORSIA for 2021, representing 87.7 percent of total growth in aviation emissions.[70]

There has been support for CORSIA. The EU, for instance, has heralded the ICAO resolution on CORSIA as "a decisive step towards the carbon neutral growth of aviation"[71] and seems generally pleased with the progress made at the recent ICAO General Assembly.[72] The Canadian government called it a historic agreement and underlined the leading role Canada

65 See e.g. Transport and Environment, "Rejecting the ICAO CO_2 Standard" (25 April 2016), online: <www.transportenvironment.org>.

66 See e.g. International Coalition for Sustainable Aviation, "ICAO's CO_2 Standard for New Aircraft" (2016) International Civil Aviation Organization Working Paper A39-WP/207, online: ICAO <www.icao.int/Meetings/a39/Documents/WP/wp_207_en.pdf>; Jeff Tollefson, "UN Agency Proposes Greenhouse-Gas Standard for Aircraft" 530:7590 Nature 226 (9 February 2016), online: <www.nature.com>.

67 Jane Hupe, "CAEP Progresses on Noise and Emissions Standards" (2015) 70:4 ICAO J 7 at 12, online: ICAO <www.icao.int>.

68 *Ibid*.

69 International Civil Aviation Organization, *Resolutions Adopted at the 39th Session of the Assembly*, provisional ed (27 September–6 October 2016), at Resolution A39-9, online: ICAO <www.icao.int/Meetings/a39/Documents/Resolutions/a39_res_prov_en.pdf> (Resolution A39-9 is the Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection—Global Market-Based Measure Scheme).

70 International Civil Aviation Organization, "Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)", online: ICAO <www.icao.int> [ICAO, "CORSIA"].

71 European Commission, Statement, 16/3331, "Commission Welcomes Landmark Deal to Curb International Aviation Emissions" (6 October 2016), online: <europa.eu>.

72 European Commission, Memo, 16/3332, "Memo: 39th Assembly of the International Civil Aviation Organization" (7 October 2016), online: <europa.eu>.

played in reaching sufficient support for the measure.[73] The International Air Transport Association[74] and the Airports Council International[75] are also happy with the outcome.

On the other hand, there are some criticisms including the following relating to time lag, coverage, and focus on growth versus absolute reductions. First, CORSIA will only come into force as a pilot phase in 2021, and the first phase (2024 to 2026) will only cover states that volunteer to be covered.[76] It is not until 2027 (beginning of phase two) that participation becomes mandatory for all except least developed countries, small island developing states, and landlocked developing countries.[77] Emissions up until the end of 2020 will be allowed to grow without any offsetting requirements. This could be significant. For instance, the International Air Transport Association (IATA) estimated that air passenger numbers are expected to double to 7 billion by 2034, which represents an average annual growth of 3.8 percent, using a 2014 baseline.[78] Estimates for Canada during this period predict annual growth of international aviation of 4.4 percent between 2012 and 2020.[79]

Second, only emissions from "international flights on the routes between States, both of which are included in CORSIA" will be covered.[80] Since not all international aviation emissions will be covered, this could result in route changes or distortions to flight patterns. Relatedly, CORSIA does nothing to address emissions from domestic flights, which are projected to grow considerably, especially in China and India, and within

73 Kathleen Harris, "'Historic Agreement:' Canada Signs on to World's 1st Airline Climate Plan", *CBC News* (6 October 2016), online: <www.cbc.ca>.

74 International Air Transport Association, Press Release, No 56, "Airlines Hail Historic ICAO Carbon Agreement" (6 October 2016), online: IATA <www.iata.org>.

75 *Ibid*; Airports Council International, Media Release, "Airports Council International Reaffirmed Support of the Implementation of the Carbon Offset and Reduction Scheme for International Aviation as the Global Market Based Measure for International Aviation" (30 September 2016), online: ACI <www.aci.aero>.

76 International Civil Aviation Organization, "Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection—Global Market-Based Measure (MBM) Scheme" (2016) ICAO Working Paper A39-WP/52 at paras 7(a)–(b), online: ICAO <www.icao.int/Meetings/a39/Documents/WP/wp_052_en.pdf> [ICAO, "Consolidated Statement"].

77 *Ibid* at para 7(d).

78 International Air Transport Association, Press Release, 55, "IATA Air Passenger Forecast Shows Dip in Long-Term Demand" (26 November 2015), online: IATA <www.iata.org>.

79 Transport Canada, "Air Transportation" (27 February 2017), online: <www.tc.gc.ca> [Transport Canada, "Air Transportation"].

80 ICAO, "Consolidated Statement", *supra* note 76 at para 8(a).

the United States (US). Finally, and perhaps most notably, the offsetting mechanism, while a laudable step, does not require any actual reductions in aviation emissions itself, but simply requires the purchase of offsets outside the international aviation industry. The aviation director for Transport & Environment (a sustainable transport advocacy group), for instance, stated that "[a]irline claims that flying will now be green are a myth.…this deal won't reduce demand for jet fuel one drop. Instead, offsetting aims to cut emissions in other industries."[81]

In terms of implementation, CORSIA was approved through an Assembly Resolution and will be operationalized through a set of ICAO standards. Although ICAO standards are not mandatory, states can file a "difference" with ICAO if another state is not following the standard.[82] While implementing CORSIA through standards (rather than the treaty itself) may reduce its effectiveness, negotiating a change to the agreement would have been more politically challenging and likely would have delayed action.[83] There are ways to promote compliance with CORSIA, including creating a central agency to maintain a public registry documenting compliance. Additionally, dominant actors, such as the US and the EU, could exert a powerful influence by making access to their airspace contingent upon compliance with CORSIA.[84]

The International Air Transport Association (IATA) estimates that achieving carbon-neutral growth from 2020 onwards through CORSIA will cost the airlines between 4 and 12 billion dollars (USD) in 2030.[85] Another estimate places the costs at 23 billion dollars (USD) from 2021 to 2035, which represents around three percent of the industry's annual global revenue.[86] This translates into a carbon price of between 2.66 and

81 Roger Harrabin, "Aviation Industry Agrees Deal to Cut CO2 Emissions" *BBC News* (7 October 2016), online: <www.bbc.com>; Stephen McNeice, "Agreement Reached to Limit Emissions from Aviation Industry", *Newstalk* (6 October 2016), online: <www.newstalk.com>.

82 *Chicago Convention*, *supra* note 52, art 38.

83 Alejandro Piera, "Designing the Legal Form of a Global Aviation Market-Based Measure" (2016) 10:2 Carbon & Climate L Rev 144 at 146–47 (in addition, a treaty change might not receive sufficient ratification to bring it into force, and even it did, the system would only apply to States that have ratified the treaty).

84 *Ibid* at 152.

85 Christopher Peacock, "Comments on the Cost Impact of a Global Carbon Offsetting Mechanism" (2016) International Civil Aviation Association Working Paper A39-WP/153 EX/57, at 3, online: ICAO <www.icao.int/Meetings/a39/Documents/WP/wp_153_en.pdf>.

86 Dan Rutherford, "Brother, Can You Spare Three Cents (for the Climate)?" (3 October 2016), International Council on Clean Transportation, online: <www.theicct.org>.

18.82 dollars (USD) per tonne of CO_2.[87] While the estimates vary significantly, since it is difficult to predict what it will cost to purchase offsets in the future, it is clear that the costs to the industry will not be negligible. However, as Rutherford highlights, perhaps this is the cost of doing business in a carbon-intensive industry in a carbon-constrained world.[88] The ICCT estimates that aviation emissions will cause 700 billion dollars (USD) in damage over the period of the offset system, or 30 times the costs of offsetting.[89]

In sum, while CORSIA is generally seen as a move in the right direction, there remain valid concerns and critiques that it is inadequate to address aviation's climate footprint, especially given projections for growth. In terms of concerns with the actual mechanism, the Assembly Resolution creating CORSIA includes a mechanism for review every three years, beginning in 2022.[90] This will be an opportunity to address concerns and weaknesses of the measure moving forward.

B. European Union Action

One of the jurisdictions that has been proactive on international aviation and climate is the EU, which brought aviation into its emissions trading system with the EU 2008 Directive (this prompted an outcry from the US airline industry and China).[91] However, the EU postponed their decision when ICAO indicated, at its 2013 Assembly, it would develop its global market-based measure.[92] Whether the EU moved on aviation due to the lack of action on the part of ICAO, or a desire to include more of the EU economy in their new emissions trading system (EU ETS), is anyone's guess.[93] Either

87 Peacock, *supra* note 85 at 3.

88 Rutherford, *supra* note 86.

89 *Ibid*.

90 ICAO, "Consolidated Statement", *supra* note 76 at para 9(g).

91 Verki Michael Tunteng, ed, *Legal Analysis on the Inclusion of Civil Aviation in the European Union Emissions Trading System* (Montréal: Centre for International Sustainable Development Law, 2012) at 8, online: CISDL <www.cisdl.org/public/docs/news/CISDL_EU_ETS_Expansion_Legal_Brief.pdf>; European Commission Climate Change, "Reducing Emissions from Aviation", online: ECCC <ec.europa.eu>; Prum & Kisska-Schulze, *supra* note 35 at 8.

92 ICAO, "CORSIA", *supra* note 70.

93 See EC, *Commission Directive 2008/101/EC of the European Parliament and the Council of 19 November 2008 Amending Directive 2003/87/EC so as to Include Aviation Activities in the Scheme for Greenhouse Gas Emission Allowance Trading within the Community*, [2009] OJ, L 8/3 at para 11 [EC, *Commission Directive 2008/101/EC*] (the Directive states "policies and

way, the 2008 Directive[94] has been the source of much controversy. It may have been the impetus for ICAO States moving forward with CORSIA.

The 2008 Directive states that "[i]n order to avoid distortions of competition and improve environmental effectiveness, emissions from all flights arriving at and departing from Community aerodromes should be included from 2012."[95] Effectively, this means that all flights (domestic and international) into or out of an EU airport, regardless of country of registration, would be covered under the EU ETS framework. Perhaps not surprisingly, this resulted in international opposition, political challenges, and legal disputes over its compliance (or not) with international law.[96] Specifically, in 2011, 21 ICAO member States (excluding Canada) signed a joint agreement to indicate their displeasure with the EU incorporating aviation within its ETS.[97] Some countries even resorted to threatening trade sanctions or telling their aviation operators to not comply with the EU ETS requirements.[98]

The United States, through the Air Transportation Association of America, challenged the United Kingdom's implementation of the Directive.[99] The US claimed that the inclusion of international aviation under the EU ETS breached international law.[100] The matter was referred to the European Court of Justice (ECJ), since the matter affected more than one EU member.[101] The ECJ was asked to examine whether the EU ETS violated

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measures should be implemented at Member State and Community level across all sectors of the Community economy in order to generate the substantial reductions needed").

94 *Ibid*.

95 *Ibid* at para 16.

96 Uwe M Erling, "Introductory Note to the Court of Justice of the European Union: Air Transport Association of America (ATA) et al. v. Secretary of State for Energy & Climate Change" (2012) 51:3 ILM 535.

97 International Civil Aviation Organization, "Inclusion of International Civil Aviation in the European Union Emissions Trading Scheme and its Impact" (2011) International Civil Aviation Organization Working Paper C-WP/13790, at Appendix.

98 United States of America, Congressional Research Service, *Aviation and the European Union's Emission Trading Scheme*, by Jane A Leggett, Bart Elias & Daniel T Shedd (Washington: Congressional Research Service, 2012) at 28–30, online: FAS <www.fas.org/sgp/crs/row/R42392.pdf>.

99 See Erling, *supra* note 96 (the challenge was done through a claim for judicial review in the High Court of Justice of England and Wales).

100 For more details on this case, see Prum & Kisska-Schulze, *supra* note 35 at 9–12.

101 See *Air Transport Association of America* (*ATA*) *et al v Secretary of State for Energy & Climate Change*, Case C-366/10, [2011] ECR I-13833 at para 47 [*ATA v Secretary of State*] (ECJ jurisprudence requires this to ensure the laws of the EU are applied consistently by national courts).

"(1) sovereignty over airspace, (2) the principle that no state may subject any part of the high seas to its territory, and (3) freedom to fly over high seas."[102] After examining the *Chicago Convention*, the *Open Skies Agreement*, the *Kyoto Protocol*, and principles of customary international law the ECJ issued an advisory opinion supporting the Directive, stating that: "no factor of such a kind [was found] as to affect its validity."[103]

Although the Court confirmed the EU's right to regulate emissions from flights to and from the EU,[104] the EU "stopped the clock" on implementation of the ETS on international flights in response to political pressure, and ostensibly, to allow ICAO to develop a market-based mechanism.[105] The initial stay of implementation ended in 2016, but it looks likely that it will be extended at least until the first phase of CORSIA begins, though the proposed EU regulation also allows for earlier review of the derogation, depending on the progress of CORSIA and its implementation.[106] The EU Parliament provisionally voted for this modification in October of 2017.[107]

If the EU Parliament ultimately is unsatisfied with the implementation of CORSIA or the degree of impact it is having on emissions from aviation, they could still choose to include flights into and out of the EU in their existing ETS. Should this happen, it is important to remember that there is a provision in the original Directive which allows for the creation of "[b]ilateral arrangements on linking the Community scheme with other trading schemes to form a common scheme or taking account of equivalent measures to avoid double regulation."[108] Effectively, this means that a

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102 Erling, *supra* note 96 at 536.

103 *ATA v Secretary of State*, *supra* note 101 at para 157.

104 For a more detailed analysis of the advisory opinion, see Prum & Kisska-Schulze, *supra* note 35 at 9–12.

105 EC, *Commission Decision No 377/2013/EU of the European Parliament and of the Council of 24 April 2013 Derogating Temporarily from Directive 2003/87/EC Establishing a Scheme for Greenhouse Gas Emission Allowance Trading within the Community*, [2013] OJ, L 113/1 at para 6 (which states, in reference to progress made on a market-based measure at the 38th session of the ICO Assembly, "[i]n order to facilitate this progress and provide momentum, it is desirable to defer the enforcement of requirements arising prior to the 38th session of the ICAO Assembly and relating to flights to and from aerodromes in countries outside the Union…").

106 Gregor Erbach, *Briefing: EU Legislation in Progress* (Brussels: European Parliament Research Service, 2017), online: EPRS <www.europarl.europa.eu/RegData/etudes/BRIE/2017/603925/EPRS_BRI(2017)603925_EN.pdf>

107 Centre for Aviation, "EU Parliament Votes for CO2 Emissions to Remain Outside of ETS until CORSIA is Introduced" (22 October 2017), online: CAPA–Centre for Aviation <centreforaviation.com>.

108 EC, *Commission Directive 2008/101/EC*, *supra* note 93 at para 17.

Canadian approach to mitigating aviation emissions could be connected to the EU ETS, and/or that Canadian airlines subject to an equivalent carbon price or regulation could be exempted from EU ETS fees.

These bilateral agreements are not new in the aviation context. In fact, Canada has signed bilateral agreements and Memoranda of Understanding with many countries.[109] While many of these bilateral tools focus on safety, airworthiness, flight frequencies, traffic rights, and aeronautical products, it is possible that measures relating to GHG emission reductions could be included. Similarly, new bilateral (or even multilateral) arrangements on CO_2 could be negotiated between Canada and other countries wishing to go beyond what has been negotiated under ICAO.

In sum, the 2016 ICAO vote in favour of CORSIA is a step in the right direction. But, the system's initially voluntary nature and slow start suggests that additional action is needed to ensure the international aviation sector plays its part in contributing to the global goal of keeping average temperatures from rising beyond one and a half or two degrees Celsius. The EU has already taken a number of important steps, such as including flights internal to the EU, and possibly all flights eventually, in their ETS. This sets a precedent for other countries that are motivated to help reduce global CO_2 emissions. For the rest of this article, we focus on what Canada can do.

III. AVIATION IN CANADA

Given the size of Canada's territory, and that it shares land borders with only one other jurisdiction, air transportation plays an important role in commercial trade and the movement of people, especially in remote communities.[110] Unsurprisingly, passenger and cargo traffic in Canada increase yearly. From 2009 to 2014, the number of passengers using air transportation in Canada grew by 24.6 percent.[111] The average annual distance flown domestically per passenger in Canada (1,325 km in 2009) is more than many other industrialized countries with smaller landmasses (*e.g.* 425 km in the UK in the same year).[112] The same holds true for the average

109 Transport Canada, "Bilateral Agreements" (1 December 2016), online: <www.tc.gc.ca>. See also Transport Canada, "Memoranda of Understanding" (5 August 2010), online: <www.tc.gc.ca>.

110 Transport Canada, *Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation* (27 May 2015), online: <www.tc.gc.ca> [Transport Canada, *Canada's Action Plan*].

111 Statistics Canada, *Air Carrier Traffic at Canadian Airports*, Catalogue No 51-203-X (Ottawa: Statistics Canada, 2014) at 4, online: <www.statcan.gc.ca> [Statistics Canada, "Air Carrier Traffic"].

112 See Transport Canada, *Canada's Action Plan*, *supra* note 110 (this statistic is from 2009).

distance per tonne of cargo, which was around 1,050 km for Canada, as compared to 385 km in the UK in 2009.[113]

The aviation sector also has a strong economic impact. In 2009, the Canadian aviation sector served 71 million passengers, carried 762, 000 tonnes of cargo, directly supported 401,000 jobs (2.4 percent of the Canadian workforce), and contributed 33 billion dollars (CAD) to the country's GDP.[114] Transport (of people and cargo) by air is not the only economic activity associated with the aviation industry. The Aerospace Industries Association of Canada (AIAC) estimates that there are over 700 companies of different sizes involved in manufacturing (73 percent), maintenance, repair, and overhaul (27 percent) related to aviation.[115] Canada is ranked third in global civil aircraft production, and growth in this area is forecasted to "outpace the global market for the 2014–2021 period."[116]

A. CO_2 Emissions, Trends, and Growth Projections for Aviation in Canada

GHG emissions from domestic aviation, in 2013, represented one percent of Canada's total emissions, or approximately four percent of Canada's domestic emissions from transportation.[117] While this may not seem significant, this proportion will grow given projections for growth in this sector relative to other areas. As illustrated in Table 1, overall fuel consumption within the Canadian aviation sector grew steadily between 2012 and 2014.[118]

113 *Ibid*.

114 *Ibid*.

115 Industry Canada, *The State of the Canadian Aerospace Industry*, in collaboration with Aerospace Industries Association of Canada (Ottawa: AIAC, 2015) at 5, online: AIAC <aiac.ca/wp-content/uploads/2015/11/The-State-of-the-Canadian-Aerospace-Industry-2015-Report.pdf>.

116 Innovation, Science and Economic Development Canada, *Strategic Aerospace and Defence Initiative: Program Highlights 2014-15*, Catalogue No Iu56-1E-PDF (Ottawa: Industry Canada, 2016) at 4–5, online: <oti.ic.gc.ca/eic/site/ito-oti.nsf/eng/h_00939.html>.

117 Environment Canada, *National Inventory Report: 1990-2013*, Part III (Ottawa: Environment Canada, 2015) at 18, online: <publications.gc.ca/collections/collection_2016/eccc/En81-4-2013-1-eng.pdf>.

118 See Transport Canada, *Canada's Action Plan to Reduce GHG Emissions from Aviation: 2012 Annual Report*, (Ottawa: Transport Canada, 2012), online: <tc.gc.ca/media/documents/policy/6121_TC_ActionPlanGasEmiss-EN_ACCESS.pdf> [Transport Canada, *Action Plan 2012*]; Transport Canada, *Canada's Action Plan to Reduce GHG Emissions from Aviation: 2013 Annual Report* (Ottawa: Transport Canada, 2013), online: <tc.gc.ca/media/documents/policy/TC_ActionPlanGasEmiss2013-E.pdf> [Transport Canada, *Action Plan 2013*]; Transport Canada, *Canada's Action Plan to Reduce GHG Emissions from Aviation: 2014 Annual*

While there have been some improvements in fuel efficiency, these gains have been outpaced by the growth in traffic. The pattern for GHG emissions is similar, with Canada's aviation emissions growing steadily from 15.99 to 16.99 Mts of CO_2e between 2012 and 2014.[119] In other words, in spite of fuel efficiency gains, GHG aviation emissions have increased.

Approximately two-thirds of GHG aviation emissions in Canada are from international flights, while one third are from domestic flights.[120] Transport Canada forecasts annual growth of 4.4 percent for international and 2.8 percent for domestic air traffic between 2012 and 2020.[121] It is difficult to accurately predict the volume of CO_2 emissions that the Canadian aviation industry will produce over this period given the prospect for technological development and changes in the rate of economic growth. However, current projections to 2020 for domestic CO_2 aviation emissions suggest an average annual growth of 2.2 percent.[122] Further growth (beyond 2020) may also be partly mitigated by gains from fuel efficiency in aviation and other measures based on innovation and operational/managerial improvements. However, absolute growth will outpace efficacy gains. The pilot phase of CORSIA, which comes into effect in 2021, will require operators on routes to and from states, both covered by the system, to acquire offsets for growth in international emissions.[123] Since the system does not cover domestic aviation emissions, their reductions will depend upon action by individual states or other measures.

Report (Ottawa: Transport Canada, 2014), online: <www.tc.gc.ca/media/documents/policy/TC_ActionPlanGasEmiss2014-E.pdf> [Transport Canada, *Action Plan 2014*].

119 Transport Canada, *Action Plan 2012*, *supra* note 118 at 8; Transport Canada, *Action Plan 2014*, *supra* note 118 at 10 (there was a similar pattern of growth between 2005 and 2014, when total fuel use increased an average of 3.4 percent annually. The rates of RPK and Cargo RTK within the same period also show an average annual growth of 4.9 percent and 4.1 percent respectively. However, while fuel use and revenue per kilometres increased, fuel efficiency increased. Under a scenario where fuel efficiency remained at the 2005 level, total GHG aviation emissions would have reached 19.22 Mts of CO_2e by 2014. However, it was possible to reduce this number to 16.99 Mts (see *ibid*)).

120 Transport Canada, *Action Plan 2012*, *supra* note 118 at 8, 35; Transport Canada, *Action Plan 2013*, *supra* note 118 at 10, 41; Transport Canada, *Action Plan 2014*, *supra* note 118 at 10, 41.

121 Transport Canada, "Air Transportation", *supra* note 79.

122 *Ibid*.

123 *Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection—Global Market-Based Measure (MBM) Scheme*, Res A39-3, online: ICAO <www.icao.int/environmental-protection/Documents/Resolution_A39_3.pdf>.

TABLE 1 — FUEL CONSUMPTION, FUEL EFFICIENCY, AND GHG EMISSIONS[124]

	2012	**2013**	**2014**
Total fuel consumed	6.26 billion litres (64.5% internationally; 35.5% domestically)	6.31 billion litres (63.7% internationally; 36.3% domestically)	6.58 billion litres (64.4% internationally; 35.6% domestically)
Fuel efficiency			
Fuel consumption by domestic aviation	45.0 litres per 100 RTK[125]	44.58 litres per 100 RTK	42.61 litres per 100 RTK
Fuel consumption by international aviation	33.91 litres per 100 RTK	33.52 litres per 100 RTK	32.81 litres per 100 RTK
Total GHG emissions	**15.99 Mt**	**16.14 Mt**	**16.99 Mt**
International GHG emissions	10.32 Mt	10.29 Mt	10.93 Mt
Domestic GHG emissions	5.68 Mt	5.85 Mt	6.05 Mt
GHG emissions increase from prior year	2.7% (2011–2012)	0.9% (2012–2013)	4.2% (2013–2014)

B. Current Approach to Regulating Aviation in Canada

Aviation is a matter of federal jurisdiction under section 91 of the Canadian Constitution,[126] although certain provincial regulations (such as fuel taxes) apply to aviation.[127] In addition, to-date, two provinces (Alberta and British Columbia) have included intra-provincial emissions in their carbon pricing programs.[128] This simplifies matters in the Canadian federation since the federal government does not need provincial approval to address interprovincial and international aviation emissions.

124 Transport Canada, *Action Plan 2012*, *supra* note 118 at 8, 11; Transport Canada, *Action Plan 2013*, *supra* note 118 at 9–10, 12–13; Transport Canada, *Action Plan 2014*, *supra* note 118 at 9–10, 13.

125 RTK stands for Revenue-tonne kilometers.

126 *Constitution Act, 1867* (UK), 30 & 31 Vict, c 3, reprinted in RSC 1985, Appendix II, No 5.

127 See generally *Quebec (Attorney General) v Canadian Owners and Pilots Association*, 2010 SCC 39, [2010] 2 SCR 536 (confirming federal jurisdiction over aeronautics); Peter W Hogg, *Constitutional Law of Canada* (Toronto: Carswell, 2014) at 22.11ff.

128 See Alberta Treasury Board and Finance, Tax and Revenue Administration, Informational Circular CL-AV-3R1, "Aviation Fuels — Exemptions and Licences" (11 January 2017) at para 4; British Columbia, Ministry of Finance, Tax Bulletin CT 005, "Commercial Air or Marine Services: Carbon Tax Act" (Revised June 2017).

Civil aviation is regulated under the federal *Aeronautics Act*[129] and its key regulation, the *Canadian Aviation Regulations*.[130] The *Aeronautics Act* and associated regulations do not contain specific provisions targeting GHG emissions, although they do include aircraft emission standards relating to noise and other emissions, including: smoke, unburned hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx).[131] CO_2 is not considered a regulated engine emission, although its measurement is required to comply with ICAO reporting requirements.[132] The regulations authorize the Ministry[133] to develop and regulate aeronautics and supervise all matters connected with aeronautics, including the construction, maintenance, and operation of airports; control and management of aircraft and related equipment; and air traffic routes.[134] This is also where the ICAO CO_2 emissions standard could be enacted since the regulatory power is sufficiently broad to allow regulations of emissions from flights and related aviation activities. However, a separate regulation pertaining to GHG emissions could also be enacted.

Aviation is also subject to a variety of taxes, both at the federal, provincial, and territorial levels. These are examined in more detail in Part IV, B below.

1. Canada's Current Plan for Reducing GHG Aviation Emissions

Canada has an Action Plan (Plan) on reducing GHG aviation emissions.[135] First published in 2012 and updated annually,[136] the Plan establishes a goal of achieving an "average annual improvement in fuel efficiency of at least two percent per year until 2020 from a 2005 baseline."[137] The Plan also signals that Canada supports the aspirational goals of the international

129 *Aeronautics Act*, 1985 RCS, c A-2.

130 *Canadian Aviation Regulations*, SOR/96-433.

131 The smoke and gaseous emission regulation refer to Chapter 516 of the Airworthiness Manual (*ibid*), which, in turn, refer to International Civil Aviation Organization, *Annex 16 to the Convention on International Civil Aviation Environmental Protection, Volume II Aircraft Engine Emissions*, 3rd ed (Montréal: ICAO, 2008).

132 *Canadian Aviation Regulations*, *supra* note 130, Appendix 3, s 3.

133 *Aeronautics Act, supra* note 129, s 4.2.

134 *Ibid*, s 4.2 (b), (e), (f), (j), (l), (o).

135 See International Civil Aviation Organization, "Climate Change: Action Plans and Assistance", online: ICAO <www.icao.int> (as of May 2017, 102 states (accounting for 90 percent of global RTK), including Canada, had submitted national action plans to ICAO).

136 Canada's Action plan replaced the Memorandum of Understanding Between Transport Canada and the Air Transport Association of Canada signed in 2005. See Transport Canada, *Action Plan 2012*, *supra* note 118 at 43.

137 Transport Canada, *Action Plan 2012*, *supra* note 118 at 3.

community to achieve carbon-neutral growth from 2020 onwards and absolute emissions reductions by 2050.[138]

As Table 2 illustrates, the fuel efficiency target represents current practice. While achieving ongoing improvements in efficiency is important, such improvements are unlikely to result in an absolute decrease of CO2 emissions given growth projections. In addition, there is a limit to improvements that can be made in fuel efficiency. While the first spike in reductions was relatively significant, the consecutive marginal abatement costs of subsequent reductions increase exponentially, thus reducing the cost-effectiveness of this approach. When we account for growth in air traffic, the benefits of improved fuel consumption are overshadowed.

TABLE 2 — IMPROVEMENTS IN CANADIAN AVIATION FUEL EFFICIENCY[139]

	2012	**2013**	**2014**
Fuel efficiency improvement litres per RTK (as compared to the year prior to the report year)	1.7% (2011–2012)	0.9% (2012–2013)	3.0% (2013–2014)
Cumulative annual improvement in fuel efficiency since 2005	8.1%	8.9%	11.6%
Average annual fuel efficiency improvement from 2005	1.2%	1.2%	1.4%
RTK increase (the year prior to the report year)	4.5% (2011–2012)	1.8% (2012–2013)	7.4% (2013–2014)

Canada's Plan is aimed at achieving the 2020 efficiency target. Achieving carbon-neutral growth from 2020 onwards is a much more ambitious undertaking. According to the Plan, measures addressing GHG aviation emissions are divided into two groups: "key" measures and "second set" measures.[140] Key measures include three main mechanisms: (1) fleet renewal and upgrade; (2) improvement of the efficiency of air operations; and, (3) improvement of air traffic management. The "second set" measures include: (1) aviation environmental research and development; (2) use of alternative fuels; (3) airport ground operations and infrastructure use; (4) regulatory measures; and, (5) international coordination. The following offers a closer look at the above measures.

138 Transport Canada, *Canada's Action Plan*, *supra* note 110.

139 Transport Canada, *Action Plan 2012*, *supra* note 118 at 11, 25; Transport Canada, *Action Plan 2013*, *supra* note 118 at 3, 13; Transport Canada, *Action Plan 2014*, *supra* note 118 at 3, 13.

140 Transport Canada, *Action Plan 2012*, *supra* note 118 at 1 (the value of the measures seem to depend on their capability of being expressed in quantitative terms rather than on their inherent efficiency).

i. Key Measures

The first key measure, fleet renewal, is predicted to result in an average annual fuel efficiency improvement of 0.7 percent for domestic and international flights between 2005 and 2020.[141] To achieve this measure, new aircraft will need to be delivered on schedule, and old aircraft retired.[142] The measure currently depends primarily on voluntary efforts by aviation industries. One thing the Canadian Government has done to support innovation in the aviation industry is to ratify and implement the *Cape Town Convention* and its *Aircraft Protocol*. The *Protocol* gives effect to a financing regime that offers protections to aircraft financiers in the context of bankruptcy proceedings. Because of Canada's participation in the regime, the Canadian aviation industry receives preferential financing rates from domestic and international financiers who can remove their assets (aircrafts and engines) during bankruptcy proceedings.[143]

The second key measure, more efficient operations, involves continuing to increase the efficiency of fuel use during flights. Operational efforts to reduce emissions are predicted to lead to a further 0.2 percent reduction for both domestic and international flights. To facilitate these efforts, Transport Canada has helped develop an ICAO manual (*Operation Opportunities to Minimize Fuel Use and Reduce Emissions*),[144] which provides tips for airlines to improve efficiency.[145]

The third key measure involves improving efficiency by manipulating air traffic patterns. This is predicted to improve fuel efficiency by one to two percent annually between 2005 and 2020.[146] These improvements will come from changes to the performance-based navigation system in partnership with NAV Canada, which is the private company that owns and

141 Transport Canada, *Action Plan 2012*, *supra* note 118 at 14. See Transport Canada, *Action Plan 2014*, *supra* note 118 at 18 (for an example of how fleet renewals can impact efficiency is the retrofitting of Boeing 767-300 airplanes with blended winglets, which improved efficiency). See also Transport Canada, *Action Plan 2013 Annual Report*, *supra* note 118 at 19 (for other examples, which include reducing weight through introduction electronic flight bags to create a paperless cockpit, using reduced landing flaps, reconfiguring airplane cabins with lighter seats).

142 Transport Canada, *Action Plan 2012*, *supra* note 118 at 3, 6.

143 See *International Interests in Mobile Equipment (Aircraft Equipment) Act*, SC 2005, c 3.

144 International Civil Aviation Organization, *Operational Opportunities to Reduce Fuel Burn and Emissions*, Doc No 10013 (Montréal: ICAO, 2014).

145 Transport Canada, *Action Plan 2014*, *supra* note 118 at 18.

146 Transport Canada, *Action Plan 2013*, *supra* note 118 at 20.

operates Canada's air traffic system.[147] The changes are conditional upon a number of changes to policies and practices.[148]

ii. Additional "Second Set" Measures

Research and development is one of the long-term measures identified in Canada's Action Plan. To date, aviation environmental research and development has been primarily provided through a number of established initiatives, including the Green Aviation Research & Development Network,[149] Partnership for Air Transportation Noise and Emissions Reduction,[150] Canadian National Research Council, and the United States Transportation Research Board's Airport Cooperative Research Program.[151] Most of this research has been related to alternative fuels.

Research relating to alternative fuels has also been supported by the Sustainable Development Technology Canada, which has provided more than 12 million dollars (CAD) in support of alternative aviation fuels research since 2010.[152] At the same time, Transport Canada addresses the political

147 Transport Canada, *Action Plan 2012*, *supra* note 118 at 15; Nav Canada, "About Us" online: <www.navcanada.ca>.

148 See Transport Canada, *Canada's Action Plan to Reduce GHG Emissions from Aviation: 2015 Annual Report*, (Ottawa: Transport Canada, 2015) at 21, online: <www.tc.gc.ca/media/documents/policy/canadas-action-plan-reduce-greenhouse-gas-emmissions-aviation.pdf> [Transport Canada, *Action Plan 2015*].

149 See Green Aviation Research & Development Network, "Who We Are", online: <gardn.org> (Green Aviation Research and Development Network (GARDN) is a non-profit organization funded by the Canadian Government and Canadian Aerospace Industry established to fund research projects that will reduce the environmental footprint of the next generation of aircraft, engines, and avionics systems developed in Canada). See also Transport Canada, *Action Plan 2014*, *supra* note 118 at 7 (as of 2014 the network has supported 17 projects worth 42 million dollars (CAD) in research. In March 2014, the mandate was renewed for an additional 5 years with 24 million dollars (CAD) budget).

150 See Partnership for Air Transportation Noise and Emissions Reduction, "About", online: <partner.mit.edu> (the partnership is co-funded by the US Federal Agencies and Transport Canada and 12 universities and approximately 50 advisory board members, which include airspace manufacturers, airlines, airports, national and local governments, professional and trade associations, non-governmental organizations, and community groups).

151 See Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine, "Airport Cooperative Research Program" (2017), online: <www.trb.org> (the US National Advisory Board originally established for providing mechanisms for exchanging information and research results about highway technology. Currently the responsibilities of the board were extended to include, among others, management of new cooperative research programs in airports).

152 Transport Canada, *Action Plan 2015*, *supra* note 148 at 27.

obstacles of alternative fuels by negotiating with the US Federal Aviation Administration on the exchange of information on biofuels development.[153]

Airport ground operations and infrastructure use,[154] meanwhile, are primarily addressed through voluntary cooperation and information exchanges between the Canadian companies aiming to reduce emissions at the gate and on the ground. Examples of these types of initiatives include efforts to implement efficient taxi operations and work on reducing GHG emissions from airport ground operations.

Last but not least, Canada's Plan specifies that Canada will implement CO_2 emissions standards under the *Aeronautics Act,* in accordance with the ICAO standard.[155] In early 2017, the ICAO Council adopted the CO_2 emissions standard for aircraft,[156] which can be found in Volume III of Annex 16 to the *Convention on International Civil Aviation*, once published.[157] The measure is a global design certification standard intended to reduce GHG emissions from flights—it applies to "new aircraft type designs from 2020, and to aircraft type designs already in-production as of 2023."[158] In addition, Canada's Plan promises the enactment of a standard for nvPM, which has implications for not only the climate but also human health.[159]

In sum, Canada's plans with regards to aviation emissions are quite modest. While the measures in the Plan will be complimented by CORSIA, there is scope to do more. Given the importance of emissions from this sector and Canada's commitment to reach its Paris target by 2030, the next section evaluates options for Canada's aviation emissions.

153 Transport Canada, *Action Plan 2014*, *supra* note 118 at 25.

154 See e.g. RWDI AIR Inc, *Final Report: 2007 Emissions Inventory Toronto Pearson International Airport* (Toronto: RDWI, 2009), online: <www.torontopearson.com/uploadedFiles/Pearson/Content/About_Pearson/Environment/090430_TPIA_Emissions_Inventory_Final_Report.pdf> (CAC and Transport Canada completed airport emission inventories for 26 of the NAC airports and all of the airports owned by Transport Canada. These inventories quantify airport emissions from various activities. Such activities may include categories such as: aircraft emissions, ground support equipment emissions, parking lots emissions, *etc*).

155 Transport Canada, *Action Plan 2015*, *supra* note 148 at 30.

156 International Civil Aviation Organization, News Release, "ICAO Council Adopts New CO2 Emissions Standard for Aircraft" (6 March 2017), online: ICAO <www.icao.int> [ICAO, "Council Adopts New CO2 Emissions"].

157 *Ibid*.

158 ICAO, "Council Adopts New CO2 Emissions", *supra* note 156.

159 Transport Canada, *Action Plan 2015*, *supra* note 148 at 30.

IV. OPTIONS FOR MOVING FORWARD IN CANADA

Considering that the projected average annual growth in Canadian aviation for 2012–2020 is 2.8 percent domestically and 4.4 percent internationally,[160] failure to mitigate emissions will mean increases in Canada's overall CO_2 emissions inventory at a time when there is great need to reduce them.

Canada has already agreed to participate in the global ICAO offsetting mechanism, which will help mitigate emissions from international flights. For CORSIA to apply domestically, most states will need to implement domestic legislation.[161] This is certainly the case for Canada, where under the current interpretation of the Constitution, provinces are not bound automatically when the federal government signs an international treaty.[162] As noted earlier, the federal government has the constitutional authority to regulate CO_2 aviation emissions, whether international or domestic. The obligation to purchase offsets once CORSIA takes effect could be brought into the *Aeronautics Act* or separate legislation (perhaps as part of the federal carbon pricing backstop legislation and regulations).[163] ICAO may develop model legislation to encourage compatibility among its Member States. As an early actor, Canada could exert influence by offering a domestic model. This could also be an opportunity for Canada to define an approach that deals both with international and domestic aviation emissions together.

Canada could also take additional steps to address international emissions not covered by CORSIA, either unilaterally or in concert with other jurisdictions, such as the EU. These emissions include those from flights not covered by CORSIA (those between locations in participating states and non-participating states). Canada could also implement more rigorous reductions in emissions than what is mandated by CORSIA.

In addition to implementing CORSIA, Canada could legislate the measures identified in Canada's Action Plan. These measures, which aim to

160 Transport Canada, "Air Transportation", *supra* note 79.

161 See *Chicago Convention*, *supra* note 52 at art 11. See also Piera, *supra* note 83 at 152.

162 See discussion in Daniel Dupras, *International Treaties: Canadian Practice*, PRB 00-04E (Ottawa: Library of Parliament, 2000) at 12–15, online: <lop.parl.ca/Content/LOP/ResearchPublicationsArchive/pdf/bp1000/prb0004-e.pdf>.

163 Environment and Climate Change Canada, *Technical Paper on the Federal Carbon Pricing Backstop*, Catalogue No En4-306/2017E-PDF (Gatineau: ECCC, 2017), at 14–16 online: <www.canada.ca/content/dam/eccc/documents/pdf/20170518-2-en.pdf> [ECCC, *Carbon Pricing Backstop*] (discusses aviation and the role that the federal government could play with regards to inter-jurisdictional flight emissions. Currently, though, the federal backstop will only apply to intra-jurisdictional flights).

produce a two percent annual gain in efficiency until 2020, are all voluntary. Transforming those commitments into binding legal requirements could be helpful to ensure the commitments are realized. We identify and discuss three options that the federal government could pursue. These approaches are not mutually exclusive and, in fact, could be undertaken together as complementary approaches. They include: (i) regulatory measures; (ii) pricing carbon; and (iii) transport mode transition. Each of these options will be described and evaluated in detail below.

A. Option 1: Regulatory Measures

Regulatory measures, such as performance or technology standards, have long been the common choice for government decision-makers dealing with environmental problems.[164] In recent years, economic instruments have become a more popular policy choice, especially in the context of climate change mitigation,[165] in part, because they often can achieve the same environmental result at a lower overall cost. However, regulatory measures continue to play an important role in environmental policy-making and have a role in the Canadian policy package on aviation emissions. Canada's Plan identifies two areas for regulatory action: (1) CO_2 emission standards in line with both ICAO standards and (2) regulations relating to nvPM.

The federal government has indicated that it will implement the ICAO standards. It has noted that the clean fuel standard will be performance-based (thus not prescribing a particular technology) and flexible.[166] There is often a resistance among economists to regulate specific technologies since this can constrain innovation and reduce the cost-effectiveness of environmental gains. The extent to which technology standards

164 See e.g. Mark Winfield, "Policy Instruments in Canadian Environmental Policy" in Debora L VanNijnatten & Robert Boardman, eds, *Canadian Environmental Policy and Politics: Prospects for Leadership and Innovation* (Don Mills, Ont: Oxford University Press, 2009) at 47; Christopher Taylor et al, "Selecting Policy Instruments for Better Environmental Regulation: a Critique and Future Research Agenda" (2012) 22:4 Environmental Policy & Governance 268 at 270; Carolyn Abbot, "Environmental Command Regulation" in Benjamin Richardson & Stepan Wood, eds, *Environmental Law for Sustainability: A Reader* (Portland, Or: Hart Publishing, 2006) at 62.

165 See e.g. Jenni Sumner, Lori Bird & Hillary Dobos, "Carbon Taxes: A Review of Experience and Policy Design Considerations" (2011) 11:2 Climate Policy 922.

166 Environment and Climate Change Canada, "Government of Canada to Work with Provinces, Territories and Stakeholders to Develop a Clean Fuel Standard" (25 November 2016), online: <www.canada.ca>.

are more or less cost-effective depends upon the extent to which there is a "clearly identifiable best technology or practice."[167] It is certainly possible that such a technology could be identified in the aviation industry, as it is a relatively standardized sector, at least among the major airlines. However, even within this industry, there are different strategies, such as structural, aerodynamic, and propulsion-based technologies, which may be of differing relevance depending on factors such as the size of the aircraft. As such, establishing a standard and letting the industry determine the best way to achieve it is generally preferable.

One study suggests that aircraft manufacturers could cost-effectively reduce fuel consumption in new aircraft by 25 percent in 2024 and 40 percent in 2034.[168] While the Canadian government will want to avoid significant competitiveness impacts, the US Environmental Protection Agency was also considering more stringent efficiency standards for the industry,[169] which would create an opportunity for the Canadian government to pursue a joint standard with the US as it has done with emission standards for on-road vehicles and engines.[170] A similar situation could emerge on the nvPM standard. Prime Minister Justin Trudeau and then President Barack Obama specifically mentioned mitigating aviation emissions in their 2016 Joint Statement on Climate, Energy, and Arctic Leadership.[171] However, the new US administration, under Donald Trump, has indicated that it will not be acting to mitigate emissions from climate change, making bilateral cooperation unlikely in the near future.[172]

In addition to standards for CO_2 and nvPM, there are a number of other voluntary initiatives in Canada's Plan that could be legislated. These include operations and air traffic management (both identified as key measures) and improving airport ground operations and infrastructure

167 Kenneth R Richards, "Framing Environmental Policy Instrument Choice" (2000) X:2 Duke Envtl L & Pol'y F 222 at 255.

168 Anastasia Kharina, Daniel Rutherford & Mazyar Zeinali, *Cost Assessment of Near and Mid-Term Technologies to Improve New Aircraft Fuel Efficiency* (Washington, DC: ICCT, 2016) at iv, online: ICCT <www.theicct.org/sites/default/files/publications/ICCT%20aircraft%20fuel%20efficiency%20cost%20assessment_final_09272016.pdf>.

169 Tollefson, *supra* note 66.

170 Environment and Climate Change Canada, "Vehicle and Engine Regulations" (17 July 2013), online: ECCC <ec.gc.ca>.

171 Office of the Prime Minister of Canada, News Release, "U.S.–Canada Joint Statement on Climate, Energy, and Arctic Leadership" (10 March 2016), online: <pm.gc.ca>.

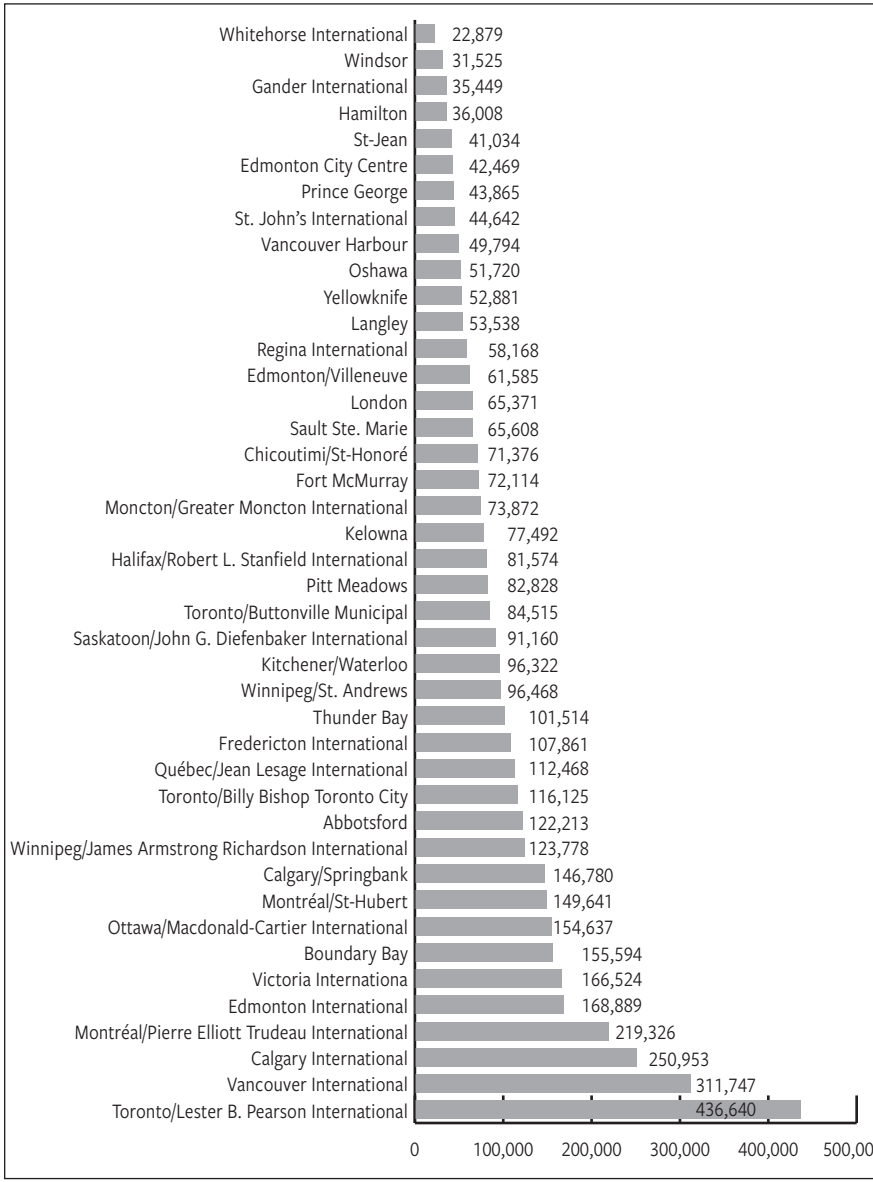
172 Coval Davenport, "Climate Change and the Incoming Drumpf Government" *The New York Times* (19 December 2016), online: <www.nytimes.com>.

use (a secondary measure). Regulations could, for instance, require the use of industry best practices and offer support for innovative developments.

One concern with regulations is that smaller aircraft operations and airports can face disproportionately higher compliance costs relative to their larger counterparts. There are many ways to deal with such concerns, including applying the regulations only to jurisdictions or airports with a certain volume of air traffic or exempting smaller operations from certain regulatory requirements. For instance, Ontario has the highest volume of air traffic in Canada, accounting for 29 percent based on domestic passengers boarding and exiting aircraft.[173] Alberta and British Colombia account for 24 percent and 21 percent respectively.[174] All other provinces and territories account for under ten percent each.[175] In terms of air traffic volume from international flights, Ontario accounts for almost half (47 percent) while British Columbia has 19 percent of the international air traffic volume arriving and departing from Canada.[176] Quebec has 18 percent, and Alberta has 12 percent, while the remaining provinces and territories account for the rest.[177] The vast majority of passengers embark or disembark at one of the 50 major Canadian airports. Fourteen of these airports represent 85.2 percent of passenger traffic, with the top four accounting for 76.6 percent of the passenger volume.[178] In other words, the majority of passengers are moving through Ontario, British Columbia, and Alberta. The picture for transportation of air cargo is fairly similar, with the leading provinces for both domestic and international air cargo being Ontario, British Columbia, Alberta, and Quebec. However, it is worth noting that the share of loaded and unloaded cargo in the other provinces is notable for domestic flights (27 percent).[179] The majority of air traffic, whether it is passenger or cargo transportation, occurs between a few major airports—the top 20 airports cover 73 percent of flights.[180]

173 Statistics Canada, "Air Carrier Traffic", *supra* note 111 at 11.
174 *Ibid*.
175 *Ibid*.
176 *Ibid*.
177 *Ibid*.
178 *Ibid* at 10.
179 *Ibid* at 14.
180 *Ibid* at 12.

FIGURE 2: FLIGHT ARRIVALS/DEPARTURES IN 2014[181]



181 For data used to create Figure 2, see Statistics Canada, *Aircraft Movement Statistics: NAV CANADA Towers and Flight Service Stations: Annual Report (TP 577) 2014*, Catalogue No 51-209-X (Ottawa: Statistics Canada, 2014); Statistics Canada, *Aircraft Movement Statistics: Airports without Air Traffic Control Towers: Annual Report (TP 577) 2014*, Catalogue No 51-210-X (Ottawa: Statistics Canada, 2014).

Given these flows, the federal government could consider tailoring its regulatory strategy for aviation emissions to target operations and/or flights in certain airports if there are valid concerns about compliance costs. Considerable progress on regulating aviation GHG emissions could still be made by focusing on particular regions and/or airports, given the concentration of traffic.[182] Since the bulk of passenger and cargo traffic goes through four or five major Canadian airports, it would be worth considering whether some geographic-specific regulations (*e.g.* relating to operations) should be applied to only these large airports. This could reduce enforcement costs to government and to the rest of the airports (since smaller airports would feel the burden of regulations more than larger hubs). More analysis would be required to select and design regulations so that they reach the emissions reduction target in a way that is cost-effective, fair, and avoids potential distortions through changes in routes. But, it is important to consider a variety of approaches. In each of these cases, the *Aeronautics Act* is likely to be the enabling legislation with specifics laid out in either a new regulation or under the existing *Canadian Aviation Regulations*.

B. Option 2: Carbon Price

Pricing carbon[183] is a cornerstone of most new climate change plans, both in Canada[184] and other parts of the world.[185] Carbon prices, which can take the

182 See the discussion in Part IV, A, above, and Statistics Canada, "Air Carrier Traffic", *supra* note 111.

183 Carbon pricing is a form of regulation, as it requires legislation to establish the price (e.g. tax) or quantity (e.g. cap) and relevant enabling provisions (e.g. rules regulating emission trades). However, given that it is quite distinct from more traditional forms of regulation, such as performance standards, we deal with it separately.

184 See e.g. Government of Canada, "Pan-Canadian Framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy", Catalogue No En4-294/2016E-PDF (Ottawa: Government of Canada, 2016), online: <www.canada.ca/content/dam/themes/environment/documents/weather1/20170125-en.pdf>; *Climate Change Mitigation and Low-carbon Economy Act*, SO 2016, c 7; Alberta Government, "Climate Leadership Plan—Alberta's Plan to Take Action on Climate Change and Protect the Province's Health, Environment and Economy", online: <www.alberta.ca>; Ministry of Sustainable Development, Environment and the Fight against Climate Change, "A Brief Look at the Québec Cap-and-Trade-System for Emission Allowances", online: Government of Quebec <www.mddelcc.gouv.qc.ca/changements/carbone/documents-spede/in-brief.pdf>; Brian C Murray & Nicholas Rivers, "British Columbia's Revenue-Neutral Carbon Tax: A Review of the Latest 'Grand Experiment' in Environmental Policy" (2015) Duke Nicholas Institute for Environmental Policy Solutions Working Paper NI WP 15-04, online: <nicholasinstitute.duke.edu/sites/default/files/publications/ni_wp_15-04_full.pdf>.

185 See European Commission, *EU ETS Handbook: Climate Action*, online: <ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf>; Sumner, Bird & Dobos, *supra* note 165.

form of taxes, fees, cap and trade programs, or offsetting systems function by attaching a price to harmful emissions, with the goal of influencing economic actors to change their behaviour and emit fewer emissions. As noted earlier, they tend to be more cost-effective than "command and control" regulations since they allow economic actors the flexibility to choose how to respond to the price and find innovative ways to avoid the price (and thereby the emissions). However, most carbon pricing policies (with the notable exception of the EU ETS) exclude international aviation emissions. As such, the sector has generally not been subject to the price increases associated with carbon pricing, which can drive innovation and reductions.

The ICAO offset mechanism is the first step in pricing aviation emissions. However, as noted earlier, CORSIA has been criticized for relying upon reductions in other sectors and only covering international emissions of participating members. To stimulate CO_2 reductions for international emissions not covered by CORSIA and domestic emissions, states could impose a carbon price, whether in the form of a tax, fee, cap and trade, or an offsetting system on these emissions. There is likely to be considerable resistance to any additional carbon price, given that it would increase costs for the industry. For example, WestJet estimates that Alberta's carbon levy will cost the company approximately 3 million dollars (CAD) in 2017.[186] The levy, which took effect on January 1, 2017, is set at 5.17 cents (CAD) per litre for aviation jet fuel[187] and applies to fuel purchases for intra-provincial flights.[188] WestJet indicated it already pays 60 million dollars (CAD) annually in provincial and federal fuel taxes, and that the federal carbon price would add an extra 60 to 70 million dollars (CAD) in costs for the airline.[189] The estimated increase would roughly represent one to two percent of the company's yearly revenues.[190] It is worth noting that the costs to the airline industry in the EU, in terms of growth in demand, through the inclusion of intra-EU aviation in the EU ETS has been small.[191] Further, some have argued[192] that more needs

186 Amanda Stephenson, "WestJet CEO: Carbon Taxes Will Cost Us Between $60 and $70 Million in 2017" *The Calgary Sun* (1 November 2016), online: <www.calgarysun.com>.

187 *Climate Leadership Act*, SA 2016, c C-16.9, Schedule, s 1(7) (Table Carbon Levy Rates).

188 *Ibid*, s 7.

189 Stephenson, *supra* note 186.

190 WestJet, *2015 Annual Report: Evolving Our Business* (WestJet), online: <www.westjet.com/assets/wj-web/documents/en/about-us/financialReports/WestJet2015AR.pdf>.

191 Annela Anger & Jonathan Köhler, "Including Aviation Emissions in the EU ETS: Much Ado About Nothing? A review" (2010) 17 Transport Policy 38 at 42.

192 International Coalition for Sustainable Aviation, Press Release, TE-0715, "Global Aviation CO_2 Deal Adopted with Mixed Results, just as Paris Agreement Takes Off" (6 October 2016), online: ICSA <icsa-aviation.org>.

to be done to reduce emissions from a sector that represents two percent of global emissions, with projections for that percentage to grow. Relatedly, the cost of negative externalities associated with air traffic needs to be part of any cost-benefit equation.

Given that constitutional authority for regulating aviation lies with the federal government, Parliament could institute a carbon price on the CO_2 emissions not covered by CORSIA, or even an additional price on flights captured by the mechanism. One-third of the flights in Canada are domestic, so a price associated with such emissions could motivate aircraft carriers to reduce their emissions. Revenue generated from such a price could be reinvested in supporting decarbonisation of the sector and/or promoting alternative forms of travel or reducing demand for air travel,[193] although the latter would be unpopular with the airline industry.

Currently, CO_2 aviation emissions are indirectly subject to taxation through the fuel taxes imposed by the federal and provincial governments.[194] The federal government, as well as all ten provinces and three territories, have a regulation imposing a tax on fuel. Aviation fuel, even though covered by regulation of fuel in general, is also a specifically designated type of fuel. The two basic groups of aviation fuels are aviation gasoline and aviation turbine fuel (or jet fuel).[195] Note that under different subnational regulations, aviation fuel may have slightly different legal

193 See Parts IV, C and Parts IV, D, below.

194 Provinces like Ontario and Alberta have introduced a fuel tax on aviation, see Ontario Ministry of Finance, "Gasoline Tax" (17 February 2014), online: <www.fin.gov.on.ca>; Alberta Treasury Board and Finance, "Fuel Tax Overview" (13 October 2016), online: <www.finance.alberta.ca>. Three municipalities, Vancouver, Victoria and Montréal, also charge fuel taxes. For more information on Vancouver and Victoria tax rates, see British Columbia Ministry of Finance, Tax Bulletin, MFT-CT 005, "Tax Rates on Fuels" (Revised August 2016), online: <www.sbr.gov.bc.ca/documents_library/bulletins/mft-ct_005.pdf>. For more information on Montréal's tax rate, see British Columbia, Ministry of Community Sport and Cultural Development, *Municipal Revenue Sources Review: Inter-jurisdictional Comparison of Revenue Tools* (August 2012) at 1 (Table on Tax Measures), online: <www.cscd.gov.bc.ca/lgd/library/revenue_source_review/Interjurisdictional%20Comparison%20of%20Revenue%20Tools.pdf>).

195 The difference between the above aviation fuels is in their purpose. Aviation gasoline is designed to be used in spark ignition piston engines, whereas jet fuel is used in turbo-fan, turbo-jet, and turbo-prop engines, see "Shell Aviation Fuels" in Shell Aviation, *The Aeroshell Book*, 19th ed (London, UK: Shell International Petroleum, 2012) at 2.1, online: <www.shell.com/business-customers/aviation/aeroshell/knowledge-centre/the-aeroshell-book/_jcr_content/par/textimage_1433441235.stream/1445039847869/8569d8853bc1b4677e222cdc9ab8a2fbd90a80941acdab1a8b85d4918ad5a84b/theaeroshellbook.pdf>.

definitions, separating aviation gasoline from jet fuel or including both of these types under the same term.

Federally, there are two types of taxes that apply to aviation: fixed excise tax and sales tax. The *Excise Tax Act*[196] sets specific rates for aviation gasoline and fuel:[197] leaded aviation gasoline is 11 cents (CAD) per litre, unleaded aviation gasoline is 10 cents (CAD) per litre, and aviation fuel is 4 cents (CAD) per litre.[198] The *Excise Tax Act* also has a specific regulation for air transportation. On November 1, 1996, the federal government transferred responsibility for the provision of air navigation services to a private corporation—NAV Canada—financing it with revenues collected from the air transportation tax.[199] This arrangement was a temporary two-year measure, which was replaced by user fees paid to NAV Canada by air carriers.[200] Fuel is also subject to federal GST.[201]

The provinces also have a variety of fuel taxes that apply to aviation fuels. As a result, the rates and methods of taxing aviation fuel in Canada vary widely between jurisdictions. Like other countries, in Canada, fuel used for international flights is not taxed.[202] Further, there is inconsistency with respect to the applicability of carbon aviation emissions within provincial carbon pricing schemes. For instance, the British Columbia carbon tax applies to intra-provincial flights (*e.g.* Vancouver to Victoria), but not inter-provincial ones (*e.g.* Vancouver to Toronto).[203] As already mentioned, intra-provincial flights within Alberta will be subject to Alberta's carbon

196 *Excise Tax Act*, RSC 1985, c E-15.

197 Whereas the *Excise Tax Act* clearly distinguishes aviation fuel and aviation gasoline (s 68.4(1) states that aviation fuel does not include aviation gasoline), it does not provide a specific definition of these types of fuels. Environment and Climate Change Canada explains that aviation gasoline (avgas) is used in small general aviation aircrafts, in internal combustion aircraft engines with spark ignition engines. Jet and turboprop planes do not use this fuel, see Environment and Climate Change Canada, "Environment Canada's Gasoline Regulations: A Discussion Paper on the Potential Extension for Leaded Gasoline Used in Competition Vehicles" (24 April 2013), online: <www.ec.gc.ca>.

198 For quick reference, see Canada Revenue Agency, "Current Rates of Excise Taxes" (23 April 2008), online: Government of Canada <www.cra-arc.gc.ca>.

199 See Canada Revenue Agency, Notice, ETSL35, "Notice to All Licensed Air Carriers—Changes to the Air Transportation Tax (ATT)" (20 August 1997); *Excise Tax Act*, *supra* note 196, s 16.1.

200 *Excise Tax Act*, *supra* note 196, s 8.

201 Natural Resources Canada, "Fuel Consumption Taxes in Canada" (16 November 2016), online: NRC <www.nrcan.gc.ca>.

202 See *Chicago Convention*, *supra* note 52, art 24.

203 British Columbia Ministry of Finance, Bulletin, MFT-CT 005, "Commercial Air or Marine Services" (Revised December 2015), online: <www.sbr.gov.bc.ca/documents_library/bulletins/ct_005.pdf>.

tax (though inter-provincial flights will be exempt).[204] In contrast, the aviation sector (intra- or inter-provincial) is not covered by either Quebec or Ontario's cap and trade programs.[205] This inconsistency among the provinces and territories with respect to aviation fuels could create confusion and inefficiencies and possibly market distortions, especially as prices rise. There are certainly reasons for these differences, including a desire by provinces to maintain jurisdiction over intra-provincial fuel taxes, which generate considerable revenue. However, a federal approach to mitigating aviation emissions could help harmonize requirements across the country and enable connections to other international schemes.[206] A federal scheme would likely (at least initially) be primarily aimed at inter-provincial aviation emissions, as well as filling the gaps on intra-provincial flight emissions (where not covered by provincial schemes). There may be opportunities to reduce the administrative burden on the sector by having the federal government collect taxes on CO_2 aviation emissions. This would not preclude an agreement to return some or all of such revenues to the provinces.

The two main options that the federal government has for pricing carbon aviation emissions (aside from offsetting) are carbon levies or taxes and emissions caps with provisions for trading. Much has been written on these different approaches, and we refer the interested reader to this material.[207] In the Canadian context, the federal government has mandated a national

204 *Climate Leadership Act*, *supra* note 187, s 7.

205 *Regulation respecting a cap-and-trade system for greenhouse gas emission allowances*, CQLR c Q-12, r46.1, s 2(2)(1); *Greenhouse Gas Emissions Reporting*, O Reg 452/09, s 3(3)(a).

206 This is an issue we return to in Part IV, A, 1, below.

207 See e.g. Cameron Hepburn, "Regulation by Price, Quantities, or Both: A Review of Instrument Choice" (2006) 22:2 Oxford Rev Economic Policy 226; Organization for Economic Co-Operation and Development, *Environmentally Related Taxes in OECD Countries: Issues and Strategies* (Paris: OECD, 2001); Martin L Weitzman, "Prices vs Quantities" (1974) 41:4 Rev Economic Studies 477; Robert N Stavins, "Market-Based Environment Policies", Discussion Paper 98-26 (Washington, DC: Resources For the Future, 1998); Richard B Stewart, "Economic Incentives for Environmental Protection: Opportunities and Obstacles" in Richard L Revesz, Philippe Sands & Richard B Stewart, eds, *Environmental Law, the Economy and Sustainable Development* (Cambridge: Cambridge University Press, 2000) 171; David Driesen, "Economic Instruments for Sustainable Development" in Richardson & Wood, *supra* note 164 at 277; Stewart AG Elgie, "Carbon Offset Trading: A Leaky Sieve or Smart Step?" (2007) 17:3 J Envtl L & Prac 235 at 245; Nathaniel O Keohane & Shella M Olmstead, *Markets and the Environment*, 2nd ed (Washington, DC: Island Press, 2007) at 173 (indicating trading systems work best with universally distributed problems); Neil Gunningham & Peter Grabosky, *Smart Regulation: Designing Environmental Policy* (Oxford: Oxford University Press Inc, 1998).

carbon price as part of its Pan-Canadian Framework on Clean Growth and Climate Change.[208] The strategy allows provinces to choose either a carbon tax or a cap and trade system at the rate of 10 dollars (CAD) per tonne in 2018 rising annually by 10 dollars per tonne to 50 dollars per tonne in 2022), with a formula for determining equivalency.[209]

One issue of interest in the context of cap and trade programs is the participation of small operators (or small emitters). The EU experience with its cap and trade program showed that the participation of small operators in the system considerably increased the administrative burden.[210] Small aircraft operators did not generate revenue for the ETS, had a relatively insignificant impact on the CO2 objective, and increased the administrative burden, which suggests there may be arguments for excluding them. In Canada, air operators are divided into three main categories by federal regulations, with 39 licenses issued to large operators (with a capacity of more than 20 passengers and a given threshold of weight), 89 licenses issued to small commuter operations (carrying between 10 and 19 passengers and a more modest weight threshold), and 538 licenses issues to air taxis.[211] A Canadian aviation emissions trading program would need to determine whether the smaller operators (which hold 97 percent of the licenses) would be included in the system. Since one of the keys to a successful emission trading system is having enough market actors to generate a reasonable volume of trades, [212] one would need to consider whether a system with a reasonably small number of market actors would function optimally. Of course, aircraft operators would be integrated into the broader system.

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208 Environment and Climate Change Canada, News Release, "Government of Canada Announces Pan-Canadian Pricing on Carbon Pollution" (3 October 2016), online: <news.gc.ca> [ECCC, "Pan-Canadian Pricing"].

209 ECCC, *Carbon Pricing Backstop*, *supra* 163 at 6.

210 Data from 2011–2012 showed that the costs of including small operators in the EU ETS exceeded the revenue generated. Even if emissions and allowances prices increase by 50 percent by 2020, it is expected that the administrative costs of CO2 related to small emitters will still exceed the revenues by 166 percent, see EC, *ETS Aviation Small Emitters: Cost Assessment of Applying EU ETS on Aviation Small Emitters and Analysis of Improvement Potential by simplifications, Alternative Thresholds and Alternative Means of Regulation* (24 March 2014), online: European Commission <ec.europa.eu/clima/sites/clima/files/transport/aviation/docs/report_ets_avaiation_small_en.pdf>).

211 See the air service categories established in the *Canadian Aviation Regulations*, *supra* note 130; Transport Canada, *Transportation in Canada 2011: Comprehensive Review*, TP 14816 (Ottawa: Transport Canada, 2011) at 46–47, online: <www.tc.gc.ca/media/documents/policy/Transportation_in_Canada_2011.pdf>.

212 Gunningham & Grabosky, *supra* note 207 at 72.

Regardless of whether aviation emissions were priced through a tax, cap and trade, or offset system, and even if only some part of the Canadian airline industry was subject to the resulting price, the question of what to do with any revenue generated is key. Options include recycling the revenue back to citizens through reduced taxes or to those taxed in a proportion different than they were received (*i.e.* "cleaner airlines" might get more back than higher emitting airlines).[213] Revenue could also be used to offset distributional impacts on the smaller airlines, to the extent these are covered by the scheme, or on disproportionately impacted consumers or regions. Alternatively, the revenues could be used to finance investments in research and development for the aviation industry to reduce emissions (flagged as a goal in Canada's Action Plan), or for other environmental purposes, such as developing realistically comparable (in terms of cost and time commitment) alternatives to short-haul flights.[214] If implemented as part of the pan-Canadian carbon price plan, revenue from aviation could be earmarked for the federal government to use in one of these identified areas. This would be in contrast to the policy the federal government announced of allowing provinces and territories with an equivalent carbon price to keep revenues.[215]

If it decides to proceed with a carbon price, the federal government would need to determine not only the type of instrument (*e.g.* tax or cap and trade) but also the scope of application and the rate. With respect to scope, the federal government could choose to price aviation emissions from all domestic flights (or those above a certain emissions threshold) or domestic plus international flights. One consideration in determining the scope of any carbon price is the potential for such a price to be integrated with other bilateral or multi-lateral approaches, as it is possible that such agreements may emerge between countries (including Canada) that feel the ICAO offsetting scheme does not go far enough.

It is possible, for instance, that the EU may reinstate their requirement for international flights to be covered under the ETS. If this happens, it would be important for Canada to have "equivalent measures" (discussed next), which would allow revenues from the carbon price to remain in Canada, rather than being paid into the EU ETS.

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213 Thomas Sterner & Jessica Coria, *Policy Instruments for Environmental and Natural Resource Management*, 2nd ed (New York: Resources for the Future Press, 2012) at 112–13.

214 See the discussion in Part IV, A, 3 above.

215 ECCC, "Pan-Canadian Pricing", *supra* note 208.

1. A Note on "Equivalent Measures"

If the EU once again subjects flights into and out of the EU to the ETS,[216] Canadian flights to or from Europe will be required to report their CO_2 emissions to the EU and purchase emissions allowances should their emissions be above the allowances they hold. This means that Canadian airline companies would be paying either European governments or other companies to comply with the ETS caps. What this would mean in terms of costs is relatively uncertain due to the fluctuating price of allowances in the EU,[217] as well as the way the market is structured at the time international aviation enters.[218] In addition, the EU has proposed changes to the EU ETS for phase four (2021–2030) which include "align[ing] the cap with the EU's 2030 target to reduce GHG emissions by at least 40% domestically by 2030, provid[ing] for better targeted free allocation rules and to further support low-carbon innovation and energy sector modernization." [219] However, it likely means that any money paid by Canadian companies would most likely be leaving the country.

However, the EU ETS Directive contains an important exception for nations with equivalent measures:

> If a third country adopts measures, which have an environmental effect at least equivalent to that of this Directive, to reduce the climate impact of flights to the Community, the Commission should consider the options available in order to provide for optimal interaction between the Community scheme and that country's measures, after consulting with that country....
>
> Bilateral arrangements on linking the Community scheme with other trading schemes to form a common scheme or taking account of equivalent measures to avoid double regulation....[220]

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216 See discussion above about the possibility of this still happening in Part II, B.

217 See Nicolas Koch et al, "Causes of the EU ETS Price Drop: Recession, CDM, Renewable Policies or a bit of Everything?—New Evidence" (2014) 73 Energy Policy 676, online: PIK <www.pik-potsdam.de/members/edenh/publications-1/CausesoftheEUETSpricedrop.pdf> (in 2008 prices peaked to €28 and later dropped to €5 in 2013).

218 See European Commission, "Allocation to Aviation" (3 March 2016), online: <ec.europa.eu> (from January 2014, 82 percent of allowances are grandfathered (granted free) and 15 percent are auctioned while an additional three percent are kept in reserve to deal with new market entrants, *etc.*).

219 International Carbon Action Partnership, *EU Emissions Trading System* (*EU ETS*) (London, UK: ICAP, 2017) online: <icapcarbonaction.com>

220 EC, *Directive 2008/101/EC*, *supra* note 93 at para 17.

In other words, if Canada enacts domestic measures to mitigate aviation emissions from international flights coming from Canada to the EU, the EU could opt to exempt some or all of Canadian airline flights from its ETS. If the domestic measures adopted by the Canadian government imposed a carbon price on some portion of international flights, or included inbound or outbound flights in an emissions trading system with auctioned permits, this means that the revenue generated—which could be quite substantial—could stay in Canada. There are many ways in which such a system could be designed, including an agreement whereby revenue from permits on Canadian–EU flights is split between the jurisdictions.

Using data on emissions from Canada's Action Plan,[221] including growth projections and a price of 30 dollars (CAD) per tonne, we estimated the revenue that would be generated by a tax on CO_2 aviation emissions. If only domestic emissions in Canada were taxed at 30 dollars (CAD), the measure would generate 181.5 million dollars (CAD) in revenue. If international flights were included, that figure would be closer to 509 million dollars (CAD). If a cap and trade system was used, and we assume that 15 percent of allowances (2.54 Mts of CO_2e,) were auctioned[222] and use the high and low prices from the EU ETS (€5 to €28),[223] auction revenues would be between 18.31 million dollars and 102.51 million dollars (CAD).[224] These estimates are illustrated in Figure 3. If more than 15 percent of permits were auctioned, these figures would be higher.

It is probable that actual revenues from either system would be less since some flights (*e.g.* small operators) would likely be exempt. However, this illustrates the potential scale of revenue that could be generated by a 30-dollar (CAD) price on aviation emissions. Using the estimates above, the revenue from a carbon tax would represent approximately 0.18 percent of annual total government revenues.[225] It would be considerably less under an ETS (0.006 to 0.03 percent).

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221 Transport Canada, *Action Plan* 2014, *supra* note 118 at 10.

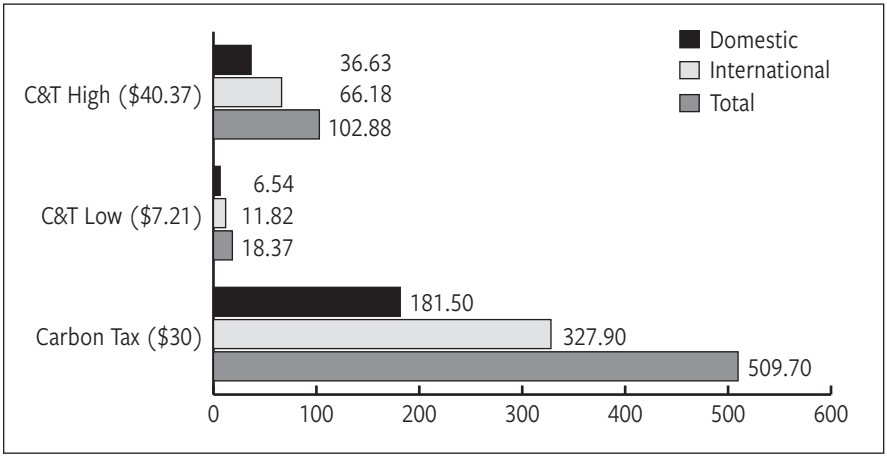
222 See European Commission, "Auctioning" (2 March 2016), online: <ec.europa.eu> [European Commission, "Auctioning"] (tradable emission permits might also become a subject to other taxes levied on companies trading them, thus contributing to the total revenue in a less direct way. This aspect is not considered here for the purpose of the clarity of the discussion).

223 Koch et al, *supra* note 217.

224 Calculated on 12 July 2016 with the Google currency exchange tool. See European Commission, "Auctioning", *supra* note 222.

225 These estimates were derived based on estimates of total federal government revenue in 2014–2015 of 282.3 billion dollars (CAD) of total revenue. Government of Canada, "Annual Financial Report of the Government of Canada Fiscal Year 2014–2015", (14 September 2015), online: <www.fin.gc.ca>.

FIGURE 2: ESTIMATES OF REVENUE (IN MILLION CANADIAN DOLLARS) FROM AVIATION EMISSIONS (TOTAL, INTERNATIONAL, AND DOMESTIC) IN CANADA



One final issue that will need to be addressed as Canada moves forward with a carbon price or any other CO_2 regulations is how such measures will dovetail with legislation to implement CORSIA. It will be important to develop a coordinated approach to make compliance with CORSIA and any additional national requirements as easy as possible for airlines.

C. Option 3: Transport Mode Transition

Transitions in the mode of transportation—from aviation to another mode which emits less CO_2—is a longer-term mitigation option, but one which should be considered nonetheless. In fact, it could be seen as the third phase in a government's plan to mitigate emissions from the aviation industry. There is little alternative to long-haul overseas traffic, except perhaps marine shipping for cargo.[226] Short-haul flights, however, can be substituted for other forms of transportation. Rail transport can move similar numbers of people and can reduce energy use per passenger kilometer by as much as 66–80 percent.[227] The IPCC AR5 specifically notes that "[h]igh-speed rail can substitute for short-distance passenger

226 Travel by ship across the oceans is certainly possible as is rail travel across continents, but marine travel has its own set of challenges when it comes to CO_2 emissions and is similar to aviation in that the international community has excluded these emissions from international agreement, instead passing their mitigation along to the International Maritime Organization.

227 International Energy Agency, *Energy Technology Perspectives in Support of the G8 Plan of Action: Scenarios & Strategies to 2050*, (Paris: IEA, 2008) at 450.

air travel "normally up to around 800 km…as well as for most road travel over those distances, and hence can mitigate GHG emissions."[228]

Like with carbon pricing, the ultimate goal of transitioning to other modes of transportation is to reduce aviation emissions by reducing the number of flights taken. This is in contrast to regulatory measures, which are more generally aimed at reducing the emissions per flight, but not necessarily reducing the number of flights taken. Given this, transitioning transportation modes may be less popular with aviation carriers, though the potential is there for them to expand their parameters and enter a different sort of transportation market. This may seem a stretch, but it is not unheard of for companies (especially large ones) that specialize in a certain part of an industry to transition some of their efforts towards a new, more environmentally sustainable, method or mode. Think, for example, of some of the oil and gas companies that have invested in developing renewable energy technologies.[229]

In the Canadian context, there are certain regions that offer a more realistic set of conditions for transitioning transportation modes. For instance, cross-country, long-haul flights (*e.g.* Toronto to Vancouver) and flights that give access to the Canadian North are not ideal candidates for shifts in transportation mode. That said, there are many areas of the country where the potential exists, and in some cases, initial infrastructure is already in place. These tend to be regions where people commute between large cities—for example, the Quebec City–Windsor corridor, Montreal–Ottawa, Edmonton–Calgary, Vancouver–Victoria, and also potentially Calgary/Edmonton–Vancouver, among others. Over the years, there have been discussions about the possibility of implementing a high-speed train in the Quebec–Ontario corridor, specifically to get people between Montréal and Toronto more quickly and frequently.[230] Proposals for passenger rail between Edmonton and Calgary have also been floated.[231] Additionally, hyperloop technology has been presented as having the potential to get

228 Sims et al, *supra* note 8 at 621.

229 See e.g. Suncor, "About Us", online: Suncor <www.suncor.com> (Suncor, for example, is part of a wind power project, though their main area of business is oil sands extraction).

230 Terry Pedwell, "'High-frequency' Hybrid Trains Planned for Toronto-Montreal Corridor" *CTV News Kitchener* (14 April 2016), online: <kitchener.ctvnews.ca>; Mike De Souza, "Part Two: Momentum Still Building for High-Speed Rail", *Canwest News Service* (4 August 2009), online: <www.canada.com>.

231 "High-Speed Rail Between Calgary, Edmonton Not Feasible, Finds Committee" *CBC News* (23 May 2014), online: <www.cbc.ca>.

people from Montréal to Toronto in approximately 30 minutes.[232] Similar arguments can be made for cargo transportation, though with potentially different routes. Of course, the cost of either of these options is typically seen as prohibitive, but that is where including these ideas in a multi-stage government policy makes sense. The funds raised through pricing carbon on air travel could be funnelled, in part, back into the development of alternative transportation infrastructure.

D. Option 4: Reduction in Demand for Air Traffic

A final option worth mentioning is that aviation emissions can be reduced through an absolute reduction in demand for air traffic, whether for transporting cargo or people. There are many ways in which demand for air transportation can be reduced, including encouraging the participation of people in meetings by video-conferencing, encouraging locally-based tourism and locally-based consumption of food and other products, and ensuring that flights are full. While most of these initiatives would likely stem from voluntary measures, there are ways in which such choices could be encouraged and supported through government policy. There would likely be pushback from the airline industry, but this option is an important consideration as part of any strategy to reduce aviation emissions. There are many ways in which government policies can influence demand for air transportation, from educating consumers to financing programs that encourage efficiency in cargo transportation. We will not elaborate on these here.

CONCLUSION

If aviation were a country, it would be among the world's top ten emitters of CO_2. The industry is poised for considerable growth, and little has been done globally to mitigate the industry's CO_2 emissions. While CORSIA is an important first step in helping to offset growth in international aviation emissions post 2020, additional action is needed in a world already experiencing the effects of a changing climate, especially given the particular vulnerability of small island states, developing countries, and vulnerable people all over the world. Wealthy nations have a responsibility to take

232 Oliver Sachgau, "Hyperloop: The Tube that Promises to get you from Montreal to Toronto in Less than 30 Minutes", *Toronto Star* (13 March 2016), online: <www.thestar.com>.

steps to mitigate domestic aviation emissions, and to continue to contribute to reductions in international emissions.

This paper examined Canada's role in addressing aviation emissions, in the context of ICAO's recently announced global offsetting system. The Canadian government has made it clear that it is serious about acting on climate change, pledging to reduce emissions by at least 30 percent below 2005 levels by 2030. Implementing a plan to achieve this target has been fraught with difficulty, given that jurisdiction over energy and environment is shared. However, aviation is a matter clearly within federal authority, which makes achieving reductions simpler (at least legislatively). This article discussed a number of options the federal government could pursue to reduce emissions from domestic aviation, including regulations, a carbon price, and transitions in transportation mode. Since the federal government has moved forward with a national carbon price, we have argued that it would make sense to extend this price to emissions from domestic flights not otherwise covered by a provincial program. This approach would primarily target inter-provincial flight emissions, but would also cover emissions from intra-provincial flights in jurisdictions where no other mitigation scheme exists. The program should be designed in a way so that it could work in conjunction with other international emissions reduction plans, as well as those undertaken by other individual nation states. We have discussed ways in which distributional impacts on smaller operators could be mitigated, including exempting them.

It is likely that the federal government will need to enact a mix of measures, each tailored at a particular segment of the market. For example, the regulatory measures and a carbon price could be enacted simultaneously and aimed at different aspects of the industry (airport operations versus emissions from actual flight) or at different locations of the industry (remote flights versus those that operate between the most heavily used airports).

Revenue generated from a carbon price could be considerable and be invested in a way that contributes to longer-term goals. For instance, revenues could finance research and development of alternative fuels and more efficient aircraft, as well as more reliable and comparable (in price and speed) alternatives to short-haul travel. In addition, should other emissions reduction strategies that impact Canadian aviation (such as the EU ETS) be implemented, devising a strategy that fulfills "equivalent measure" provisions means keeping that revenue in Canada instead of having it flow elsewhere.

In the end, we conclude that Canada has several options for ensuring a path to reducing the impact of aviation on the climate. The best approach, we suggest, is one utilizing a mix of these instruments—regulation, pricing, strategic investments, and capacity building. Ultimately, the policies will need to be carefully selected and designed based on a detailed analysis of the sector and in a way that builds on CORSIA's foundations. The most important thing is for Canada to show leadership in this area.