McGill | Centre for Research in Air and Space Law
Centre de recherche en droit aérien et spatial

Occasional Paper Series

No. XIII

July 2016

Sustainable Aviation and the Transfer of Environmentally Sound Technologies to Africa: Paradoxes, Barriers and Prospects

by

Damilola S. Olawuyi

Occasional Paper Series:
Sustainable International Civil Aviation

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

As the title of the book suggests, bringing together these various scholars and papers is the central theme of the sustainable development of international aviation. In particular, the work of the International Civil Aviation Organization (ICAO), the primary United Nations body tasked with regulating the environmental aspects of international aviation, and the provisions of the Chicago Convention which lays down powers of the Organization and the fundamental rules of international air law, form the primary focus of this collection. At the next ICAO Assembly in September-October of 2016, ICAO has the ambitious mandate to finalise a global scheme to limit CO_2 emissions from international aviation. As many of the articles contained in the book are of immediate relevance to the discussions due to take place at ICAO, publishing and disseminating these draft chapters will contribute to the growing interest and debates on the issue of the environmental impact of aviation. It is hoped that these papers will contribute to the work of the Assembly and that informed readers and delegates participating at the ICAO Assembly will have constructive comments to share with the authors.

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

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

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

SUMMARY

Sustainable Aviation in Africa: What are the legal and institutional barriers?

The issue:
- What are needed to promote sustainable aviation in Africa?
- What hinders the development of sustainable aviation in Africa?

Its importance:
- Sustainable aviation will improve the quality of life in Africa as it reduces pollution and noise from airports
- Promotion of sustainable aviation in Africa will create sustained in-flow of infrastructural investments in the aviation sector.

The treaty law:
- United Nations Framework Convention on Climate Change
- Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreements

The analysis:
- The reduction of emissions from aviation would largely depend on the availability, accessibility, and affordability of environmentally sound technology (EST).
- A number of regulatory and institutional barriers to the access to EST hinder the transfer of necessary technology. In a number of surveyed African countries, technology transfer laws are either absent, or when present, are archaic, overzealous, anachronistic, and complex.
- Another concern with technology transfer laws in Africa is the multiple licensing and permit systems that investors may have to face when trying to bring in ESTs. The processes of navigating through each bureaucratic agency are often daunting and frustrating.
- Even if African countries will have access to ESTs, there is not enough human capacity to utilize or maintain them.

Options for decision-makers:
1) African policy leaders to address the identified barriers to technology transfer, through proactive law making and institutional rearrangements that would make the transfer of aviation technologies into Africa less cumbersome.
2) African governments to include fiscal incentives and measures such as custom and duties waivers, tax breaks, and technology bonuses or incentives for foreign investors in order to attract technologies required to improve the aviation sector.
3) No action on the part of decision-makers which may result to the slower progress of sustainable aviation in Africa.

SUSTAINABLE AVIATION AND THE TRANSFER OF ENVIRONMENTALLY SOUND TECHNOLOGIES TO AFRICA: PARADOXES, BARRIERS AND PROSPECTS

By

Damilola S. Olawuyi[*]

I.   INTRODUCTION

The central focus of this chapter is to highlight and discuss legal and institutional barriers to the transfer of sustainable aviation technologies to Africa. The International Civil Aviation Organization (ICAO) has been at the forefront of promoting drastic cuts in greenhouse gas (GHG) emissions from aviation. According to ICAO, a transition from dirty aviation to a more sustainable aviation future would require technological and operational measures, state action plans; sustainable alternative fuels; Market-based Measures (MBMs); and global aspirational goals to promote cleaner and more efficient technologies in the aviation sector.[1] Reducing emissions from aviation would, to a large extent, depend on the availability, accessibility and affordability of environmentally sound technologies (ESTs) that aid the transition from old, inefficient and environmentally unsound technologies and aviation facilities, to cleaner and energy efficient ones.[2]

Furthermore, Chapter 34 of Agenda 21 emphasizes that ESTs protect the environment, are less polluting, leverage aviation resources in a more sustainable manner, recycle wastes and by-products, and handle residual wastes in a more acceptable manner than the technologies for which they substitute. [3] ESTs in the aviation sector would result in a drastic cut in emissions associated with flying. Through fleet upgrades and renewals; 'cleaner' and energy efficient aircrafts, improved facilities for air traffic control and management and alternative/renewable fuel options, and robust technological infrastructure that

---

[*] The author can be contacted at: dsolawuyi@yahoo.com

[1] International Civil Aviation Organization, Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change, (Resolution A37-1, 2010).

[2] *Ibid*, see also International Transport Forum, "Reducing Transport GHG Emissions: Opportunities and Costs", online:
<www.internationaltransportforum.org/Pub/pdf/09GHGsum.pdf> accessed 14 March 2016.

[3] United Nations, "Agenda 21 – Chapter 34, Transfer of Environmentally Sound Technology, Cooperation and Capacity-Building" United Nations Conference on Environment & Development Rio de Janerio, Brazil, 3 to 14 June 1992.

would support the migration to more sustainable aviation practices, countries could begin to make progress in adopting cleaner methods of aviation. To attain these objectives, a number of countries have put together voluntarily national action plans to reduce CO_2 emissions from international civil aviation and to promote sustainable and carbon neutral aviation.[4]

Despite increased global awareness and drive on sustainable aviation, African countries continue to grapple unsuccessfully with the idea of sustainable aviation. A major challenge facing the continent is that cleaner and more efficient technologies that are required to foster sustainable aviation are either unavailable, or where they are available, there is a dearth of human capacity to maintain or optimally utilize them. This concern is not new; it was in fact envisaged by climate change negotiators as far back as 1992 when the United Nations Framework Convention on Climate Change (UNFCCC) was adopted. Article 4(1) (c) of the UNFCCC therefore enjoins industrialized countries to promote and cooperate in the transfer of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases in the transport sector.[5] Article 4 (5) also provides that developed countries shall promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how needed by the developing country parties to meet the targets of emission reductions. Developed countries therefore have general obligations to facilitate the transfer of ESTs to developing countries in order to foster emission reduction in key sectors and sub-sectors, such as transportation and aviation.

However, the extents to which these ambitious provisions of the UNFCCC have resulted in the transfer of ESTs to African countries remain doubtful. While technologies and measures that promote sustainable aviation, such as the use of alternative fuels, have increasingly become available in many industrialized states, a number of African countries are still unable to access, deploy and utilize these

---

[4] Currently twenty five (25) countries/regional groups have submitted to the ICAO, their respective Action Plans aimed at reducing greenhouse gas emissions from aviation. They include Australia, Austria, Brazil, Canada, Central American States, China, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Nepal, Norway, Slovak Republic, Sri Lanka, Sweden, Switzerland, Thailand, Trinidad and Tobago, United Kingdom and United States. Notably, no African country has submitted an Action Plan on emissions reduction. See for example Canada's Action Plan to Reduce Green House Gas Emissions from Aviation, online: ICAO <www.icao.int/environmental-protection/Documents/ActionPlan/AviationGHGActionPan_En.pdf>; see also Action Plan of Central America to Reduce Emissions from International Civil Aviation (CAAPER); and Brazil's *Flight path to Aviation Biofuels in Brazil: Action Plan,* < www.fapesp.br/publicacoes/flightpath-to-aviation-biofuels-in-brazil-action-plan.pdf>.

[5] United Nations Framework Convention on Climate Change adopted by the United Nations General Assembly, 20 January 1994, A/RES/48/189.

newer technologies.[6] Arguably, this is mainly due to a number of regulatory and institutional barriers that hinder the transfer of advanced biofuel technologies, technology enhancements, engineering /infrastructural improvements, and improved air traffic control gadgets that could reduce emissions in Africa's aviation sector.

For African countries to attract robust renewal of aviation infrastructure and benefit from technology transfer provisions of the UNFCCC, the appropriate starting point is to create a legal framework that defines sustainable aviation priorities; and then removes institutional, regulatory and bureaucratic barriers to the smooth transfer of ESTs that could aid sustainable aviation. This chapter unpacks some of the legal and institutional barriers that stifle the transfer of aviation technologies into Africa. These barriers include the absence of comprehensive aviation action plans on sustainable aviation, archaic laws on technology transfer, inadequate legal protection for intellectual property rights, lack of intergovernmental cooperation of technology transfer, the absence of a coordinated focal point or institution on technology transfer and the hectic bureaucratic process in securing governmental permits for technology transfer. While some of these barriers are pre-existing and are not peculiar to the aviation sector alone, this chapter demonstrates how they particularly hinder the capacity of African countries to attain any meaningful progress in the global quest for sustainable aviation.

This chapter is divided into four parts. Following this introductory part, part two analyzes the meaning of sustainable aviation within a developing country context. Efforts to propagate the sustainable aviation message in low income countries in Africa, would only be tenable if it spearheads a radical transformation of existing aviation technologies, opens the door to newer jobs for local communities, reduces the cost of aviation to make it accessible to the poor, while promoting sustained economic growth. Part two will highlight the absence of adequate technologies to move this idea of 'sustainable aviation' from the realm of theory to practice in many African countries. Part three identifies legal and institutional barriers to technology transfer in Africa. It discusses pre-existing and unique concerns to the transfer of aviation technologies that hinder progress in efforts to achieve sustainable aviation in Africa. Part four discusses how legal and institutional frameworks on aviation in African states can be revitalized to remove barriers to the transfer of aviation technologies.

---

[6] Le Grange and Buys, for example document how several legal, bureaucratic and regulatory barriers hinder the transfer of aviation technologies to South Africa. See L.Le Grange & A.J. Buys, "The Management of Maintenance Technology Transfer in the South African Aviation Industry" (2002) 13 (2) South African Journal of Industrial Engineering 81-99.

II. SUSTAINABLE AVIATION: A DEVELOPING COUNTRY PERSPECTIVE

The concept of sustainable aviation draws heavily from general notions of sustainability and sustainable development, concepts that have been heavily theorized under public international law. The most commonly cited definition of sustainable development is the definition provided by the Brundtland Commission: 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.[7] Article 3(1) of the 2002 Convention for Cooperation in the Protection and Sustainable Development of the Marine and Coastal Environment of the Northeast Pacific also defines sustainable development in terms of economic growth with social equity through the transformation of production methods and consumption patterns, sustained by the ecological balance and life support systems of the region.[8] Sustainability emphasises the need to protect the environment while pursuing economic growth and development. As the International Court of Justice (ICJ) noted in the *Gabcikovo – Nagymaros Case*, the need to reconcile economic development with the protection of the environment is aptly expressed in the concept of sustainable development.[9] Furthermore, the Rio+20 United Nations World Summit on Sustainable Development held in 2012 specifically identifies the three mutually reinforcing pillars of sustainable development as economic development, social development and environmental development.[10]

In the context of aviation, the 2010 ICAO Assembly adopted *Resolution A37-19*, which promotes a suite of measures aimed at achieving a balance among the three pillars of sustainability – social, economic and environmental.[11] The ICAO

---

[7] The United Nations World Commission on Environment and Development Report (the Brundtland Report) *Our Common Future* (OUP 1987). See also M.C. Cordonier Segger and A. Khalfan, *Sustainable Development Law: Principles, Practices and Prospects* (Oxford: Oxford University Press, 2004) 45–50; D. French, *International Law and Policy of Sustainable Development* (Manchester: Manchester University Press, 2005), 51.

[8] United Nations Environment Program (UNEP), 2002 Convention for Cooperation in the Protection and Sustainable Development of the Marine and Coastal Environment of the Northeast Pacific (Antigua Convention) Adopted 18 February 2002,
< www.unep.ch/regionalseas/main/nep/nepconve.html>.

[9] *Case Concerning the Gabcikovo-Nagymaros Dam* (25 September 1997) (Hungary v Slovakia) I.C.J. Rep., 37 I.L.M. (1998) 162.

[10] 2012A/CONF.216/L.1, United Nations, Rio de Janeiro, Brazil 20-22 June. See also the 2009 United General Assembly Resolution A/RES/64/236 which also describes economic development, social development and environmental protection as interdependent and mutually reinforcing pillars of sustainable development, online: UN
<daccess-dds-ny.un.org/doc/UNDOC/GEN/N09/475/99/IMG/N0947599.pdf?OpenElement>.

[11] International Civil Aviation Organization, Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change, Resolution A37-19.

advocates for technological and operational measures, state action plans; sustainable alternative fuels; Market-based Measures (MBMs); and global aspirational goals to ensure the long-term sustainability of aviation. [12] This predominantly requires the use of alternative fuels such as biofuels; use of low-carbon technology, environmentally friendly materials new aircraft systems and sustainable energy sources; reducing the impact of air transport operations on noise and local air quality around airports, and reducing GHG emissions from aircrafts through aircraft that are more fuel-efficient and quieter. There is already increased progress in ensuring that aviation does not produce environmental pollution or irreversible social impacts. For example, a number of airlines in Europe and North America now run on jatropha, camelina, animal fats and used cooking oils to reduce GHG emissions from conventional energy sources.[13] The ICAO has also developed CO_2 emissions calculator for passenger flights; fuel savings estimation tool (IFSET); and green meetings calculator as toolkits for achieving these low GHG emissions in air travels.[14]

Despite these renewed awareness and progress however, global efforts aimed at promoting sustainable aviation are often faced with the realization of the intricate social dynamics of wholesale upgrade of airport facilities in many African countries where the requisite technologies are either unavailable, or where they are available, there is dearth of human capacity to maintain them or to properly put them to use.[15] As Biru notes, while commenting on the lack of training facilities and human capacity in Ethiopia's aviation sector, Africa as a whole has a huge deficit and need when it comes to aviation training and capacity development.[16] Lack of requisite skilled, reliable and experienced workforce needed to implement the precepts of sustainable aviation remains a fundamental impediment facing the African continent.[17]

---

[12] *Ibid*.

[13] On 6 October 2011 Thomson Airways became the first commercial flight in Europe to fly using biofuels. The Boeing 757-200 carried 232 passengers from Birmingham Airport, UK to Arrecife, using a sustainable biofuels blend in one engine. From 2011, the Dutch airline KLM says it has used 50% biokerosene derived from recycled cooking oil (collected in the EU and refined in the US) on 200 flights between Paris and Amsterdam. In 2012, The European Commission, in coordination with Airbus, leading European airlines such as Lufthansa, Air France/KLM, & British Airways) and key European biofuel producers (Neste Oil, Biomass Technology Group and UOP), launched an initiative to speed up the commercialization of aviation biofuels in Europe. See European Biofuels Technology Platform, "Biofuel for Air Travels" < www.biofuelstp.eu/air.html#firstcom>; also EIA, "The Potential and Role of Biofuel in Commercial Air Transport"
< www.bioenergytrade.org/downloads/T40-Biojetfuel-Report-Sept2012.pdf>.

[14] See ICAO, "ICAO Carbon Emissions Calculator" (ICAO 2012).

[15] I Biru, "The Need and Challenges of Harmonizing CAA trainings in Africa" (ICAO, Aviation Panel 3).

[16] *ibid*.

[17] See the *2012 Abuja Declaration on Aviation Safety in Africa* (Adopted on July 20, 2012 in Abuja,

Furthermore, in a number of African countries, current aviation infrastructures are dilapidated, unsafe and outdated. While African countries such as South Africa, Morocco Egypt, and Tunisia have fared comparably well in aviation infrastructure and safety, there remains a desperate need in several African countries, especially in sub-Saharan Africa, to upgrade and modernize aviation facilities to catch up with international standards. Due to poor infrastructure and inadequate regulatory emphasis on safety, aviation fatalities in Africa remain over 12 times more than the global average.[18] For example in Nigeria, Africa's most populous nation, many years of corruption, neglect and inadequate maintenance have resulted in a largely dysfunctional aviation sector which has been bedeviled by fatal crashes, unprecedented inefficiency and infrastructural decay. These problems have seen a number of international aircrafts operating in or passing through Nigeria, being faced with incessant cases of power outages at airports, herds of cows on a runway; obsolete safety facilities, dysfunctional information and communication systems; and potholes in runways.[19] Where facilities are available, they often antiquated mainly due to many years of zero upgrades or the consistent proliferation of cheap and disused aviation facilities into Nigeria by unscrupulous state authorities.[20] For example, Nigeria is currently one of the most consistent locations for old and disused airplanes. A number of airlines run on ageing but meticulously refurbished and repainted airplanes, which were not designed to use alternative fuels, while a number of designated international airports in Nigeria are surviving on ancient imported air traffic control and communication technologies and equipment that barely work.

Nigeria) <www.afcac.org/en/documents/conferences/october2012/15wp4c.pdf>, which decries the "insufficient number of competent/skilled aviation professionals for ensuring aviation safety in Africa." See also African Union, *African Civil Aviation Policy*, (Second session of the African Union Conference of Ministers Responsible for Transport 21 – 25 November 2011, Luanda, Angola*)* stating that "there is a growing insufficiency in qualified personnel that is worsened by attrition to other markets commonly referred to as "brain drain" and high turnover of middle and senior managers particularly in government owned institutions" para 1.2.7.

[18] See International Air Transport Association (IATA) Safety Performance Results for 2011-2015 < www.iata.org/pressroom/pr/pages/2011-02-23-01.aspx>.
As of January 2016, only 21 African States had accomplished at least 60% of implementation of ICAO's safety-related standards and recommended practices (SARPS), online: IATA <www.iata.org/pressroom/pr/Pages/2016-02-15-01.aspx>.

[19] BBC News, "Plane Hits Cows on Nigeria Runway" (2005) < news.bbc.co.uk/2/hi/africa/4659281.stm>. See generally C Eze,"Nigeria: Impediments, Challenges to Aviation Sector Growth" (All Africa Report, 2012). Also A Amwe & D Jonathan,."An Appraisal of Nigerian Transport Sector: Evidence from the Railway and Aviation Subsectors" (2013) 4 (10) Journal of Economics and Sustainable Development 6-9.

[20] G. Odidi, "Challenges Facing the Aviation Industry in Nigeria" (*The Nigerian Voice,* June 5, 2012).

Mauritania, Mali, Niger, Chad, Uganda, Central African Republic, and the Republic of the Congo all present even more worrisome situations in which radio communication and radar coverage, GPS and performance-based navigation (PBN), precision approaches, near-real-time weather and good airports gadgets, are at worst, nonexistent, or at best archaic and unreliable. [21] To speak of sustainable aviation under such models may therefore be an illusion. [22] In many of these referenced countries, environmental objectives, such as switching to aircraft that utilize Sustainable Alternative Fuels (SUSTAF), utilizing CO_2 emissions calculator for passenger flights, adopting fuel savings estimation tool (IFSET) and leveraging green meetings calculator, are simply relegated to the background due to several pre-existing infrastructural deficits in the aviation sector.[23]

Considering current infrastructure, capacity and technology gaps in aviation sector governance in many African states, global action plans to reinforce sustainable aviation practices must, to be effective, deliver coherent economic, environmental and social outcomes. From an economic and financial perspective, a key question is how international climate finance mechanisms under the international climate can *facilitate and assist* developing countries to access financial resources, technology transfer and capacity building required for low-carbon and cheaper aviation.[24] The international legal regime must ensure a systemic and coherent commitment to the founding principle and need to "promote, facilitate and finance the transfer of, or access to, environmentally sound technologies and

---

[21] See Aviation Week, 'Assessing Africa's Aviation Infrastructure' <aviationweek.com/bca/assessing-africa-s-aviation-infrastructure> stating that the best infrastructure in Africa can be found in the arid north (Morocco, Egypt), sub-Saharan west (Senegal, Guinea, Ivory Coast and Ghana), in some states along the eastern coast (Kenya, Rwanda, Tanzania) and in the extreme south (Republic of South Africa, which is the cream of the crop).

[22] The European Union has gone as far as banning several African airlines from flying in Europe due to their inability to comply with safety and technical upgrade standards. Thirteen of the 17 countries affected by the EU ban are from Africa, with a total of 111 African airlines blacklisted. See EC, *Commission Regulation (EC) No 474/2006 of 22 March 2006 establishing the Community list of air carriers which are subject to an operating ban within the Community referred to in Chapter II of Regulation (EC) No 2111/2005 of the European Parliament and of the Council*, [2006] OJ, L 84/14, as amended. See further European Union, 'List of airlines banned within the EU', online: European Commission <ec.europa.eu/transport/modes/air/safety/air-ban/search_en.htm>

[23] See African Union, *African Civil Aviation Policy, supra* note 17, at paras. 1.2.4 and 12, which note that due to inadequate financing for aviation infrastructure, human resource development, and airline capitalization, Africa continues to lag behind the rest of the world in the quest for sustainable and environmentally friendly civil aviation industry.

[24] African Union, African Civil Aviation Policy, ibid., see also The ICAO High Level Meeting (see HLM-ENV/09) in October 2009 agreed on, "further elaboration on measures to assist developing States and to facilitate access to financial resources, technology transfer and capacity building"; also the Abuja Declaration which decries the inadequacy of financial resources to ensure aviation safety in Africa.

know-how needed by the developing country parties to meet the targets of emission reductions." [25]

Table 2.1 Sustainable Development Matrix

SOCIAL DIMENSIONS	ECONOMIC DIMENSIONS	ENVIRONMENTAL DIMENSIONS
Improved quality of life due to less pollution and noise from airports	Sustained in-flow of infrastructural investments in the aviation sector Carbon neutral growth in the aviation sector	Reduction of GHG emissions and the use of fossil fuels; reduced air and water pollution Reduced air craft noise
Poverty alleviation through increased employment opportunities in the aviation sector	Financial returns to local aviation companies; creation of new growth opportunities Availability of flights at affordable rates (new technologies should not result in higher fares)	Reduced pressure on local environments and improved local air quality Harmonization of routes to reduce environmental impacts
Improved stakeholder engagement in the design of aviation policies; capacity building opportunities for stakeholders in the aviation sector	Transfer of environmentally sound technologies (ESTs) to replace old and dirty technologies	Meeting local renewable energy portfolio standards and other environmental standards

As indicated in the above table, sustainable aviation in African context, arguably, goes above and beyond shifting to low carbon fuels or practices in the aviation sector. Achieving sustainable aviation in Africa requires technology transfer, capacity development and financial assistance to address several pre-existing infrastructural deficits. International drive on sustainable aviation will only be meaningful and successful in the Africa context if underpinned by the transfer of ESTs that could facilitate a renewal and upgrade of aircrafts, foster a holistic revamp of current infrastructure to first of all bring them to speed; and then a near 100 percent replacement

---

[25] Art. 4 (1), United Nations Framework Convention on Climate Change, *supra* note 4.

with newer and more efficient technology. This would be followed by capacity development to train stakeholders in the aviation sector on how to properly utilize these new technologies.

Furthermore, there is need for sustainable aviation technology and measures that impose minimal financial or economic pressure on fragile economies in several African states. For example, how will costs of airport and flight upgrades be allocated in many African countries where air travel costs are already considered to be exorbitant and the exclusive preserve of the rich? This question of allocating costs of aircraft technology improvements and upgrades is a key contributor to the continued use of old and dilapidated aviation infrastructure in many African states.[26] As airlines strive for profitability, and members of the public protest against marginal increases in airfares, issues of safety, technology upgrades, aircraft efficiency, low-carbon aviation and proper aircraft maintenance have taken the back seat. To facilitate sustainable aviation in Africa, tailored mechanisms, such as the UN Technology Mechanism, must be enhanced and implemented to provide developing countries with requisite aviation specific technology and high-performance aviation infrastructure at low to moderate costs. [27] Without tailored aviation technology deployment mechanisms, many African countries will simply not be willing, or able to afford, the cost of shifting to sustainable and low carbon aviation.

Despite this reality, technology transfer to many African states has not been the easiest endeavour. The international climate regime, through the Technology Executive Committee (TEC), has therefore increasingly recognized the need for national systems innovations (NSI) to address and remove barriers to climate technology development and transfer in developing countries.[28] The next section examines key barriers to technology deployment and transfer that must be addressed in African states to foster the transfer of sustainable aviation technology.

---

[26] See The Infrastructure Consortium for Africa, *Opening Up Aviation Services in Africa* (African Development Bank) para. 35-66, discussing high operational costs and pressure to reduce fare price as some of the key barriers to the development of aviation in Africa. <www.icafrica.org/fileadmin/documents/Publications/Opening_up_Aviation_Services_in_Africa_-_Phase_1_Review_Report.pdf>.

[27] The Conference of the Parties (COP), by decision 1/CP.16 established a Technology Mechanism comprising a Technology Executive Committee (TEC) and a Climate Technology Centre and Network (CTCN), to facilitate the implementation of enhanced action on technology development and transfer to support action on mitigation and adaptation. For example, the Joint report of the Technology Mechanism released in 2015 fails to discuss aviation or measures aimed at enhancing sustainable aviation technology development and transfer. Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010.

[28] See UNFCCC, Decision 12/CP.21 *Enhancing climate technology development and transfer through the Technology Mechanism,* Conference of the Parties Twenty-first session Paris, 30 November to 11 December 2015.

III. LEGAL AND INSTITUTIONAL BARRIERS TO TECHNOLOGY TRANSFER

Technology transfer is the dissemination of know-how, experience and equipment amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research education institutions.[29] With respect to sustainable aviation, it includes the movement of cleaner aviation facilities and technologies from countries where they are readily available for use in other countries where they are not. Despite the prevailing rhetoric on the transfer of sustainable aviation technologies into Africa, the practical reality is that not a lot have been achieved. For example, although the international climate regime has established a Technology Mechanism that will assist developing countries to assess and meet their climate technology needs, much of the work of the mechanism has failed to focus on aviation.[30] This lack of a coherent and system integration of international efforts to promote the transfer of ESTs in the aviation sector, coupled with local barriers to technology deployment and transfer, continue to stifle the abilities of developing countries in Africa to access the required technology needed to revitalize aviation infrastructure.[31] The section highlights and discusses some pre-existing legal and institutional concerns that generally stifle and frustrate the transfer and proliferation of sustainable aviation technologies in Africa's aviation sector.

A. ABSENCE OF COMPREHENSIVE SUSTAINABLE AVIATION ACTION PLANS

As earlier noted, a number of countries have, in response to ICAO's call, come up with voluntary sustainable aviation action plans to reduce GHG emissions from domestic and international civil aviation.[32] Such action plans describe the series of proposed strategies, measures and programmes, which States aim to voluntarily adopt to reduce emissions from flights and to enhance

---

[29] See Intergovernmental Panel on Climate Change (IPCC), Climate Change 2001: SynthesisReport. A Contribution of Working Groups I, II, and III to the First Assessment Report of the Intergovernmental Panel on Climate Change (CUP 2001). See also Draft International Code on the Transfers of Technology, 1985).

[30] The Conference of the Parties (COP), by decision 1/CP.16 established a Technology Mechanism comprising a Technology Executive Committee (TEC) and a Climate Technology Centre and Network (CTCN), to facilitate the implementation of enhanced action on technology development and transfer to support action on mitigation and adaptation. For example, the Joint report of the Technology Mechanism, released in 2015, fails to discuss aviation or measures aimed at enhancing sustainable aviation technology development and transfer.

[31] Decision 12/CP.21 Enhancing climate technology development and transfer through the Technology Mechanism, *supra* note 29.

[32] *Supra* note 4.

environmental protection in general. It also provides robust descriptions of how sustainable aviation is conceptualized in a country and how the nation intends to attain its desired level of sustainability. According to the ICAO, the action plans will allow a State to showcase the specific voluntary measures they intend to take in order to improve efficiency and thereby contribute to the global environmental aspirational goals established by the Assembly. [33]

Apart from providing concrete legal frameworks that spell out the technologies and approaches that must be adopted to reach carbon neutral growth. For example, one of the key features of Brazil's action plan is to establish a new biofuels industry to replace jet fuels.[34] This gives an idea on the question of 'how', *i.e* the mechanisms to be adopted by the country to achieve its ambitious sustainable aviation goals. Such Action Plans also highlight institutional strengthening strategies, infrastructure modernisation, operational improvements, fiscal incentives, research development and investigation, and compensation programmes that could bring about sustainable aviation within the country .Furthermore, such action plans would identify clearly, technology deficiencies, needs and areas where international collaboration, technical assistance and financial support is needed.[35] The Action Plan therefore serves as statement of intent by the government of a country to pursue sustainable aviation, invest in aviation technologies and to welcome foreign collaborations in respect to the set objectives.

Many African countries are however yet to come up with such comprehensive Action Plans. A survey of the ICAO compilation of national Action Plans shows that no African country has submitted an action plan to the ICAO. In fact only Lesotho has established something comparable.[36] Nigeria, South Africa, Ethiopia, Kenya and a number of other African countries have yet to put in place such robust action plans that could have helped the ICAO identify areas where they require technical and technological collaboration. This is in spite of the fact that ICAO has repeatedly offered, and has conducted, regional trainings aimed at assisting States to prepare their action plans.[37]

---

[33]   ICAO, "Action Plans on Emissions Reduction" <www.icao.int/environmental-protection/Pages/action-plan.aspx>.

[34]   See Flight path to Aviation Biofuels in Brazil: Action Plan; <www.fapesp.br/publicacoes/flightpath-to-aviation-biofuels-in-brazil-action-plan.pdf>.

[35] ICAO, "Action Plans on Emissions Reduction", online: ICAO <www.icao.int/environmental-protection/Pages/action-plan.aspx>.

[36] See ICAO Action Plan for Lesotho, online: ICAO <www.icao.int/safety/scan/PlansOfAction/ICAO%20Plan%20of%20Action%20for%20Lesotho%20(Accepted) pdf>.

[37] For example, the ICAO worked with the Government of Lesotho to design an action plan, ibid.

There is need for African countries to develop robust action plans on sustainable aviation. To be comprehensive an inclusive, such plans must be put together with the active participation and involvement of key stakeholders in the aviation sector such as heads of airlines, airport management authorities; air navigation service providers; airport and air traffic navigation staffs; fuel suppliers and aircraft manufacturers. [38] The Action Plan would be comprehensively designed after a holistic national assessment of the technological, economic and sustainability challenges and opportunities associated with the development and commercialization of sustainable aviation fuels, practices and approaches in the country. The resultant document would be able to highlight the technology needs of every respective country thereby opening the door for technical and financial support from private sector participants, foreign companies and international agencies such as the ICAO, the World Bank and the African Development Bank.

B. DEFICIENT OR ARCHAIC LAWS ON TECHNOLOGY TRANSFER AT NATIONAL LEVELS

Technology transfer into Africa is often stifled by laws that tend to protract and complicate technology transfer processes. In a number of surveyed African countries, technology transfer laws are either absent, or when present, are archaic, overzealous, anachronistic and complex.[39] For example, in Nigeria, the *National Office for Technology Acquisition and Promotion Act* (NOTAPA) established a licensing and permit system, which includes the registration of contracts and agreements for virtually all technologies coming into Nigeria.[40] NOTAP is also empowered to examine the quality of imported technology with a view to determining price, ensure compliance with intellectual property requirements, register contracts/agreements, which deal with the transfer and acquisition of foreign technology and grant permits for their importation into Nigeria. In order to prevent the transfer of obsolete technology, the Director of NOTAP may refuse to register any contract/agreement in which in his opinion may result in price distortion, monopoly or violation of intellectual property laws.[41]

---

[38] The Actions Plans can build on some of the core strategic action points already identified by the African Union in *African Civil Aviation Policy, supra* note 17.

[39] See J De Beer, C Armstrong, C Oguamanam and T Schonwetter 'Innovation, Intellectual Property and Development Narratives in Africa' in J De Beer, C Armstrong, C Oguamanam and T Schonwetter, *Innovation & Intellectual Property Collaborative Dynamics in Africa* (University of Cape Town Press 2014) 2-5, discussing how administrative bottleneck, systemic inefficiencies and overzealous IP protection regimes raise the costs of future innovations in Africa and may, therefore, discourage potential innovators and creators who can- not afford high up-front investments.

[40] *National Office for Technology Acquisition and Promotion Act* (NOTAPA) Cap N 62, Laws of the Federation of Nigeria 2004.

[41] Section 6 (2), *ibid.*

While these are very necessary and important mandates, the process of obtaining approvals and registrations from NOTAP are most often not easy and straightforward. Due to bureaucratic delays in processing permit applications, institutional corruption and lack of institutional coordination with other relevant regulatory agencies, obtaining relevant documentation and clearance for technology transfer to Nigeria is often herculean and frustrating.[42] The situation is the same in many other African countries where administrative inefficiency and lack of transparency often stagnate registration and regulatory approval processes for ESTs, thereby reducing the ease of doing business.[43] Le Grange and Buys, also document how several legal, bureaucratic and regulatory barriers hinder the transfer of aviation technologies to South Africa.[44]

Similarly, technology transfer laws in Africa have lagged in terms of establishing financial and policy incentive mechanisms that would stimulate private sector participation in technology development and transfer in Africa. For example India and China have been able to attract foreign transfer of technology through a web of tax incentives and fiscal measures that make their markets very attractive to investors.[45] In order for African markets to favourable compete with other countries in attracting the required technologies required to improve the aviation sector, there is a need for established technology transfer laws to include fiscal incentives and measures such as custom and duties waivers, tax breaks and technology bonuses or incentives for foreign investors. This will aid the competitiveness and attractiveness of African countries to favorably attract ESTs into the aviation sector.

There is a need to address the gap in laws and policies on technology transfer by establishing comprehensive and updated laws that simplify

---

[42] See T. Akande, *NOTAPA and Technology Transfer in Nigeria*, (Nigerian Institute of Social and Economic Research, NISER Joint ICTSD/FES, 2 December 2002) at 2.

[43] In the 2015 World Bank's "Ease of Doing Business" rankings, by which the World Bank gauges the intricacies of running a company in different countries, including the ease of obtaining regulatory approvals, African countries rank very low. Mauritius is the highest ranked African country at 28 out of 189 nations surveyed, followed by South Africa (43) Rwanda (48), Morocco (71); while Kenya (136), Nigeria (170), Libya (188), Eritrea (189) and several other African countries all dominate the very poor layer of the list.
<www.doingbusiness.org/~/media/GIAWB/Doing%20Business/Documents/Annual-Reports/English/DB15-Chapters/DB15-Report-Overview.pdf>.

[44] See L.Le Grange & A.J. Buys , "The Management of Maintenance Technology Transfer in the South African Aviation Industry" (2002) 13 (2) South African Journal of Industrial Engineering.81-99.

[45] Article 66.2 of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), signed at Marrakesh on April 15, 1994, recognizes the importance of incentives in promoting technology transfer. It requires developed country WTO Members to "provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country Members."

technology transfer processes, establish less cumbersome methods of screening technologies and also provide financial and policy incentives on transferred technologies.

C. INADEQUATE LEGAL PROTECTION FOR INTELLECTUAL PROPERTY RIGHTS (IPRS)

One of the key barriers to the transfer of technology to many developing countries, especially African countries, is the inadequate level of protection accorded to intellectual property rights (IPR). Generally, innovators want to be sure that their innovations and technological advancements are not abused, or deployed without adequate permission or protection under national regimes of the country to which the technology is transferred. Generally, countries that do not have in place adequate and efficient intellectual property rights system to protect innovation struggle to attract aviation technology. As Article 7 of the Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreements note, the objective of the protection and enforcement of IP should be to contribute "to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare…" Article 8 also recognizes that measures "may be needed to prevent the abuse of intellectual property rights by right holders or the resort to practices which … adversely affect the international transfer of technology." Although many African countries are parties to the TRIPS regime, legal and policy frameworks have not been robustly implemented to strengthen IPR protection.[46]

Concerns over inadequate protection of IPR in Africa manifest in two broad ways. One is the wide exclusion of certain technologies from patentability. A patent is usually a grant made by relevant government authorities within a country that confers upon an inventor the right to exclude others from the commercial exploitation of a particular invention.[47] It is simply a form of market monopoly granted to inventors as an incentive to invent or innovate. Prior to the TRIPS Agreement, countries could exclude inventions of certain types or in certain areas of technology from patentability, based on their development priorities and strategies. However, Article 27.1 of the TRIPS Agreement now requires WTO Members to grant patents to all types of inventions in all fields of technology, as

---

[46] D Foray, *Technology Transfer in the TRIPS Age: The Need for New Types of Partnerships between the Least Developed and Most Advanced Economies* (ICTSD, 2008).

[47] See section 2(1) of the Nigeria's Patents and Designs Act (PDA) Cap. P2 Laws of the Federation of Nigeria 2004, stating that a patentee is thereby granted a right in law to prevent others from making, using or dealing in his invention whether by sale, importation or hire. See also William Cornish and David Llewelyn, *Intellectual Property: Patents, Copyright, Trade Mark, and Allied Marks* (2003) 112.

long as these inventions meet certain basic criteria of novelty, inventive step and industrial applicability. [48] However, patent laws in many African states still maintain and apply rigid and exclusionary definitions of patents and inventions, which exclude certain technologies from patentability. As Mgbeoji rightly argues, most of the legal approaches to patenting in Africa are still be based on colonial antecedents, with only few countries reflecting modest improvements on the *status quo* since the colonial era.[49]

For example, section 1 of the *Nigerian Patents and Design Act* (PDA) discusses circumstances in which an invention could be considered patentable. Under the section, an invention is patentable if: (i) it is new, results from inventive activity and is capable of industrial application, or, (ii) if it constitutes an improvement upon a patented invention, and also, is new, results from inventive activity and is capable of industrial application. However, under the PDA, scientific principles and discoveries are not classified as inventions for purposes of a patent application and grant. Furthermore, under section 1(4)(a) and (b) of the PDA, patents cannot validly be granted or obtained in respect of plant or animal varieties, or essentially biological processes for the production of plants or animals (other than microbiological processes and their products; or for inventions the publication of or exploitation of which would be contrary to public order or morality. Section 1 (4) has created uncertainty as to whether biofuel innovations or low-carbon fuels from agricultural products such as coconuts, jatropha and sugar cane can be patented in Nigeria. Concerns about legal barriers to biofuel patenting, have also been raised in Mozambique and Egypt.[50] Furthermore, the PDA does not define the benchmark for determining inventions that would be contrary to public order or morality in Nigeria. This vagueness has operated as a master key that can be deployed at any time by governments to deny any innovation from patentability. The excessive and arbitrary power to deny patentability on undefined public policy or morality grounds, coupled with the fear of autocratic regimes in African states, results in uncertainty and has remained a disincentive for innovators to transfer needed technology to African states.

A second paradox in IPR protection laws in surveyed African countries is the application of expanded compulsory license provisions, that allow the use of

---

[48] Cap. P2 Laws of the Federation of Nigeria 2004.

[49] I Mgeboji, 'African Patent Offices Not Fit for Purpose' in J De Beer, C Armstrong, C Oguamanam and T Schonwetter, *Innovation & Intellectual Property Collaborative Dynamics in Africa* (University of Cape Town Press 2014) 234.

[50] Bassem Awad and Perihan Abou Zeid, 'Reflections on the Lack of Biofuel Innovation in Egypt', *ibid.*, at 267; see also Fernando dos Santos and Simão Pelembe, 'The State of Biofuel Innovation in Mozambique, *ibid.* at 248; stating that despite the clear articulation of biofuel policies in Mozambique's National Policy and Strategy on Biofuels (NPSB) of 2009, patenting and IPR protection are not adequately addressed in Mozambique's biofuel strategy.

a patented product or process without authorization or compensation to patent rights holder. Compulsory license provisions, as recognized under articles 30 and 31 of TRIPS, allow an administrative or judicial authority to grant to a third party, rights to exploit or use a patented invention without consent of the patent for overriding public policy or emergency reasons.[51] A person that has been granted a compulsory licence has all the rights of a patentee. Article 31 of the TRIPS Agreement, however provides some safeguards including the requirements that the proposed user should have made good faith efforts to obtain authorization from the patent holder, the use will be for domestic supply only, that the patent holder shall be granted adequate remuneration, and that there be an established review process for considering the application for compulsory licenses. In many of the surveyed African regimes, several of the procedural safeguards under TRIPS are not replicated.[52] In Nigeria for example, not only does the PDA not codify these safeguards, it in fact provides that once a compulsory licence has been granted, the licensee is insulated from making any payment to the patentee in the form of royalty or any other manner described. Similarly, the Nigerian law authorizes federal, and even state authorities, to utilize or obtain a patented product for the service of the government agency in Nigeria for public interests. This excessive power to leverage innovations for "public interest" again raises concerns on the adequacy of legal protection available, in practical terms, to IPRs in African regimes.

In a continent in dire need of ESTs, over-zealous legal provisions and policies that narrow or weaken IPR protection must be addressed and removed. The level of protection accorded to IPR must not only be strengthened, appropriate institutions and regulatory structures must also be revitalized or put in place to instil confidence in inventors that transferred ESTs will be protected from arbitrary confiscation or abuse.

IV. INSTITUTIONAL BARRIERS

A number of institutional gaps also frustrate technology transfer processes into African countries. Some the most critical include:

A. LACK OF INTERGOVERNMENTAL COORDINATION AND LINKAGES

One chief concern with technology transfer laws in Africa is the multiple licensing and permit systems that investors may have to face when trying to bring

---

[51] PDA, note 47.

[52] See for example s. 55 and 56 of South Africa's *Patents Act* No. 57 of 1978.

in ESTs. In Nigeria for example, investors have been faced with the herculean task of obtaining permits and licenses from multiple agencies, departments and parastatals at the federal, state and local government levels when bringing in new technologies. Apart from registration with NOTAP, other allied organizations that may have statutory oversight roles and functions; for example the Nigeria Custom Service which is often the first point of scrutiny before importation; the Standard Organization of Nigeria (SON), which is empowered to ensure that all equipment or tools are not obsolete of fake; the Ministry of Finance which must approve importations exceeding certain financial benchmarks; the Ministry of Environment, and the Ministry of Commerce and Industry to mention but a few. While these standards are required, the processes of navigating through each bureaucratic agency are often daunting and frustrating.

Countries in Eastern Europe have increasingly adopted a "one stop shop approach" which allows one agency to coordinate all required approvals.[53] Such that investors do not have to deal with multiple licensing agencies. This approach streamlines the process of technology transfer, reduced administrative bottlenecks and ultimately reduces the frustration and stress involved in registering technology transfer agreements.

There is a need for African countries to streamline technology transfer processes and ensure the coordination of governmental ministries, agencies and departments involved in technology transfer. This way, the process of importing the required aviation tools, facilities and technology required to transform the aviation sectors would be more encouraging and less daunting.

B.   LIMITED CAPACITY

To promote sustainable aviation, there is a need for a large pool of officers and staffs trained and skilled in utilizing the newer and cleaner technology options. This is one area that requires more work in Africa. Importation or availability of new technologies is not enough; without the required human capacity, such facilities may rot away without use or may be sub-optimally deployed. Governments must therefore as priority, identify the training needs of regulators, airport management agencies and airport officials and then endeavor to provide adequate and updated knowledge for them in essential areas.

Relevant air force institutions in many African countries lack updated training resources, funding and technology to foster improvement in aviation practices. For example, the Nigerian College of Aviation Technology, set up to

---

[53] See World Bank, "Doing Business 2011: Making a Difference for Entrepreneurs" (World Bank, 2011).

train aviation professionals such as Pilots, Air Traffic Controllers, Aircraft Maintenance Engineers, Aeronautical Telecommunications Engineers, Flight Dispatchers, Cabin Crew, Avionics Engineers, amongst others, has often been reported as lacking adequate operational and top-level training facilities and management personnel. [54] As the ICAO notes, a considerable number of institutions in Africa that have been training pilots, air traffic controllers and mechanics for decades now do not possess the critical mass of resources to meet an increasing demand. [55] Biru also noted the lack of training capacity in broad range of disciplines at the Ethiopian Aviation Academy.[56] Despite efforts and initiatives by regional bodies, such as the African Civil Aviation Commission, in spearheading safety training courses for aviation personnel in Africa, overall success has been too little and too slow due to financial constraints, lack of political will, and lack of adequate capacity and resources to meet the overwhelming need and demand in various African states.[57]

Concerted regulatory and institutional change is therefore necessary if Africa is to shift to sustainable aviation. There is need for collaborative efforts between international community, private sector and African governments to remove barriers to the transfer of aviation specific ESTs; and to provide increased financing for aviation training institutions such that they can be abreast of new technologies, facilities and best practices in aviation. There is also a need to provide continuous learning opportunities for key stakeholders in the aviation sector to learn of new trends in sustainable aviation, this could be through foreign exchange programs, capacity development conferences and short courses. The International Airline Training Fund (IATF), which is supported by the International Air Transport Association (IATA), already provides a number of laudable training programs on safety oversight for aviation authorities and professionals in Africa.[58] These training programs will even deliver more value if training centers are brought closer to African countries where trainings are highly required. Currently, many of IATA's training centers are located in Europe and

---

[54] See A Amwe & D Jonathan, "An Appraisal of Nigerian Transport Sector: Evidence from the Railway and Aviation Subsectors" (2013) 4 (10) Journal of Economics and Sustainable Development 6-9; also G. Odidi, "Challenges Facing the Aviation Industry in Nigeria" (*The Nigerian Voice,* June 5, 2012).

[55] ibid.

[56] See I Biru, "The Need and Challenges of Harmonizing CAA trainings in Africa" (ICAO, Aviation Panel 3).

[57] For a discussion of the several practical and logistical constraints facing aviation training in Africa, see African Civil Aviation Commission, "Efforts and Commitment Towards the Provision of Sustainable Aviation Training in Africa", online: ICAO <www.icao.int/safety/afiplan/documents/aato%20assembly,%20abuja,%20nigeria,%20april%20 2013/presentations/presentation%20by%20afcac.pdf>.

[58] A comprehensive list of tailored courses is available online: IATA <www.iata.org/about/Pages/iatf.aspx>

the American region, with no training center in Africa. This logistical challenge makes it more expensive and difficult for aviation professionals in Africa to access IATA's training programs.

V. CONCLUSION

Despite the increased awareness on the need for countries to adopt basket of measures aimed at reducing emissions from civil aviation, African countries are often hindered by the fact that ESTs required to transform the aviation sector to a cleaner and carbon neutral one are often not readily available in the continent. Technology transfer is therefore key if Africa must transit to an era of sustainable aviation. Even though Article 4(1) (c) of the UNFCCC enjoins industrialized countries to promote and cooperate in the transfer of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases in the transport; transferring technologies to Africa have often times not being the most straightforward endeavor.

Stakeholders and investors have perennially been faced with inherent legal and institutional barriers that stifle technology transfer and frustrate foreign and private investments in Africa's aviation sector. Drawing examples from Nigeria, Ethiopia and South Africa, this paper has discussed some of the key barriers to the smooth transfer of technology to Africa, specifically the lack of coherent national action plans on sustainable aviation; deficient technology transfer laws; lack of institutional coordination and the lack of human capacity to optimally utilize relevant clean technologies.

To attain the goals of sustainable aviation in the African context, there is a need to remove all the identified barriers to the transfer of environmentally sustainable aviation technologies. African policy leaders must address and remove these identified barriers to technology transfer, through proactive law making and institutional rearrangements that would make the transfer of aviation technologies into Africa, less cumbersome. Doing so would not only signify Africa's readiness to contribute to the global goals of sustainable aviation, it could also deliver local social, environmental and economic benefits that would solve some of the perennial sustainability challenges facing Africa as a whole.

About Centre for Research in Air and Space Law

The McGill University Centre for Research in Air and Space Law is the principal research and educational outreach arm of McGill's Institute of Air & Space Law, established in 1951. The Institute provides the core degree-granting educational programme, while the Centre produces research, publishes books and other literature, and offers educational products around the world.

Since its inception in 1976, the Centre has published a number of monographic studies, proceedings of symposia, reports and books, and held numerous workshops, seminars and conferences in Montreal and various other international venues.

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

For more information, please visit:
Institute of Air and Space Law
https://www.mcgill.ca/iasl/

Centre for Research in Air and Space Law
https://www.mcgill.ca/iasl/centre