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**Innovation is in the (clean) air - The
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Innovation is in the (clean) air – The inclusion of aviation in the EU emissions trading scheme as a driver of innovation in air transport

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Keywords:

Research and Development and Innovation (R&D&I), EU innovation policy, emissions trading, EU Emissions Trading Scheme (EU ETS), aviation, air transport, growth, sustainable development, biofuels, aeronautics, air traffic management, Single European Sky (SES-SESAR), US NextGen Programme, EU State aid law, Seventh Framework Programme (FP 7), Trans-European Networks framework programme (TEN-T).

Abstract:

The paper looks at the inclusion of international aviation in the EU emissions trading scheme from the perspective of innovation. It argues that the initiative of the European Union to subject international aviation to the scheme has functioned as a catalyst for green innovation in the sector. Green innovation in aviation has particularly manifested itself in the areas of air traffic management, aeronautics and biofuels. The paper examines the funding mechanisms activated to foster innovation to address the issue of whether the EU has developed an innovation policy. Departing from the overarching goal of growth, which nowadays appears to be synonymous with sustainable development, the paper examines the contribution of the Environmental Policy Integration principle to the gradual coordination and alignment of EU policies and actions in the direction of sustainable development. Innovation is seen as a facilitator of this process. The paper concludes that although it does not appear that the EU has developed an autonomous system of horizontal rules on innovation, it does have plenty of instruments, which, if well-orchestrated, could lead to an innovation concert.

JEL codes:

K32, O31, O32, O44, R11, R41, R42

I. Introduction

Innovation is a key word of our times; and although it is timeless in that it is inherent in human nature, it is the current financial crisis that makes the discussion about innovation appear more relevant than ever before. In fact, the EU has advocated an approach “whereby innovation is the overarching policy objective”¹. At the same

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¹ See Commission Communication, Europe 2020 Flagship Initiative – Innovation Union, 06.10.2010, COM (2010) 546 final, at p. 2: “Perhaps the biggest challenge for the EU and its Member States is to adopt a much more strategic approach to innovation. An approach whereby innovation is the overarching policy objective, [...], where all policy instruments, measures and funding are designed to

time, the realization that growth – the end result of innovation - needs also to be sustainable, has led to the concept of eco-innovation². It is, therefore, of no surprise that the EU has developed comprehensive rules on innovation aid, as well as market based measures (MBMs) for the tackling of environmental harm, most notably an ambitious emissions trading scheme (ETS)³.

It is of no surprise either that the more opportunities are created for innovation at either national or EU level⁴, the more the ETS expands in scope and reach. A notable example comes from the aviation industry. Whilst, for instance, the aeronautics industry has been the greatest beneficiary of R&D&I State aid in the period 2007-2010, having absorbed 29% of overall funding for large aid measures⁵, airlines are, as of 1 January 2012, included in the EU ETS⁶ (in stark contrast with other modes of transport, especially maritime transport). This inclusion, and especially the decision of the EU to subject third-country airlines to the scheme as well, so long as they use an EU aerodrome, has not only infuriated airlines, but also resulted in litigation.

In December 2011, the Court of Justice issued a preliminary ruling, in response to a reference made by the High Court of Justice of England and Wales, declaring the EU Directive on the inclusion of aviation valid⁷. In its turn, this judgment, insofar as it recognises no extraterritorial application of EU law even when airline emissions are calculated for the entire distance between the point of departure and the point of arrival, has infuriated a vast number of third countries, who have threatened retaliatory measures. The danger, whether artificial or real, of a trade war, whose first and direct victims will be the airlines, has brought together all industry stakeholders, from airlines to aircraft manufacturers and airports to air navigation service providers,

contribute to innovation...”. See also p. 8: “In a post-crisis world, Europe must move away from “business as usual” and make innovation its overarching policy objective”.

² Eco-innovation is defined as: “all forms of innovation activities resulting in or aimed at significantly improving environmental protection. Eco-innovation includes new production processes, new products or services, and new management and business methods, whose use or implementation is likely to prevent or substantially reduce the risks for the environment, pollution and other negative impacts of resources use, throughout the life cycle of related activities”. See Community Guidelines on State aid for environmental protection, OJ C 82/1, 01.04.2008, at para. 70 (4). In addition, in its Communication: “An integrated Industrial Policy for the Globalisation Era – Putting Competitiveness and sustainability at Centre Stage, COM (2010) 614, the Commission announced the launching of an Eco-innovation Action Plan, at 7.1, p.21.

³ See Directive 2003/87/EC of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, OJ L 275/32, 25.10.2003.

⁴ E.g. State aid for innovation, EU aid for innovation under EU Framework Programmes (the current Seventh Framework Programme), the Competitiveness and Innovation Framework Programme, the European Institute of Innovation and Technology, cohesion policy, in particular through Structural Fund financing for R&D&I, European Investment Bank (EIB) in particular under the Risk-Sharing Finance Facility (RSFF). See Research, Development and Innovation State Aid Framework, Consultation Paper, at p. 5-6, available at: http://ec.europa.eu/competition/consultations/2012_stateaid_rdi/en.rtf.

⁵ See Commission Staff Working Paper – Mid-Term Review of the R&D&I Framework, 10.08.2011, at p. 6, point 3.1).

⁶ See Directive 2008/101/EC 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, OJ L 8/3, 13.01.2009.

⁷ See Case C-366/10, Air Transport Association of America and others v. UK, Judgment of 21 December 2011, nyr.

in an effort to devise ways to decrease the environmental footprint of aviation. As a result, investment in R&D&I has been massive. 50,000 flights have already taken wing on biofuels, whilst new generation aircraft employ green technologies to achieve fuel efficiencies, are lighter, made out of composite materials, and aerodynamically designed. Air traffic management technology is undergoing a process of modernisation to deliver optimised flight routes, in accordance with objectives like the EU Single European Sky project or its US equivalent, the NextGen programme. On the regulatory side, the International Civil Aviation Organisation (ICAO) is developing a CO₂ standard for aircraft as a means to induce air manufacturers to produce greener aircraft, whilst efforts to reach a consensus on a global ETS for aviation are being intensified. Innovation, nevertheless, comes at a price; a price that the industry alone cannot bear. The state – be it individual states or federal governments/the EU as a whole - has, therefore, been the main risk-sharing partner of the industry. In the EU, the main mechanisms resorted to have been the EU State aid law on R&D&I, the EU research budget under, currently, the Seventh Framework Programme for research, technological development and demonstration activities (FP 7)⁸ and the Trans-European Transport framework programme⁹.

The realisation that, to be meaningful, development and growth need also to be sustainable¹⁰ has found its expression in the environmental policy integration (EPI) principle, enshrined in Article 11 TFEU and Article 37 Charter of Fundamental Rights: “environmental protection requirements must be integrated into the definition and implementation of the Union policies and activities, in particular with a view to promoting sustainable development” (Article 11 TFEU). The paper examines the contribution of this principle to the gradual alignment of EU policies as diverse as energy, air transport and innovation with one sole objective: sustainable development. In view of the fact that innovation, inherent as it is in human nature, permeates all human activities and, therefore, all EU policies and actions, special emphasis will be placed on the effect the EPI principle has on the fostering of innovation across the board and on the policies, instruments and means the EU has in place to facilitate this process.

II. Reflections on innovation

⁸ See Decision No 1982/2006/EC of the European Parliament and of the Council of 18.12.2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013), (OJ L 412/1, 30.12.2006). The Commission has set aside over €400 million for aeronautics projects under the Seventh Framework Programme. Horizon 2020, the Framework Programme for Research and Innovation that will succeed FP7, has identified “smart, green and integrated transport” as one of the societal challenges where funding will be focused (sic.). See Commission Communication, Horizon 2020 – The Framework Programme for Research and Innovation, 30.11.2011, COM (2011) 808 final.

⁹ On Trans-European Networks in general, see Articles 170-172 TFEU. See also Decision No 661/2010/EU of the European Parliament and of the Council of 7 July 2010 on Union guidelines for the development of the trans-European transport network (recast), OJ L 204/1, 05.08.2010. For an overview of the legal framework applicable, see:

http://tentec.europa.eu/en/about_us/mission_introduction/history_legal_framework.htm.

¹⁰ “Sustainable development”, as defined in United Nations terminology, is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. See World Commission on Environment and Development, 1987. Our Common Future, at p. 8.

Although the Commission has recently declared innovation to be “the overarching policy objective”¹¹ and has elevated “the free movement of innovative ideas” to a “fifth freedom”¹², the concept of innovation does not feature in primary law, at least not explicitly. Article 3(3) TEU provides that the Union “shall promote scientific and technological advance”. Article 4 TFEU reads: “In the areas of research, technological development and space, the Union shall have competence to carry out activities, in particular to define and implement programmes; [...]”. Moreover, the area of “Research and technological development and space” has been identified and regulated as one of the overall 24 Union Policies and Internal Actions¹³. Article 179(1) specifically provides that “the Union shall have the objective of strengthening its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely [...]”. As a result, in the area of EU State aid law, innovation aid as an autonomous category of aid was only recognised in 2006 with the adoption of the Framework on Research and Development and Innovation (R&D&I)¹⁴. Its predecessor, the 1996 Framework, explicitly excluded State aid for innovation, providing only for aid for Research and Development (R&D). It was not until the adoption of the State Aid Action Plan (SAAP) in 2005¹⁵ that the need to subsidise innovation activities was recognised¹⁶. The SAAP heralded a Communication on State aid and innovation (sic), eventually adopted in 2005¹⁷, which, in its turn, heralded new rules on State aid for innovation, incorporated in the 2006 Framework.

The delay in formulating State aid rules on innovation does not mean of course that the EU had not developed an innovation policy in other areas¹⁸. Nevertheless, it might be related to the absence of an explicit legal basis in primary law that would define and delineate innovation policies and actions. The question arises at this point as to why there is no mention in the Treaties of innovation, something which necessitates its association with the Treaty provisions on research and technological development. If one accepts that innovation is inherent in human nature and is not only linked to technology, then the founders of the Treaty should have, one way or another, recognised this.

Arguably, innovation is not an objective in itself but rather a means to achieve an objective. Innovation for the sake of innovation is meaningless. In this sense, elevating innovation to an objective would be inappropriate. The Commission seems to have recognised this, despite the somewhat exaggerated recent statement about

¹¹ Supra note 1.

¹² See Commission Communication Europe 2020, at 3.3, p. 18: “It is therefore more important than ever before to deliver the so-called “fifth freedom” which is not only the free movement of researchers but also the free movement of innovative ideas”.

¹³ See Title XIX (Articles 179-190 TFEU) of the TFEU.

¹⁴ Community Framework for State aid for Research and Development and Innovation, OJ C 323/1, 30.12.2006.

¹⁵ State Aid Action Plan, Less and better targeted State aid: a roadmap for State aid reform 2005-2009.

¹⁶ Somewhat earlier, in 2002, the European Council agreed at the Barcelona meeting that overall spending on R&D&I in the Community should be increased with the aim of approaching 3% of gross domestic product by 2010. See R&D&I Framework, at 1.1 (Introduction).

¹⁷ See IP/05/1169, 21 September 2005 and MEMO/05/333, 21 September 2005.

¹⁸ The Commission officially ascribed this delay to its limited experience in assessing innovation aid measures (See MEMO/05/333, 21.09.2005).

innovation becoming the overarching policy objective¹⁹. For instance, in the field of environment, the Commission has provided us with a definition of eco-innovation²⁰. In the area of transport, the Commission recently announced that it “will devise an innovation and deployment strategy for the transport sector in close cooperation with the Strategic Energy Technology Plan...”²¹. The most straightforward example comes from the area of shipbuilding where sector-specific innovation aid rules have been devised²². Putting innovation at the service of the objectives pursued by the various EU policies and actions is probably a good illustration of it being an instrument rather than a goal in itself.

Coming back to the issue of why the founders of the Treaty did not devise an EU innovation policy, speculation will not be risked in this paper, as the answer might reside in economic theory²³. What will be attempted instead is to show how the targets set in the context of the various EU policies and internal actions foster innovation and what are the instruments in place to facilitate this process. The area of scrutiny, as already mentioned, is the aviation industry.

III. Inclusion of aviation in the EU ETS

1. Background to the inclusion of aviation in the EU ETS

The protection of the environment has been a key priority of the EU ever since its inception. A common policy in the sphere of the environment was, therefore, deemed necessary from the outset as a means of fulfilling the objective of a “high level of protection and improvement of the quality of the environment”²⁴. Climate change emerged as a global consideration at a political level somewhat later. Increasing concerns about the effects of global warming led the international community to the conclusion of the 1992 United Nations Framework Convention on Climate Change (UNFCCC)²⁵, whose ultimate objective is the stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system²⁶.

¹⁹ Contrast this statement, for instance, to the statement made in Communication “Horizon 2020”, at p. 5, that: “Sustainable development will be an overarching objective of Horizon 2020”. A similar statement of a more authoritative nature has been made in Decision No 1982/2006/EC on the Seventh Framework Programme, at paragraph 29: “The Seventh Framework Programme should contribute towards promoting growth, sustainable development and environmental protection, including by addressing the problem of climate change”. See also Annex I (Cooperation) thereof: “The overarching aim is to contribute to sustainable development”, supra note 8.

²⁰ Supra note 2.

²¹ See White Paper – Roadmap to a Single European Transport Area – Towards a Competitive and resource efficient transport system, COM (2011) 144 final, 28.03.2011, at 3.2, p. 12.

²² See Framework on State aid to shipbuilding, OJ C 364/9, 14.12.2011.

²³ For inspiration, see, for instance, the discussion about an innovation ecology as opposed to an innovation system in MetCalfe (2008). “The Perpetual Dance: Competition, Innovation and the Community Framework for State Aid for R&D&I”, Study realised under the supervision of Technopolis Group France, commissioned by DG Enterprise of the French Ministry of Economy, Industry and Employment.

²⁴ See former Article 2 EC, in conjunction with former Article 3(1) EC and former Articles 174-176 EC.

²⁵ United Nations Framework Convention on Climate Change, 1992, at:

<http://unfccc.int/resource/docs/convkp/conveng.pdf>.

²⁶ See Article 2 UNFCCC.

Although the UNFCCC comes together with a number of commitments for its signatories, those are non-binding nor time-limited as to their fulfillment. Instead, they are predicated on the principle of common but differentiated responsibilities and respective capabilities (CBDRRC) and on the discretion of the Parties to “take into account” “their specific national and regional development priorities, objectives and circumstances”,²⁷. This fact alone explains why no reservations have been made, despite the 192 parties to the Convention. It was not until the adoption of the 1998 Kyoto Protocol to the UNFCCC²⁸ that the Convention was put into operation. The Kyoto Protocol, which entered into force in 2005, binds the parties to achieve their quantified emission limitations and reduction commitments in the commitment period 2008 to 2012²⁹. The EU and its Member States specifically have undertaken to reduce their greenhouse gas emissions by 8% below 1990 levels³⁰.

The Kyoto Protocol aims at imposing conditions upon the signatories with regard to emissions produced domestically. The territorial scope of the Protocol is, therefore, confined within national borders. This limitation is not without consequences for sectors of the economy that are *per se* international, most notably air transport and maritime transport. The operation of those modes of transport within several countries and, moreover, over and on the high seas respectively, i.e. in reality in no man’s land renders the quantification and apportionment of emissions a very complicated task. As a result, the Protocol provides that the Parties shall pursue limitation or reduction of emissions from aviation and marine bunker fuels not controlled by the Montreal Protocol by working through the International Civil Aviation Organization and the International Maritime Organization respectively³¹. This means that, whilst domestic aviation emissions are accounted for for the purposes of meeting the Protocol’s targets, international aviation emissions are not.

The climate change alert and the consequent mobilization of the international community is reflected in EU law, which has undergone a process of gradual adaptation to its people’s changing needs. The adoption of the Single European Act in 1986 represents a milestone in EU environmental policy in that it gave expression to the environmental policy integration (EPI) principle. Some 10 years later, the Treaty of Amsterdam (1997) added yet another dimension to the EPI principle: that of sustainable development. Along the lines of former Article 2 EC, which set the task of promoting “throughout the Community a harmonious, balanced and sustainable development of economic activities”, Article 6 of the Amsterdam Treaty provided that: “environmental protection requirements must be integrated into the definition and implementation of the Community policies and activities...in particular with a view to promoting sustainable development”. The EPI principle found its way also into the EU Charter of Fundamental Rights³². Arguably, this elevation of environmental protection to a fundamental right and, moreover, its placement under

²⁷ See Article 4(1) UNFCCC.

²⁸ Kyoto Protocol to the United Nations Framework Convention on Climate Change, UN Doc. FCCC/CP/1997/L. 7/Add.1.

²⁹ See Article 2(1), in conjunction with Article 3(1).

³⁰ See Article 3(1), in conjunction with Annex I B and Annex II.

³¹ See Article 2(2).

³² See Article 37.

the “solidarity” provisions³³, paved the way for the transition from the sustainable development of the Community under the EC Treaty to the sustainable development of the Earth under the Lisbon Treaty: “In its relations with the wider world, the Union shall...contribute to the sustainable development of the Earth”³⁴.

This evolution is important not only because it highlights the obligations of the EU under international environmental law, but also because it provides a strong legal basis for the “internalization” of EU environmental law. Although it is true that environmental activism has always been an objective of the Union policy on the environment³⁵, the Lisbon Treaty effectively concretized (albeit in a non-exhaustive fashion) this objective by focusing on climate change: “Union policy on the environment shall contribute to...promoting measures at international level to deal with regional or worldwide environmental problems, and *in particular combating climate change*”³⁶ (emphasis added). If, moreover, this activism is seen in the context of the Lisbon Treaty’s provisions on the Union’s external action³⁷, then Article 21(2) (f) TEU acquires a special importance: “The Union shall define and pursue common policies and actions and shall work for a high degree of cooperation in all fields of international relations, in order to: help develop international measures to preserve and improve the quality of the environment and the sustainable management of global natural resources, in order to ensure sustainable development”³⁸.

Environmental activism, as described, should be distinguished from the concept of environmental leadership, as developed in international environmental law. Leadership in international environmental law appears to be a corollary of the common but differentiated responsibilities and respective capabilities (CBDRRC) principle, i.e. of the idea that developed countries should take the lead in making good environmental damage or combating environmental challenges, along the lines not only of their level of development, resources and capabilities, but also of the recognition that “the largest share of historical and current global emissions of greenhouse gases has originated in developed countries”³⁹. The UNFCCC, for instance, recognizes “the need for developed countries to take immediate action in a flexible manner on the basis of clear priorities as a first step towards comprehensive response strategies at the global, national and, where agreed, regional levels...with due consideration of their relative contributions to the enhancement of the greenhouse effect”⁴⁰. Further on, it commits developed countries to national policies and measures on the mitigation of climate change as a demonstration of leadership in modifying longer-term trends in anthropogenic emissions⁴¹. Interestingly, the Convention provides for a number of steps developed countries should take to assist

³³ See Chapter IV.

³⁴ See Article 3(5) TEU.

³⁵ See Article 174 EC.

³⁶ See Article 191(1) TFEU.

³⁷ See Title V, Chapter 1 TEU.

³⁸ For an account of EU environmental policy after the Lisbon Treaty, see Benson and Jordan, “A Grand Bargain or an “Incomplete Contract”? European Union Environmental Policy after the Lisbon Treaty”, (2008) *European Energy and Environmental Law Review*, 280-290.

³⁹ See Preamble to the UNFCCC. On this point, see also Abeyratne, “Environmental Prospects for the Air Transport Industry”, 40/6 *Environmental Policy and Law* (2010), 319-328.

⁴⁰ See Preamble to the Convention.

⁴¹ See Article 4(2) (a).

developing countries in their needs and commitments⁴². Arguably, the classification by the EU Charter of Fundamental Rights of environmental protection among the solidarity provisions, might point to a certain affinity between the principle of CDDRRC and the principle of solidarity.

The environment has always been an area of shared competence between the Union and the Member States⁴³. The UNFFCC and the Kyoto Protocol thereto have, therefore, been adhered to by both the Union and the Member States. The assumption under the Kyoto Protocol of concrete and time-defined commitments to combat climate change in particular led to the establishment of the EU emissions trading scheme (EU ETS) by Directive 2003/87/EC. Emissions trading was seen as the most cost-effective and economically efficient manner to meet the Kyoto targets⁴⁴. The scope of the scheme was initially limited to the industry and energy sectors. Transport, in particular, was exempted therefrom, despite its significant environmental footprint⁴⁵. Arguably, this exemption, as far as air transport is concerned, was not necessarily dictated by the Kyoto Protocol, since the latter does not object to domestic aviation emissions being restricted.

The policy choice of the EU and its Member States at the time not to subject air transport in particular to the EU ETS is to be attributed to the active involvement of ICAO in the development of an emissions trading system for international aviation. Cooperation between the Commission and the Member States and ICAO on this issue dates from 1997, when the Kyoto Protocol was agreed⁴⁶. In 2001, the 33rd ICAO Assembly endorsed the development of an “open emissions trading system”⁴⁷ for international aviation and requested the Council to develop guidelines, as a matter of priority, focusing on establishing the structural and legal basis for aviation’s participation. Nevertheless, at the 6th meeting of the ICAO Committee on Aviation Environmental Protection in 2004, it was agreed that an aviation-specific emissions trading system based on a new legal instrument under ICAO auspices “...seemed sufficiently unattractive that it should not be pursued further”⁴⁸. Instead, at its 35th Assembly session held later in 2004, ICAO adopted Resolution A-35-5, whereby it advanced two approaches, namely a voluntary trading system and the incorporation of emissions from international aviation into Member States’ ETs consistent with the UNFCCC process. ICAO Member States were, as a result, called on to “refrain from unilateral implementation of greenhouse gas emissions charges”⁴⁹. In view of this development, in 2005 the Commission adopted a Communication, proposing the inclusion of emissions from international aviation in the EU ETS⁵⁰. The strategy set out by the Commission for tackling aviation’s contribution to climate change found

⁴² See, for instance, Article 4(3) et seq.

⁴³ See Article 4(2) (e) TFEU.

⁴⁴ See paragraph 5 of the Preamble to the Convention, in conjunction with Article 1 of the Directive.

⁴⁵ See paragraph 25 of the Preamble, in conjunction with Article 2 of the Directive.

⁴⁶ See, in this respect, and generally on the reasons behind the inclusion of aviation in the EU ETS: Calleja Grespo and Crompton, “The European Approach to Aviation Emissions Trading – Speak the Truth and Shame the Devil”, 21(3) *The Air & Space Lawyer* (2007), 16-22.

⁴⁷ I.e. ability to trade allowances with other industrial sectors.

⁴⁸ Ibid, see also paragraph 9 of Directive 2008/101/EC.

⁴⁹ See Appendix I, para. 2(b) (4).

⁵⁰ Communication of 27 September 2005, “Reducing the Climate Change Impact of Aviation”, COM (2005) 459.

the Council and the Parliament in agreement⁵¹. The green light was, thus, granted to the Commission to proceed with the preparation of a legislative proposal⁵².

The Commission had the opportunity to present its proposal, adopted in December 2006 and accompanied by an impact assessment, at the 36th Session of the Assembly of ICAO⁵³. The grounds on which the Commission justified its consideration of expanding the scope of the EU ETS to cover emissions from international aviation⁵⁴, evidently, did not convince ICAO, which resolved at its 36th Assembly in 2007 that its Member States should abstain from implementing an ETS on other Member States' aircraft operators except on the basis of mutual agreement⁵⁵. This outcome, widely perceived as a "stalemate" on emissions⁵⁶, prompted the EU Member States and 15 other European States to record their reservation to the Resolution. Recalling that the Chicago Convention recognizes expressly the right of each contracting party to apply on a non-discriminatory basis its own air laws and regulations to the aircraft of all States, the EU Member States and the 15 other European States reserved their right to enact and apply market-based measures on a non-discriminatory basis to all aircraft operators of all states providing services to, from or within their territory⁵⁷. This is, more or less, the background against which Directive 2008/101/EC including aviation activities in the EU ETS was adopted.

2. *Air Transport Association of America (ATA) et al v. UK* – A challenge to the validity of Directive 2008/101/EC

The decision of the EU to extend the scope of the EU ETS necessitated the amendment of the original Directive 2003/87/EC to reflect the reality of the aviation industry. Directive 2008/101/EC encompasses the amendments to Directive 2003/87/EC and has, therefore, to be seen in conjunction with the latter⁵⁸.

Directive 2008/101/EC refers to "aviation activities", defined as "flights which depart from or arrive in an aerodrome situated in the territory of a Member State to which the Treaty applies"⁵⁹. Subject to the scheme are, therefore, not only European airlines but also third country airlines. Nevertheless, where a third country has adopted measures to reduce the climate change impact of aviation, flights arriving from that country are,

⁵¹ See paragraph 12 of Directive 2008/101/EC.

⁵² Ibid.

⁵³ For an assessment of the proposal, see Kaminskaite-Salters, "Expansion of the EU ETS: the case of emissions trading for aviation" in Climate change and emissions trading: lessons for theory and practice, Faure, Michael (ed), 2008, Cheltenham (etc.) Elgar. For an economic assessment, see Anger and Köhler, "Including aviation emissions in the EU ETS: Much ado about nothing?", 17 Transport Policy (2010), 38-46.

⁵⁴ On this point, see Abeyratne, "The New Emissions Trading Scheme: Airlines – Is it extraterritorial?", 38/3 Environmental Policy and Law (2008), 155-160.

⁵⁵ See Appendix L to Resolution A 36-22.

⁵⁶ See, for instance, Truxal, "The ICAO Assembly Resolutions on International Aviation and Climate Change: An Historic Agreement, a Breakthrough Deal, and the Cancun Effect", 36(3) Air & Space Law (2011), 217-242.

⁵⁷ See paragraph 9 of Directive 2008/101/EC.

⁵⁸ To be mentioned that as of 1 January 2013 both Directives will have to be amended in accordance with Directive 2009/29/EC of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the GHG emission-allowance trading scheme of the Community, OJ L 140/63, 05.06.2009.

⁵⁹ See Article 3a, in conjunction with Annex I.

in principle, excluded⁶⁰. Aircraft operators are subject to the scheme with regard to their CO₂ emissions only⁶¹.

As a “cap-and-trade” system, the scheme is based on the allocation of allowances, sufficient to cover up to a certain amount of historical emissions, i.e. emissions realized in the period 2004-2006⁶². The scheme is divided into periods of application. During the first year of its application, the allowances to be allocated will be equivalent to 97% of the historical aviation emissions⁶³. The proceeds from the auctioning of allowances should be used to combat climate change⁶⁴. The administration of the scheme is entrusted to the Member States and supervised by the Commission⁶⁵. The administering Member State in respect of European airlines is the Member State that issued its operating licence⁶⁶, whilst the administering Member State in respect of a third country airline is the State where the airline flies the most⁶⁷. The number of allowances allocated to each operator for each period is based on verified tonne-kilometres data reported by that operator relating to its aviation activities in the relevant reference year⁶⁸. Once-per-year operators surrender a number of allowances equal to their total emissions during the preceding calendar year⁶⁹. Emissions are a function of fuel consumption⁷⁰. An excess emissions penalty is imposed, amounting to € 100 per tonne of CO₂, whilst failure to comply may result even in an operating ban⁷¹. Although allowances allocated to the aviation sector can only be traded within the aviation sector⁷², provision of allowances from other sectors is permitted⁷³. Lastly, operators may avail themselves of project credits from the Joint Implementation or Clean Development Mechanism (JI/CDM) provided for in the Kyoto Protocol.

In December 2009, the Air Transport Association of America (now renamed “Airlines for America” (A4A)) and a number of American airlines brought an action in the High Court of Justice of England and Wales against the measures adopted by the UK to implement the Directive – the UK being their administering Member State for the purposes of the application of the EU ETS. The applicants claimed that the Directive was unlawful in the light of international treaty law and customary international law. In view of the complexity of the legal issues at stake, the English Court stayed the proceedings and in July 2010 referred a number of questions to the Court of Justice for a preliminary ruling.

By and large, the national court wanted to know whether the application of the Directive on an extraterritorial basis encroaches upon: 1. national sovereignty; 2.

⁶⁰ See Article 25a.

⁶¹ See Article 1(3) (b), in conjunction with Annex I.

⁶² See Article 1(s).

⁶³ See Article 3d (1) and 3d (2), in conjunction with Article 3e (1).

⁶⁴ See Article 3d.

⁶⁵ See Article 3e.

⁶⁶ See paragraph 24 of the Preamble to Directive 2008/101/EC.

⁶⁷ See Article 18a.

⁶⁸ See Article 3e.

⁶⁹ See Article 12 (b).

⁷⁰ See Annex IV.

⁷¹ See Article 16.

⁷² See paragraph 27 of the Preamble to Directive 2008/101/EC.

⁷³ See Article 12 of Directive 2003/87/EC.

ICAO's exclusive competence to regulate emissions of international aviation; 3. the rule that air transport charges will only represent consideration for services provided; and, 4. the prohibition of tax on aviation fuel.

Concerning the issue of national sovereignty, the national court asked the Court of Justice to examine the validity of the Directive against:

1. the principles of customary law:
 - a. that each State has complete and exclusive sovereignty over its airspace;
 - b. that no state may validly purport to subject any part of the high seas to its sovereignty;
 - c. of freedom to fly over the high seas; and
 - d. that aircraft overflying the high seas are subject to the exclusive jurisdiction of the country in which they are registered, save as expressly provided for by international treaty.
2. The 1944 Convention on International Civil Aviation (i.e. the Chicago Convention), which provides that:
 - a. "[...] every State has complete and exclusive sovereignty over the airspace above its territory"⁷⁴;
 - b. "[...] the laws and regulations of a Contracting State relating to the admission to or departure from its territory of aircraft engaged in international air navigation, or to operation and navigation of such aircraft while within its territory, shall be applied to the aircraft of all contracting States..."⁷⁵; and
 - c. "[...] over the high seas the rules in force shall be those established under the Convention"⁷⁶.
3. The EU-US Open Skies Agreement, to the extent it replicates the Chicago Convention's admission and departure rules⁷⁷.

Concerning ICAO's exclusive competence to regulate emissions from international aviation, the national court called on the Court of Justice to examine the validity of the Directive against:

1. the Kyoto Protocol, which provides that: "The Parties...shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation...bunker fuels working through the ICAO..."⁷⁸;
2. The EU-US Open Skies Agreement, which provides that: "when environmental measures are established, the aviation environmental standards adopted by the ICAO...shall be followed except where differences have been filed..."⁷⁹.

Concerning the prohibition of charges that do not constitute consideration for the services provided, the national court called on the Court of Justice to examine the validity of the Directive against:

⁷⁴ See Article 1.

⁷⁵ See Article 11.

⁷⁶ See Article 12.

⁷⁷ See Article 7 EU-US Open Skies Agreement, in conjunction with Article 11 Chicago Convention.

⁷⁸ Article 2(2).

⁷⁹ See Article 15(3).

1. the Chicago Convention, which provides that: “ [...] Any charges that may be imposed ...for the use of such airport and ANSs...shall be published and communicated to the ICAO. No fees, dues or other charges shall be imposed...in respect solely of the right to transit over or entry into or exit from its territory of any aircraft of a contracting State...”⁸⁰; or

2. the Chicago Convention in conjunction with the Open Skies Agreement, to the extent the latter echoes the former⁸¹.

Concerning the prohibition of tax on aviation fuel, the national court called on the Court to examine the validity of the Directive against:

1. the Chicago Convention, which provides that: “...fuel...on board an aircraft of a contracting state, on arrival in the territory of another contracting state and retained on board on leaving the territory of that state shall be exempt from customs duty, inspection fees or similar national or local duties and charges...”⁸²; or,

2. the Chicago Convention, in conjunction with the EU-US Open Skies Agreement, to the extent the latter echoes the former⁸³.

The Court delivered its judgment in December 2011⁸⁴, a mere 43 days after Advocate General Kokott had opined in favour of the validity of the Directive⁸⁵ and a mere 10 days before the entering into force of the Directive. In a judgment that looks like a somewhat condensed version of the AG’s Opinion⁸⁶, the Court concluded that: “Examination of Directive 2008/101/EC has disclosed no factor of such a kind as to affect its validity”.

Although the Court considered that it was only competent to assess the validity of the Directive against the first three aforementioned principles of customary law and some provisions of the EU-US Open Skies Agreement – its competence being defined by the applicants’ *locus standi* in the main proceedings, that is to say, their ability to invoke provisions of international law – in effect it tackled all issues at stake.

With regard to the violation of the principle of national sovereignty due to the extraterritorial application of the EU ETS, the Court dismissed such an allegation on the grounds that the application of the Directive is only triggered when a third country airline touches European ground, i.e. departs from or arrives in an EU aerodrome. The Court considered that this requirement constitutes an adequate territorial link to subject third country airlines to the unlimited jurisdiction of the EU. It further justified the territorial scope of the Directive, which extends beyond the boundaries of EU airspace, over the high seas and third country territory, on the basis of EU policy on the environment, which “seeks to ensure a high level of protection”. Therefore, no

⁸⁰ See Article 15.

⁸¹ See Article 15 Chicago Convention, in conjunction with Article 3(4) and Article 15(3) of the Open Skies Agreement.

⁸² See Article 24.

⁸³ See Article 24 Chicago Convention, in conjunction with Article 11 (2) (c) of the Open Skies Agreement.

⁸⁴ Supra note 7.

⁸⁵ Opinion of Advocate General Kokott of 6 October 2011.

⁸⁶ For a comparison thereof, see Havel & Mulligan, “The triumph of Politics: Reflections on the Judgment of the Court of justice of the European Union Validating the Inclusion of Non-EU Airlines in the Emissions Trading Scheme”, 37(1) Air & Space Law 37 (2012), 3-33.

element of invalidity was detected, the proportionality check was deemed to have been met.

Regarding ICAO's role in regulating emissions from international aviation, it must be noted that the decision of the Court not to examine the validity of the Directive in the light of the Kyoto Protocol and, specifically, Article 2(2) thereof, resulted in the Court looking only at Article 15(3) of the Open Skies Agreement, which provides that: "when environmental measures are established, the aviation environmental standards adopted by the ICAO in annexes to the Convention shall be followed except where differences have been filed". The Court did not consider the absence of such environmental standards as an indirect but effective prevention of action on behalf of the Member States. Instead, it inferred from ICAO Resolution A 37-19 (which, in its annex, provides guiding principles for the design and implementation of market-based measures) the competence of the EU to proceed with the adoption of the ETS. In view of the fact that the EU ETS was found to be in line with ICAO's guidance, the Court pronounced the validity of Directive 2008/101/EC on those grounds also.

Lastly, with regard to the allegation that the EU ETS, to the extent it calculates emissions on the basis of fuel consumption, infringes the prohibition of any type of tax on fuel, the Court pointed to the architecture of the EU ETS as a market-based measure. It therefore found that "there is no direct and inseverable link between the quantity of fuel held or consumed...and the pecuniary burden on the aircraft's operator in the context of the allowance trading scheme's operation". The Court specifically focused on the price of allowances, which is not predetermined, but is a function of market forces, to rule out any parallel between the EU ETS and a duty, tax, fee or charge.

IV. Consequences of inclusion of aviation in the EU ETS for innovation

The inclusion of international aviation in the EU ETS has, admittedly, given rise to a groundswell of opposition not only from the industry, but also from the international community⁸⁷. It is hard to think of another instance in the history of civil aviation, where a regulatory initiative at a regional level has caused such a turbulence. Arguably, even the creation of the single European air transport market in the 1990s, which necessitated the renegotiation of several hundreds of bilateral air services agreements which the Member States had signed with third countries, proved to be an

⁸⁷ See, for instance, the Joint Declaration of 21 sovereign countries, among which China, Russia and the United States, against the inclusion of aviation in the EU ETS, adopted at New Delhi on 30 September 2011 and subsequent action by the ICAO Council in response, culminating in Working Paper C-WP/13790, available at:

http://www.greenaironline.com/photos/ICAO_C.194.WP.13790.EN.pdf. See also the EU Emissions Trading Scheme Prohibition Act 2011 (HR) 2492, adopted on 24 October 2011 by the US House of Representatives, prohibiting US airlines from participating in the EU ETS, available at:

<http://thomas.loc.gov/cgi-bin/bdquery/z?d112:hr2594>. In this respect, see also A4A Press Release of 31.07.2012: "A4A commends Senate Commerce Committee for EU ETS Bill Approval", at:

http://www.airlines.org/Pages/news_7-31-2012.aspx; A4A Press Release of 22.09.2012: "A4A applauds Senate passage of Bill that enables US airlines to refrain from participation in the EU ETS", at: http://www.airlines.org/Pages/news_9-22-2012.aspx. The threat of a trade war has been expressed actively by China, who suspended approval for US \$ 12 billion worth of Airbus orders. Airbus estimates that this will jeopardize more than 1,000 Airbus jobs in Europe and at least another 1,000 in the supply chain. See Airbus Press Release of 12.03.2012: "Stop ETS trade conflict", available at: <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/stop-ets-trade-conflict/>.

easier task and, most importantly, was never seriously questioned for its compliance with international law⁸⁸. In this sense, the EU ETS saga is slightly more complicated than the open skies saga of the past decade⁸⁹. Nevertheless, a closer look at the picture would reveal a dimension that could hardly be negated: never before has the industry been so united around one single mission: innovation.

It is an open secret that the sector of air transport is plagued with very low profit margins⁹⁰. Operating at a profit without any government backing is a herculean task⁹¹. The industry is, therefore, very resistant to any form of taxation that could further reduce its profitability⁹². At the same time, it appears cognizant of its environmental footprint and its obligation to internalize the cost of reducing that footprint. This is

⁸⁸ On Open Skies judgments, see Heffernan and McAuliffe, “External Relations in the Air Transport Sector: The Court of Justice and the Open Skies Agreements”, 28(5) European Law Review (2003), 601-919; Laer, “The ECJ Decisions: ‘Blessing is Disguise’?”, 30/1 Air and Space Law (2006), 19-49; Mendelsohn, “The USA and the Eu – Aviation Relations: An Impasse or an Opportunity?”, 29/4-5 Air and Space Law, 263-279; Sørensen, van Weert and Lu, “ECJ Ruling on Open Skies Agreements v. Future International Air Transport”, 28(1) Air and Space Law (2003), 3-18; Wassenbergh, “A Mandate to the European Commission to Negotiate Air Agreements with Non-EU States: International Law versus EU Law”, 28/3 Air and Space Law (2003), 139-146.

⁸⁹ Indisputably, the open skies judgments of the Court had, at the time, raised immense opposition, especially from the United States. Nevertheless, the international community had not opposed the creation of the single European air transport market in the 1990s and, most importantly, the conferral of Member State power on the Community, or in other words, the international community had accepted the *acquis communautaire* (expressed, in this case, in the form of Community competence in certain air transport issues) and, consequently, the associated jurisdiction of the European Courts. This fact alone is sufficient to distinguish between the open skies saga and the EU ETS saga. This is so for the EU ETS exceeds the boundaries of the Union, unduly interfering with international law and third country law. It is clear that the EU does not have any competence stemming from either EU law or international law to act in this manner. Whilst in the open skies case failure to replace the nationality clauses with Community clauses would nullify the freedom of establishment, in the EU ETS case, restriction of the scope of the scheme within the boundaries of the Union would not violate any provision of any order of law. It might be claimed that it would jeopardize the effectiveness of the scheme, which might be true, but this reality does not vest the EU with global powers in the field of air transport and the environment.

⁹⁰ In Warren Buffet’s words: “The worst sort of business is one that grows rapidly, requires significant investment to engender the growth and then earns little or no money. Think airlines”. See Warren Buffet’s letter of February 2008 to the shareholders of Berkshire Hathaway, available at: <http://www.berkshirehathaway.com/letters/2007ltr.pdf>.

⁹¹ Aviation ranks third among the industries that contribute most to the US economy, behind energy and farming. Yet, among the 53 principal industries that make up the nation’s economy, Fortune magazine ranked airlines last in profitability. See: <http://stopairtaxnow.com/>.

⁹² See, e.g. airberlin Press Release of 11.11.2011: “Mehdorn demands immediate abolition of aviation tax”, at: http://www.airberlin.com/en-GB/site/pressreleases_dr.php?ID=3964; Ryanair Press Release of 17.11.2011: “Airlines Urge Chancellor to axe the Tax”, at: <http://www.ryanair.com/en/news/airlines-urge-chancellor-to-axe-the-tax>; Newcastle International Airport Press Release of 25.11.2011: “‘Punitive’ air tax hike is ‘worst thing the Government could do’ for Newcastle say local businesses”, at: <http://www.newcastleairport.com/Newsroom/Press/PunitiveAitTaxHikeWorstThingGovernmentCouldDo.htm>; British Airways Press Release of 06.12.2011: “British Airways’ statement on APD”, at: <http://press.ba.com/?p=2006>; BAR UK Press Release of 06.12.2011: “Consultation on Air Passenger Duty a complete waste of time”, at: http://www.bar-uk.org/press/press_2011.htm; Flybe Press Release of 06.12.2011: “Flybe response to Treasury Air Passenger Duty (APD) consultation”, at: <http://www.flybe.com/corporate/media/news/1112/06.htm>; easyJet Press Release of 30.12.2011: “Airline CEOs’ call for APD injustice to end as ETS takes effect”, at: <http://corporate.easyjet.com/media/latest-news/news-year-2011/30-12-2011-en.aspx>; airberlin Press Release of 26.06.2012: “Aviation tax: airberlin calls for immediate implementation of responsible corrective measures”, at: http://www.airberlin.com/en-DE/site/pressnews_dr.php?ID=3980.

why it has expressed itself in favour of market-based measures as a means to address climate change, as opposed to environmental taxes. Nevertheless, the fact remains that even market-based measures, of which emissions trading schemes are an example, come at a cost. The realization that the only way to escape this cost without compromising growth is via innovation has brought together all industry stakeholders, from airlines to aircraft manufactures and from air navigation service providers to airports, in an effort to de-carbonise air transport.

1. International Civil Aviation Organisation (ICAO)

ICAO plays the role of the conductor in this process⁹³. Its aims and objectives, which are generally “to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport”⁹⁴, are further elucidated in its Business Plan. The protection of the environment constitutes one of its strategic objectives, addressed by means of a specific action plan⁹⁵. Technical work on measures to reduce the environmental effects of aviation is pursued by ICAO’s Committee on Aviation Environmental Protection (CAEP). Over the past 40 years, the Committee has been active in minimizing the impact of aircraft noise and aircraft engine emissions through technological, operational and market-based measures⁹⁶.

Recently, in July 2012, CAEP agreed on a CO₂ metric system which characterizes the CO₂ emissions for aircraft types with varying technologies⁹⁷. This is the first step towards a CO₂ standard for civil aviation. The aim of the standard is to drive aircraft manufacturers towards more CO₂ efficient aircraft, more fuel-efficient engines or innovations, such as improved aerodynamics or advanced materials⁹⁸. The standard is expected to be fully developed by the end of 2013, following the necessary certification and regulatory procedures. ICAO did not omit to state that: “That ICAO was able to achieve consensus between the states who serve on the CAEP, in addition to the major airlines, aircraft manufacturers, environmental NGOs and other stakeholders who serve as observers to this process, highlights that there is a great deal of motivation in every quarter of our sector to achieve real progress on aviation environmental performance”⁹⁹. CAEP has also recommended more stringent Nitrogen Oxides (NO_x) standards for new aircraft engines certified after 31 December 2013.

As already mentioned, the 36th Session of the ICAO Assembly failed to devise a global emissions trading scheme, something which prompted the EU to adopt Directive 2008/101/EC. Nevertheless, the pressure exerted on ICAO to provide

⁹³ On the role of ICAO in general, see Abeyratne, “The role of the ICAO in the twenty-first century”, 34 *Annals of Air and Space Law* (2009), 529-544.

⁹⁴ See Article 44 of the Chicago Convention.

⁹⁵ *Ibid.*

⁹⁶ See, www.icao.int/environmental-protection/Pages/Assembly.aspx.

⁹⁷ See, ICAO News Release COM 15/12: “New progress on aircraft CO₂ standard”, at: <http://www.icao.int/Newsroom/Pages/new-progress-on-aircraft-CO2-standard.aspx>.

⁹⁸ See Airbus Press Release of 12 July 2012: “Airbus welcomes ICAO’s first steps towards a CO₂ standard”, at: <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-welcomes-icaos-first-steps-towards-a-co2-standard/>. See also IATA Press Release of 12 July 2012: “IATA welcomes ICAO progress on a CO₂ standard for aircraft”, at: <http://www.iata.org/pressroom/pr/pages/2012-07-12-01.aspx>.

⁹⁹ *Supra* note 95.

leadership resulted in the establishment of the so-called Group on International Aviation and Climate Change (GIACC), tasked with the development of the ICAO Programme of Action on International Aviation and Climate Change. The Programme of Action, adopted in October 2009, paved the way for the “breakthrough deal” achieved a year later at ICAO’s 37th Session of the Assembly, i.e. Assembly Resolution A37-19 on Climate Change¹⁰⁰. Recognising the impact of international aviation emissions on climate change, as well as the reality that emissions are bound to increase due to the growth of air transport¹⁰¹, Member States and the industry agreed to work through ICAO to achieve a global annual average fuel efficiency improvement of two per cent until 2020 and an aspirational global fuel efficiency improvement rate of two per cent per annum from 2021 to 2050. The welcoming of the Resolution as a “breakthrough deal” by the European Commission is not, of course, due to those targets, which, in any event, are by no means binding. The Resolution was perceived as a historical agreement for it marks a transition from a state of inertia, whereby ICAO had admitted its inability to devise a global ETS to a state of action, whereby ICAO undertook to develop a framework for market-based measures in international aviation. As a first step, a list of guiding principles was prepared to be considered by the 38th Session of the Assembly.

2. Aircraft Operators

Moving on to the airlines, who, by definition, have to shoulder a great deal of the burden the EU ETS entails¹⁰², their innovation efforts have been intense and in all possible directions. Unluckily, (and as a result of the Commission explicitly encouraging the cost pass through idea, whereby the cost for purchasing allowances is passed over to the customers¹⁰³), the immediate reaction of the airlines has been to introduce EU ETS passenger surcharges¹⁰⁴. Nevertheless, the airlines have also

¹⁰⁰ On this point, see Truxal, “The ICAO Assembly Resolutions on International Aviation and Climate Change: An Historic Agreement, a Breakthrough Deal and the Cancun Effect”, supra note 55; Adam, “ICAO Assembly’s Resolution on Climate Change: A “Historic” Agreement?”, 36(1) Air and Space Law 36, 23-29.

¹⁰¹ See, for instance, Airbus Press Release of 04.09.2012: “Demand spurs need for over 28,000 aircraft in the next 20 years”, at: <http://www.airbus.com/newsevents/news-events-single/detail/demand-spurs-need-for-over-28000-aircraft-in-the-next-20-years/>.

¹⁰² According to Directive 2008/101/EC: “aircraft operators have the most direct control over the type of aircraft in operation and the way in which they are flown and should therefore be responsible for complying with the obligations imposed by this Directive...”, at para. 15.

¹⁰³ See MEMO/11/631, 26.09.2011. For a criticism of EU ETS, see Burleson, “The EU Emissions Trading System Proposal – History after Rhymes”, 21(3) The Air and Space Lawyer (2007), 16-27.

¹⁰⁴ See, for instance, Lufthansa Press Release of 02.01.2012: “Surcharge for ETS certificates included in fuel surcharge at Lufthansa as of January 2012”, at: <http://presse.lufthansa.com/en/news-releases/singleview/archive/2012/january/02/article/2059.html>; Ryanair Press Release of 12.01.2012: “Ryanair to introduce € 0.25 ETS levy to cover new EU eco-looney tax”, at: <http://www.ryanair.com/en/news/ryanair-to-introduce-0-25-euro-ets-levy-to-cover-new-eu-eco-looney-tax>; Etihad Airways Press Release of 21.02.2012: “Etihad Airways to increase surcharges to take account of EU carbon scheme”, at: <http://www.etihadairways.com/sites/etihad/eu/en/aboutetihad/mediacenter/newslisting/newsdetails/Pages/etihad-to-increase-surcharge-regarding-eu-carbon-scheme-feb12.aspx?fromNewsListing=false>; Air Transport News, 16.02.2012: “As part of its anticipation in the EU emissions trading system, Adria Airways is introducing an extra charge on its direct flights, namely €1 per flight”, at: <http://airtransportnews.aero/article.pl?mcat=&id=35064>; Virgin Australia Press Release of 28.02.2012: “Virgin Australia advises on surcharges in response to carbon pricing schemes”, at:

invested in more fuel-efficient aircraft, modernizing their fleet¹⁰⁵. Fuel efficiency has been further enhanced in manifold ways. For instance, airlines have espoused a more refined approach to aircraft loading, increased the frequency of engine washes and optimized their flight times¹⁰⁶. At the same time, pilots have engaged in green navigation, opting for continuous descent operations. During a so-called continuous descent approach (CDA) procedure, the aircraft descends continuously, avoiding level flight prior to the final approach and requires less engine thrust and therefore less fuel burn¹⁰⁷. Airlines have also partnered with air navigation authorities to achieve the most eco-efficient flight routings. High precision navigation, referred to as Performance-Based Navigation (PBN)¹⁰⁸ enables pilots to fly aircraft using radar or satellite coverage, or by using the on-board flight management system. Flight management systems onboard aircraft can determine the most efficient cruise altitude and speed to optimize fuel burn¹⁰⁹. PBN allows shorter, more direct routes that reduce flight time and fuel consumption and result in fewer carbon emissions¹¹⁰.

<http://www.virginaustralia.com/au/en/about-us/media/2012/SURCHARGES-RESPONSE-CARBON/>; SAA Press Release of 18.06.2012: “SAA to raise surcharge to comply with EU emissions trading scheme”, at: <http://www.flysaa.com/us/en/flyingSAA/News/SAA-to-raise-surcharge-to-comply-with-EU-Emissions-Trading-Scheme.html>.

¹⁰⁵ See, for instance, Air France-KLM Press Release of 15.02.2012: “Grenelle Environment Agreement: Air France takes stock of its environmental commitments”, at: <http://corporate.airfrance.com/en/press/press-releases/article/item/grenelle-de-lenvironnement-air-france-dresse-le-bilan-de-ses-engagements-environnementaux/>; Estonian Air Press Release of 09.11.2011: “Estonian Air renewing its fleet with more economical and ecological aircraft”, at: <http://estonian-air.com/en/about-us/news/press-releases/estonian-air-renewing-its-fleet-with-more-economical-and-ecological-aircraft/>; Ethiopian Airlines Press Release of 17.02.2012: “Ethiopian Airlines places firm order for five Q400 NextGen”, at: <http://www.ethiopianairlines.com/en/news/prarchive.aspx?id=295>.

¹⁰⁶ See, for instance, airberlin Press Release of 24.02.2012: “Fuel efficiency: airberlin achieves new record”, at: http://www.airberlin.com/en-DE/site/pressnews_dr.php?ID=3677; Emirates Press Release of 07.06.2012: “Emirates fleet continues to lead airline industry in fuel efficiency”, at: http://www.emirates.com/br/portuguese/about/news/news_detail.aspx?article=888781; Etihad Airways Press Release of 21.02.2012: “Etihad Airways introduces lightweight cargo containers”, at: <http://www.etihadairways.com/sites/Etihad/eu/en/aboutetihad/mediacenter/newslisting/newsdetails/Pages/etihad-introduce-lightweight-cargo-containers-feb12.aspx?fromNewsListing=false>; Air Transport News 23.04.2012: “LOT Polish Airlines selects fuel efficiency software from Aviaso”, at: http://www.airtransportnews.aero/print_article.pl?id=36315; Lufthansa Press Release of 10.06.2012: “Balance 2012: Lufthansa Group reports efficiency record – Specific fuel consumption drops to 4,18 litres”, at: <http://www.mediterraneanews.com/index/2012/07/balance-2012-lufthansa-group-reports-efficiency-record-specific-fuel-consumption-drops-to-4-18-litres/>.

¹⁰⁷ See Airbus Press Release of 13.10.2011: “Air France and Airbus undertake green commercial flight”, at <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/air-france-and-airbus-undertake-green-commercial-flight/>.

¹⁰⁸ Or else: Required Navigation Performance – Authorisation Required approach (RNP-AR).

¹⁰⁹ See SESAR and the Environment, at: http://ec.europa.eu/transport/air/sesar/doc/2010_06_sesar_environment_en.pdf.

¹¹⁰ See, for instance, US FAA Press Release of 29.02.2012: “FAA to increase efficiency and reduce aircraft emissions in Atlanta and Charlotte airspace – Initiative is part of NextGen air traffic control modernization program”, at: http://www.faa.gov/news/press_releases/news_story.cfm?newsId=13375; Airbus Press Release of 24.05.2012: “Airbus and Etihad Airways begin full RNP-AR implementation at Abu Dhabi Terminal airspace”, at: <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-and-etihad-airways-begin-full-rnp-ar-implementation-in-abu-dhabi-terminal-airspace/>; NATS Press Release of 21.03.2012: “NATS 2012 corporate responsibility report lays out strategy for sustainable aviation in the UK”, at: <http://www.nats.co.uk/news/nats-2012-corporate-responsibility-report-lays-out-strategy-for-sustainable-aviation-in-the-uk/>; Swedavia Press Release of 11.05.2012: “Green flights from gate to gate with Green Connection”, at:

Considering that fuel represents 30-40% of airlines' operating costs¹¹¹, development of sustainable aviation biofuels is an area which has attracted a great amount of attention and funding on behalf of the airlines. The principle behind biofuels is based on the carbon cycle. Plants withdraw CO₂ from the atmosphere through photosynthesis. When aircraft engines burn biofuel, this CO₂ is released back into the atmosphere. Biofuel emits about 50% less CO₂ than conventional fossil fuels¹¹². Biofuels are further encouraged by the EU ETS, which considers them to be zero emissions for compliance purposes. To the extent biofuels are used by airlines, aircraft operators do not need to surrender any allowances or international credits in respect of the proportion of biofuels used during their flights¹¹³. Arguably, this arrangement is aimed at the fact that biofuels are not yet commercially viable, their production being still limited and their price non-competitive. Aircraft operators have, therefore, teamed up with all parts of the supply chain to accelerate the commercialization of biofuels. Today, R&D in biokerosene is widespread¹¹⁴, resulting in global fuel standard-setting bodies certifying that biofuels combined with conventional kerosene at a maximum ratio of 50:50 can be used in place of pure kerosene¹¹⁵. Ever since, thousands of flights have been operated on biofuels in almost all continents and even transcontinentally¹¹⁶.

<http://www.mynewsdesk.com/pressroom/swedavia/news/view/green-flights-from-gate-to-gate-with-green-connection-403>; Jet Blue Airways Press Release of 20.06.2012: "JetBlue Airways becomes first FAA-certified carrier to fly special (non-public) RNP AR approaches with Airbus A 320 fleet at New York's JFK Airport", at: <http://investor.jetblue.com/phoenix.zhtml?c=131045&p=irol-newsArticle&ID=1706795&highlight=>.

¹¹¹ See, e.g. Air Transport News, 11.04.2012, 2012 Aviation & Environment Summit, Reports, at: [http://www.airtransportnews.aero/analysis.pl?id=1209&keys=2012 Aviation & Environment Summit](http://www.airtransportnews.aero/analysis.pl?id=1209&keys=2012%20Aviation%20&Environment%20Summit).

¹¹² See Lufthansa Press Release of 09.01.2012, "Practical trial of biosynthetic fuel at Lufthansa successful", at: <http://presse.lufthansa.com/en/news-releases/singleview/archive/2012/january/09/article/2061.html>.

¹¹³ See European Commission MEMO/11/631, 26 September 2011.

¹¹⁴ See, e.g. Boeing Press Release of 26.10.2011: "Boeing, Embraer and Sao Paulo Research Foundation to lead aviation biofuels program in Brasil", at: <http://www.prnewswire.com/news-releases/boeing-embraer-and-sao-paulo-research-foundation-to-lead-aviation-biofuels-program-in-brazil-132628443.html>; A4A Press Release of 23.05.2012: "A4A lauds the formation of Midwest aviation sustainable biofuels initiative", at http://www.airlines.org/Pages/news_5-23-2012.aspx; Airbus Press Release of 21.03.2012: "Airbus and Virgin Australia study new alternative fuel process", at: <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-and-virgin-australia-study-new-alternative-fuel-process/>; United Continental Holdings Press Release of 23.05.2012: "Aviation and clean technology leaders launch Midwest aviation sustainable biofuels initiative", at: <http://airtransportnews.aero/article.pl?mcatgeg=&id=36963>; Qantas Press Release of 13.04.2012: "Qantas announces feasibility study for sustainable aviation", at: <http://airtransportnews.aero/article.pl?mcatgeg=&id=36159>.

¹¹⁵ See Thai Airways Press Release of 23.11.2011: "Thai launches biofuels flight and first biofuels passenger flights in Asia through Travel Green initiative", at: http://www.prthaiairways.com/thaiair_4p/front/news_detail.php?lg=en&dng=1335. See also Airbus Press Release of 22.03.2012: "Airbus, Boeing, Embraer collaborate on aviation biofuel commercialization", at: <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-boeing-embraer-collaborate-on-aviation-biofuel-commercialisation/>.

¹¹⁶ See e.g. Airbus Press Release of 13.10.2011: "Air France and Airbus undertake green commercial flight", at: <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/air-france-and-airbus-undertake-green-commercial-flight/>; Air Transport News, 10.11.2011: "Alaska Airlines' biofuel-powered service takes to the skies", at: <http://airtransportnews.aero/article.pl?mcatgeg=&id=33188>; Virgin Australia Press Release of 16.05.2012: "Virgin Australia launches Australian-first biodiesel trial at Brisbane Domestic", at: <http://www.virgin.com/people-and-planet/blog/virgin-australia-launches-biodiesel-trial-at-brisbane->

3. Aircraft Manufacturers

Aircraft manufacturers could not, for their part, have been left out of the innovation equation. The more airlines demand greener aircraft, the more eco-innovation constitutes for the manufacturers an issue of survival. Competition in aeronautics is fierce and investment in environmental R&D&I is colossal. New, more fuel-efficient, aircraft have entered the fleet, in each class, such as the Airbus A380, the Boeing 787 and the proposed new Bombardier C-series¹¹⁷. Engines account for about 70% of fuel efficiency¹¹⁸, manufacturers having also engaged in re-engining existing aircraft models. It is reported that there has been about 1% improvement in engine efficiency per year for the last 30-40 years¹¹⁹. Advanced aerodynamics is another factor contributing to fuel-burn improvement¹²⁰. The mere introduction of winglets, for instance, accounts for 4-6% fuel saving per flight, winglets also being capable of being adapted to the current fleet. Composite materials out of which new aircraft are made, such as carbon fiber reinforced plastic, are lighter than metal and more resilient¹²¹. Weight is a key factor in fuel consumption and, respectively, engine emissions. If one also takes into account that airport landing charges and air navigation services charges are often a function of aircraft weight, the incentive to lighten the aircraft is huge. R&D&I in new technologies has resulted in new aircraft being plastic and electric. Wireless technologies have removed kilometers of wire from the aircraft, devices have been miniaturized, engines have shrunk in size, taxiing is becoming greener¹²² and, if all of this is not evident to the average passenger, the

domestic-airport; Boeing Press Release of 17.04.2012: “Boeing, ANA celebrate first 787 biofuel flight”, at: <http://boeing.mediaroom.com/index.php?s=43&item=2220>; Bombardier Press Release of 17.04.2012: “Porter Airlines operates Bombardier Q400 aircraft in Canada’s first biofuel-powered revenue flight”, at: <http://www.bombardier.com/en/aerospace/media-centre/press-releases/details?docID=0901260d801fe509>; Etihad Airways Press Release of 25.01.2012: “Etihad Airways operates first biofuel powered delivery flight”, at: <http://www.etihadairways.com/sites/Etihad/ae/en/aboutetihad/mediacenter/newslisting/newsdetails/Pages/etihad-operate-first-biofuel-powered-delivery-flight-jan12.aspx>; Lufthansa Press Release of 09.01.2012: “Practical trial of biosynthetic fuel at Lufthansa successful”, at: <http://presse.lufthansa.com/en/news-releases/singleview/archive/2012/january/09/article/2061.html>.

¹¹⁷ See e.g. Boeing Press Release of 03.11.2011: “Boeing updates 737 MAX engine configuration status and customer commitments”, at: <http://boeing.mediaroom.com/index.php?s=43&item=2004>.

¹¹⁸ Supra note 111.

¹¹⁹ Ibid.

¹²⁰ See e.g. Boeing Press Release of 02.05.2012: “Boeing designs advanced technology winglet for 737 MAX”, at: <http://boeing.mediaroom.com/index.php?s=43&item=2246>; Air Transport News, 04.09.2012: “First A 350 XWB wing arrives in Toulouse for ground tests”, at: http://www.airtransportnews.aero/print_article.pl?id=38785.

¹²¹ See e.g. EADS Press Release of 23.05.2012: “Eurocopter delivers the first Airbus A350 XWB jetliner passenger door, highlighting its innovative capabilities in composite technology”, at: http://www.eurocopter.com/site/en/press/Eurocopter-delivers-the-first-Airbus-A350-XWB-jetliner-passenger-door-highlighting-its-innovative-capabilities-in-composite-technology_919.html?iframe=true&width=700.

¹²² See, e.g. easyJet Press Release of 09.02.2012: “EasyJet first airline to trial electric green taxiing system by Safran and Honeywell”, at: <http://corporate.easyjet.com/media/latest-news/news-year-2012/09-02-2012-en.aspx>; Lufthansa Technic Press Release of 10.07.2012: “TaxiBot: from the gate to the runway without using the engines”, at: http://verantwortung.lufthansa.com/en/news/singleview/archive/2012/july/article/59.html?tx_ttnews%5Bday%5D=10; European Commission Press Release IP/12/792, 16.07.2012, “Mergers: Commission approves creation of TaxiBot joint venture by EADS and Israel Aerospace Industries”. Airbus Press Release of 06.07.2011: “Airbus and German Aerospace Centre (DLR) perform research tests for fuel

same could not be said of the slim-line seats installed on a number of aircraft or, even, the light-weight trolleys that make air hostesses' lives easier and the serving of passengers faster.

Rising fuel prices have rendered alternative aviation fuels a real challenge for the industry and manufacturers have been explicit as to their “goal to have in place a value chain in every continent”¹²³. Aeronautics has always been at the cutting edge of technology, yet biofuels are perceived by the industry as a game changer. Manufacturers have, as a result, been at the forefront of their development and certification¹²⁴. Flight tests show that biofuels perform as well as or better than kerosene-based jet fuel¹²⁵, something that has encouraged the use of biofuels in commercial passenger flights. Manufacturers are monitoring the fuel properties to study their long-term impact on aircraft performance, including on the maintenance and lifespan of aircraft engines¹²⁶. What is crucial is that the industry underscores on every occasion that it is not only focused on the development and commercialization of biofuels, but also on their sustainability, “on creating sustainable aviation biofuels produced from renewable resources that do not drive food competition in vulnerable regions by competing with land and water resources”¹²⁷.

4. Air Navigation Service Providers (ANSPs)

Key stakeholders in the battle against climate change are the Air Navigation Service Providers (ANSPs). Air traffic control is an essential feature of air transport, yet technological progress and the exponential growth of air transportation have largely surpassed the current infrastructure. Congestion is not only experienced on the ground, at large airport hubs, but also in the skies. Whilst, at first sight, the capacity of the skies appears virtually unlimited, in reality it largely depends on the available technologies and the way they are deployed.

The right to complete and exclusive sovereignty over the airspace above a country's territory, enshrined in Article 1 of the Chicago Convention, has naturally led to a fragmented system, whereby air navigation is organized at a national level. Each time

cell powered autonomous taxiing”, at: <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-and-german-aerospace-centre-dlr-perform-research-tests-for-fuel-cell-powered-autonomous-taxi/>.

¹²³ See e.g. Air Transport News, 21.03.2012: “Airbus and Virgin Australia study new alternative fuel process”, at: <http://airtransportnews.aero/article.pl?mcateg=&id=35665>.

¹²⁴ See Air Transport News 2011 Review, p. 12, at: <http://www.airtransportnews.aero/content/c1194.pdf>.

¹²⁵ See Air Transport News, 26.10.2011: “Boeing, Embraer and Sao Paulo Research Foundation to lead aviation biofuels program in Brazil”, at: <http://airtransportnews.aero/article.pl?mcateg=&id=32853>.

¹²⁶ Air Transport News, 2011 Review, at p. 12, at: <http://airtransportnews.aero/content/c1194.pdf>.

¹²⁷ See Boeing Press Release, of 26.10.2011: “Boeing, Embraer and São Paulo Research Foundation to lead aviation biofuels program in Brazil”, at: <http://www.prnewswire.com/news-releases/boeing-embraer-and-sao-paulo-research-foundation-to-lead-aviation-biofuels-program-in-brazil-132628443.html>. See also Hawai'i BioEnergy Press Release of 10.11.2011: “Boeing and Hawai'i BioEnergy to work on renewable biofuel for aviation”, at: <http://www.hawaii.bioenergy.com/boeing-and-hawaii%E2%80%99i-bioenergy-work-renewable-biofuel-aviation>, where it is stated that: “only plant sources that don't distort the global food chain, compete with fresh or crop water resources, or lead to unintended land use changes are being considered”. See also Embraer Press Release of 26.10.2011: “Embraer keeps its eyes on a greener future”, at: <http://www.embraer.com/en-US/ImprensaEventos/Press-releases/noticias/Pages/EMBRAER-MANTEM-O-FOCO-NAS-QUESTOES-AMBIENTAIS.aspx>.

an aircraft enters a national airspace, it is serviced by a different ANSP on the basis of different rules and operational requirements. Strikingly, the technology used to manage these operations has remained the same ever since the birth of civil aviation in the post World War II era. According to the Commission, in Europe air traffic management consists of hundreds of air traffic control sectors operated by more than sixty air traffic control centres and more than 16,700 air traffic controllers managing the traffic from and to 450 European airports and also from and to third countries. This complex structure manages more than 26,000 daily flights in the EU, accommodates approximately 38,000 daily flight hours and operates on a network of aviation routes still optimized at national level and not yet at European level¹²⁸.

In practice, this fragmentation, in conjunction with outdated radar-based technologies, has resulted in aircraft being assigned circuitous routings over direct ones, due to congested airways, as well as in delayed landings and departures. The problem of delays was initially felt at the level of passenger satisfaction. Very soon, though, it raised safety concerns and cost-efficiency considerations. Today, environmental protection has added another parameter to the problem, exemplified by the inclusion of aviation in the EU ETS. With ballooning fuel costs, and air navigation charges representing 6-10% of airlines' operating costs¹²⁹, air transport is becoming ever more expensive. The need for radical reform of the air traffic control system has been recognized by the aviation authorities around the world, who have embarked on an ambitious mission in the direction of a global seamless sky.

The most prominent efforts are probably being made in the European Union and the United States. More specifically, in the EU the Commission launched in 2000 its Single European Sky (SES) initiative¹³⁰, whose aim is to increase the capacity of the skies by organizing airspace and air navigation at a European level rather than at a local level¹³¹. As a first step to de-fragment airspace, Member States are under an obligation to establish "functional airspace blocks" (FABs). Member States have specifically undertaken to consolidate service provision across, all in all, nine FABs by the end of 2012¹³². This presupposes intense cooperation among the civil aviation

¹²⁸ See Report on the implementation of the SES legislation: time to deliver, COM (2011) 731 final, 14.11.2011.

¹²⁹ See European Commission MEMO/11/831, 25.11.2011. While the cost for the provision of air navigation services in Europe amounts to some € 8 billion per year, the total additional cost borne by airlines because of suboptimal cost-efficiency and fragmentation of European airspace is estimated at some € 4 billion per year. Ibid, at p. 2.

¹³⁰ COM (1999) 614 final of 06.12.1999.

¹³¹ For more information on the SES, see DG MOVE website, at: http://ec.europa.eu/transport/air/single_european_sky/single_european_sky_en.htm.

¹³² For more information on FABs, see DG MOVE website, at: http://ec.europa.eu/transport/air/single_european_sky/fab/functional_airspace_blocks_en.htm. See also AEA, ELFAA, ERA and IACA Press Releases of 25.11.2011: "Airline Associations: Member States must stop procrastinating on Single European Sky", at: <http://www.eraa.org/newsroom/news-releases/774-airline-associations-member-states-must-stop-procrastinating-on-single-european-sky>. Air Transport News, 28.11.2011, "Single European Sky – European Commission and Member States need to accelerate their decisions", at: <http://airtransportnews.aero/article.pl?mcatag=&id=33555>; European Commission Press Release of 09.08.2011: "Major air traffic management project receives EU support", at: http://tentec.europa.eu/en/news_events/newsroom/major_air_traffic_management_project_receives_eu_support.htm; IATA Press Release of 10.10.2011: "Another blow to European competitiveness – Air traffic management improvement off course", at: <http://www.iata.org/pressroom/pr/pages/2011-10-10-01.aspx>; European Commission Press Release IP/11/1452, 25.11.2011: "Aviation: Progress reports

authorities of neighbouring countries and the military to coordinate air traffic management. A main pillar of SES is the so-called Single European Sky Air Traffic Management Research (SESAR) project. SESAR aims at the modernization of the European air traffic control infrastructure¹³³ and is exclusively focused on the technological and operational aspects of air traffic control. The innovations that are expected to come out of SESAR are major and some early deliverables thereof, such as the Airport Collaborative Decision Making tool (A-CDM), are already paving the way towards interoperable networks and systems.

In the United States, the Federal Aviation Administration (FAA) has engaged in a comprehensive overhaul of the National Airspace System (NAS) by means of its Next Generation Air Transportation System (NextGen) programme¹³⁴. According to the FAA, “the NextGen transformation is as important and massive a technological undertaking as any upon which the aviation community has ever embarked¹³⁵. NextGen marks a transition, from the radar-based technology of the WWII era that is still used today, to satellite-based technology and advanced digital communications. Its objective is to connect airports and aircraft in the NAS to advanced infrastructure that enables continual sharing of real-time information. According to the FAA, Performance Based Navigation (PBN) capabilities and procedures, enabled by satellite positioning and other aircraft and ground-based technologies, are freeing aircraft from the old highways in the sky that are dependent on ground-based beacons. PBN enables more direct, fuel-efficient routes and provides alternatives for routing around NAS disruptions, such as bad weather or unexpected congestion. Likewise, automation system improvements are providing air traffic controllers with greater decision-making tools, while digital information sharing is helping aircraft operators, controllers and traffic managers work together to maximize efficiency in the air and on the airport surface¹³⁶. NextGen has already introduced innovations, such as the Automatic Dependent Surveillance-Broadcast (ADS-B), a satellite-based successor to radar. A number of other innovations are being rolled out, such as the Automated Terminal Proximity Alert tool for controllers.

NextGen places special emphasis on the environment, sustainability together with economic impact, flexibility and safety being one of the pillars upon which it is based. Its holistic approach to the environmental impact of aviation includes, inter alia, efforts to allow jets to cruise more often at or near optimal altitudes to reduce fuel burn, reconfigured arrival routes to allow for optimal profile descents to reduce aircraft noise and emissions, and improved departure routing to reduce miles flown and flying time. A green deliverable of NextGen is the so-called Aviation Environmental Design Tool (AEDT), which uses dynamic aircraft performance algorithms to calculate aircraft noise levels, fuel consumption and exhaust emissions.

show key targets for European air traffic management “at risk””; European Commission MEMO/11/831, 25.11.2011, “Single European Sky progress reports”; European Parliament Press Release, 11.07.2012, “Time to deliver the single European sky, says transport committee”, at: <http://www.europarl.europa.eu/news/en/pressroom/content/20120711IPR48722/html/Time-to-deliver-the-Single-European-Sky-says-transport-committee>.

¹³³ For more information on SESAR, see DG MOVE website, at: http://ec.europa.eu/transport/air/sesar/sesar_en.htm.

¹³⁴ For a comprehensive view on NextGen see, FAA NextGen Implementation Plan, March 2012, at: http://www.faa.gov/nextgen/implementation/media/NextGen_Implementation_Plan_2012.pdf.

¹³⁵ See NextGen Implementation Plan, at p. 8.

¹³⁶ Ibid, at p. 7.

The FAA estimates NextGen's environmental benefits at 14 million metric tons in cumulative reductions of CO₂ emissions through 2020 and 1.4 billion gallons in cumulative reductions of fuel use for the same period.

The most interesting feature of both SESAR and NextGen is their openness to third country operators. This is important as it paves the way for global harmonisation of concepts, systems, procedures and standards. The FAA has explicitly stated that its aim is to ensure the investments which operators make in NextGen technology, procedures and training will deliver benefits everywhere¹³⁷. On 3 March 2011, the European Commission and the FAA signed a Memorandum of Cooperation to coordinate SESAR and NextGen, embraced by a reciprocity clause that will allow European industry to participate in NextGen and American industry to participate in SESAR¹³⁸. The European Union has signed a similar agreement with Japan with a view to implementing "interoperable and seamless Air Traffic Systems worldwide"¹³⁹. Equally, the FAA is partnered with ANSPs in Australia, New Zealand, Singapore, Japan and Thailand in the context of the Asia and Pacific Initiative to Reduce Emissions (ASPIRE). Similar agreements have been signed by aviation authorities worldwide¹⁴⁰.

5. Airports

Last, but not least, the final share in environmental innovation belongs legitimately to the airports. Like all other stakeholders, airports have resolved against the inclusion of aviation in the EU ETS, urging ICAO to intervene to prevent a trade conflict that would severely affect international air transport¹⁴¹. At the same time, airports recognize that the industry needs to demonstrate environmental stewardship¹⁴² and have assumed their share of responsibility. Obviously, the main innovations embraced by airports are linked to the modernization of air traffic control infrastructure. SESAR is all about integrating the airport into the network to achieve airside and groundside synchronization and, therefore, a more predictable and interoperable "gate-in" and "gate-out" travel experience¹⁴³, what the FAA has described as "getting the right information to the right person at the right time"¹⁴⁴. A tool to achieve "common situational" awareness, i.e. real time sharing of operational data and information between the stakeholders using an airport, is the so-called Airport Collaborative

¹³⁷ Ibid, at p. 11.

¹³⁸ See website of DG MOVE, at:

http://ec.europa.eu/transport/air/sesar/sesar_international_cooperation_en.htm.

¹³⁹ See MOC at: http://ec.europa.eu/transport/air/international_aviation/country_index/doc/2011-07-19-press-release-sesar-japanese-moc.pdf.

¹⁴⁰ See e.g. NATS Press Release of 25.05.2012: "CAAS and NATS in Cooperation Agreement on Air Traffic Management", at: <http://www.nats.co.uk/news/caas-and-nats-ink-cooperation-agreement-on-air-traffic-management/>.

¹⁴¹ See ACI Press Release of 01.11.2011: "Airports call for urgent action on European Union Emissions Trading Scheme", at:

http://www.aci.aero/cda/aci_common/display/main/aci_content07_banners.jsp?zn=aci&cp=1-7-46%5E45020_725_2__.

¹⁴² See ACI Press Release of 22.04.2012: "Towards a global vision of sustainable air transport", at: http://www.aci.aero/dev/aci_common/display/main/aci_content07_banners.jsp?zn=aci&cp=1-7-46%5E46836_725_2__.

¹⁴³ See Air Transport News of 16.03.2011: "Implementing Single European Sky – The Way Forward", at: <http://airtransportnews.aero/analysis.pl?id=1050&keys=SES>.

¹⁴⁴ See website of FAA at: http://www.faa.gov/nextgen/why_nextgen_matters/.

Decision Making (A-CDM) SESAR deliverable. Successful implementation of A-CDM reduces delays and fuel consumption, resulting in less greenhouse gas emissions¹⁴⁵. Equally, the “NextGen for Airports” part of the NextGen initiative provides for a comprehensive package of measures to achieve efficiencies by means of operational and technological innovations¹⁴⁶.

Besides espousing measures to be integrated into the air traffic management network, airports have devised their own mechanisms to reduce their environmental footprint and contribute to carbon neutral growth. Airport Carbon Accreditation, the industry’s flagship climate change initiative, is a voluntary carbon management certification programme that has gathered the support of a considerable number of airports, as well as the ICAO. Initially launched in Europe in 2009, the programme provides for four levels of certification (i.e. mapping, reduction, optimization and neutrality) and has so far led to a reduction of CO2 emissions by more than one million tonnes¹⁴⁷. Airports have also been active in the areas of recycling, water conservation, green energy, air quality, noise pollution and land use. For instance, Airports of Thailand Ltd has implemented “Green Buildings”, using natural light and energy originating from heated water transformed into electricity for cooling purposes. Moreover, ground handling vehicles and airport shuttles are electrically powered to avoid air pollution. A “Fixed Electrical Ground Power Supply” system is also used to reduce “Aircraft Auxiliary Unit” in the airport parking bay area, which normally releases a substantial amount of carbon dioxide. Furthermore, some stations use solar-powered energy to generate electricity for equipment and communication tools, used to measure noise pollution¹⁴⁸. Similar measures have been adopted by a sizeable number of airports worldwide¹⁴⁹.

V. Who is paying the bill for innovation?

There is no doubt that the aviation industry is dancing to the rhythm of innovation. There is no stakeholder that has not joined the dance and there is no area of activity

¹⁴⁵ See ACI EUROPE Press Release of 29.11.2011: “Aviation partners report on roll-out of joint programme to combat airport congestion, reduce fuel burn and CO2 emissions”, at: <http://www.aci-europe.org/policy/position-papers.html?view=group&group=1&id=10>.

¹⁴⁶ See website of FAA at: http://www.faa.gov/nextgen/media/NextGen_for_Airports_9_2011.pdf.

¹⁴⁷ See e.g. Air Transport News, 31.01.2012: “Accredited airports: “We are the 52%””, at: <http://airtransportnews.aero/article.pl?mcateg=&id=34689>; Air Transport News, 15.02.2012: “CO2 reduction from Athens International Airport activities exceeded 14,000 tonnes in 2011”, at: <http://airtransportnews.aero/article.pl?mcateg=&id=35035>; Finavia Press Release of 27.02.2012: “Focusing on climate emissions of Finavia airports – Kick-off with Lapland airports”, at: http://www.finavia.fi/press/pressreleases/finavia_releases/finavia_release?id=8350181; ACI Europe Press Release of 21.06.2012: “CO2 reduction and efficiency drive go hand in hand for Europe’s airports”, at: <http://www.aci-europe.org/press-releases.html>.

¹⁴⁸ See Thai Airways Press Release of 23.12.2011: “THAI launches biofuels flight and first biofuels passenger flight in Asia through Travel Green initiative”, at: <http://www.prthaiairways.com/en/news/node/314.html>.

¹⁴⁹ See, e.g. Brussels Airport Press Release of 30.05.2012: “Green mobility: Trial project with electric cars at Brussels Airport”, at: <http://www.brusselsairport.be/en/corporate/news/25360/>; Athens International Airport Press Release of 05.06.2012: “Athens International Airport – World Environment Day”, at: <http://www.aia.gr/entry.asp?langid=2&pageid=741&tablepageid=12&entryID=403>; IATA Press Release of 02.11.2011: “Innovation in airline-airport cooperation”, at: <http://www.iata.org/pressroom/pr/pages/2011-11-02-01.aspx>; ACI Press Release of 19.04.2012: “Airports going greener to better serve passengers and their communities”, at: <http://www.aci-na.org/blog/2012/04/19/airports-going-greener-to-better-serve-passengers-and-their-communities/>.

that has not received an innovation touch. Of course, this is not innovative for an industry that is, by its nature, at the cutting edge of technology. Arguably, aviation mirrors scientific and technological progress and, as such, it is in itself a platform of innovation. The supersonic jet of the 1970s is just an example thereof. Nevertheless, there appears to be a difference between yesterday's innovation and today's innovation in that the latter is engaged not necessarily in operational improvement, but in environmental protection. In this sense, the inclusion of aviation in the EU ETS has been a catalyst for green innovation in the sector, whose effects have been most prominent in the areas of biofuels, air traffic control and aeronautics. An interesting question that arises at this point is who bears the cost of innovation, given the inability of the industry to cover it in its entirety.

1. Sustainable alternative aviation fuels

Looking first at the area of alternative fuels, one could not help noticing ICAO's role, ICAO being entrusted by the Chicago Convention with the "safe and orderly growth of international civil aviation throughout the world"¹⁵⁰. Recognising that improvements in technology and operational measures do not suffice to offset the increase of greenhouse gas emissions linked to the exponential growth of air transport, ICAO regards biofuels as a promising approach towards closing the greenhouse gas emissions mitigation gap. In November 2009, ICAO held a Conference on Aviation and Alternative Fuels (CAAF)¹⁵¹ to showcase the state of the art in this area. At the Conference, States agreed to develop, deploy and use sustainable alternative fuels to reduce aviation emissions. To facilitate, on a global basis, the promotion and harmonization of initiatives that encourage and support the development of aviation biofuels, the Conference established the so-called ICAO Global Framework for Aviation Alternative Fuels (GFAAF). The key activities ICAO has engaged in, in this respect, are the following:

1. providing fora for education and outreach on sustainable aviation biofuels;
2. providing fora for facilitating the exchange of information on financing and incentives for sustainable biofuels for aviation programmes working with the relevant United Nations and regional financial entities;
3. facilitating the development of standardized definitions, methodologies and processes;
4. supporting a platform for access to research roadmaps and programmes¹⁵².

ICAO has been active in all of those areas¹⁵³, whilst, at the request of CAAF, it has entered into preliminary discussions with the World Bank and the Inter-American Development Bank to facilitate a framework for financing infrastructure development

¹⁵⁰ See Article 44 (a). See also Article 44 (d), which in a similar fashion entrusts ICAO with the task of meeting "the needs of the peoples of the world for safe, regular, efficient and economical air transport".

¹⁵¹ See www.icao.int/caaf2009/.

¹⁵² See www.icao.int/environmental-protection/Pages/Gfaaf_icao-role.aspx.

¹⁵³ For a summary of accomplishments, see: www.icao.int/environmental-protection/Pages/GlobalFramework.aspx.

projects dedicated to alternative aviation fuels and incentives to overcome initial market hurdles¹⁵⁴.

At EU level, the promotion of biofuels has to be seen in the context of the EU climate and energy policy. In 2007, the European Council set a number of targets to be achieved by the year 2020, namely a 20% share of renewable energy, a 20% improvement in energy efficiency and a 20% reduction in greenhouse gas emissions. In execution of this goal, the Renewable Energy Directive (RED) that followed¹⁵⁵ prescribed that 10% of all energy in the transport sector must come from renewable energy sources, sustainable biofuels being counted towards this target¹⁵⁶. To spearhead the commercialization of aviation biofuels in Europe, in 2011 the European Commission, in cooperation with Airbus and leading European airlines and biofuel producers, launched the so-called “European Advanced Biofuels Flightpath” initiative¹⁵⁷. The Flightpath aims at a two million tonne take-off of sustainable biofuels in the EU civil aviation sector by the year 2020, addressing the main hurdles on the way to commercialization, namely: 1. lack of policy incentives, 2. lack of adequate financing, and 3. lack of long-term off-take agreements between the biofuel producers and the aviation industry. So far, the European Commission has organized, in cooperation with the industry, a number of workshops to facilitate the fulfilment of the targets set¹⁵⁸.

On the same wavelength with the EU are also the US authorities, who consider sustainable alternative jet fuels key to meeting the environmental goals of NextGen¹⁵⁹. In particular, the FAA aims at an aviation biofuel capacity of one billion gallons per year by 2018, as well as at carbon neutral growth by 2020 – the year 2005 being used as the baseline. In 2006, as a result of the volatility in petroleum prices, fuel became the single largest component of US airline operating costs. At the same time, security of supply and environment concerns prompted the FAA to instigate the so-called “Commercial Aviation Alternative Fuels Initiative” (CAAFI), a coalition of interested stakeholders, engaged in the development and deployment of sustainable alternative jet fuels. CAAFI functions as a clearing house, facilitating the exchange of information and coordinating private sector and governmental initiatives. Its activities, which are centered around the areas of fuel and certification, R&D, environment and business and economics, are promoted by means of technical workshops, outreach to domestic and international aviation, energy and financial industry fora, and communications with the news media. CAAFI is sponsored by the FAA and third trade associations¹⁶⁰.

¹⁵⁴ See www.icao.int/environmental-protection/Pages/alternative-fuels.aspx.

¹⁵⁵ See Directive 2009/28/EC of 23/04/2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, OJ L140/16, 05.06.2009.

¹⁵⁶ For a comprehensive overview of EU policies and actions towards meeting the climate and energy targets for the year 2020, see Technical Paper: “2 million tons per year: A performing biofuels supply chain for EU aviation”, June 2011, available at: http://ec.europa.eu/energy/renewables/biofuels/doc/20110622_biofuels_flight_path_technical_paper.pdf.

¹⁵⁷ For more information, see http://ec.europa.eu/energy/renewables/biofuels/flight_path_en.htm.

¹⁵⁸ For a summary of events, see *ibid*.

¹⁵⁹ For an outline of US views and approach regarding sustainable alternative jet fuels, see presentation by Dr Lourdes Maurice at the Workshop on Incentives for Biofuels in Aviation, June 2012, at: http://ec.europa.eu/energy/technology/events/2012_06_20_biofuels_flightpath_en.htm.

¹⁶⁰ For more information on CAAFI, see <http://caafi.org/>.

The main accomplishment of CAAFI to date is, arguably, the approval by ASTM International, the standard-setting organization in charge of certification of commercial aviation kerosene, of new fuel specifications. In August 2009, ASTM International approved the use of synthetic fuel from a process known as Fischer-Tropsch (FT) synthesis up to a 50% blend with conventional Jet A fuel¹⁶¹. In July 2011, ASTM approved another process of production of synthesized hydrocarbon jet fuels, based on hydroprocessed esters and fatty acids (HEFA)¹⁶². This amended fuel specification is the culmination of a collaborative effort among the FAA, the Department of Defence and the aviation industry through the CAAFI¹⁶³.

In July 2010, the US Department of Agriculture (USDA) and Boeing signed a resolution, formalizing their commitment to work together on the “Farm to Fly” initiative. The Farm to Fly programme seeks to “accelerate the availability of a commercially viable and sustainable aviation biofuel industry in the United States, increase domestic energy security, establish regional supply chains and support rural development”¹⁶⁴. To advance the initiative, each organization designated personnel to serve on the Farm to Fly Working Team to discuss appropriate actions. The Team’s discussions culminated in a report, published in January 2012, exemplifying the nexus between clean-energy innovation and rural development. To date, Farm to Fly has emerged as the nation’s most promising effort to promote aviation biofuel development across the federal government and in partnership with the private sector. The US Department of Agriculture and Department of Energy are working together with the FAA, Department of Defence, other government agencies and airlines and aerospace manufacturers to promote this new industry¹⁶⁵.

Lastly, the Continuous Lower Energy, Emissions and Noise (CLEEN) programme is a NextGen effort to accelerate development and commercial deployment of, *inter alia*, sustainable alternative fuels. Starting from the premise that there is no single renewable jet fuel solution that will meet all of aviation’s needs and that crop availability, diverse climates and the energy production potential of a given region are variables that necessitate multiple solutions for meeting fuel demand¹⁶⁶, CLEEN focuses on a wide range of alternative fuels. To that end, the FAA seeks to achieve ASTM approval of as many commercially viable and environmentally sustainable drop-in alternative fuel options as possible¹⁶⁷. CLEEN further focuses on the quantification of the associated benefits, a process that requires quantifying the full-cycle emissions from alternative fuel production, distribution and use. Moreover,

¹⁶¹ See, ASTM D7566 - 10a Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons, at: <http://www.astm.org/Standards/D7566.htm>.

¹⁶² See ASTM D7566 - 11 Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons, at: <http://www.astm.org/Standards/D7566.htm>.

¹⁶³ For more information, see <http://caafi.org/faq.html>. See also NextGen Implementation Plan, at p.14, and EU 2011 Implementation Plan: “2 million tons per year: A performing biofuels supply chain for EU aviation”, at p. 12, *supra* note 153.

¹⁶⁴ See <http://www.usda.gov/documents/usda-farm-to-fly-resolution-july-2010.pdf>.

¹⁶⁵ See “Agriculture and Aviation: Partners in Prosperity”, January 2012, USDA, A4A and Boeing, at: <http://www.usda.gov/documents/usda-farm-to-fly-report-jan-2012.pdf>. See also A4A Press Release of 19.07.2012: “A4A commends the US Navy for its ongoing commitment to biofuels, “Great Green Fleet” demonstration”, at: http://www.airlines.org/Pages/news_7-19-2012.aspx.

¹⁶⁶ See p. 14 of 2012 NextGen Implementation Plan.

¹⁶⁷ *Ibid*.

safety and transition strategies that enable “drop-in” replacement of petroleum-derived aviation fuels are being explored¹⁶⁸. In December 2011, the FAA announced contract awards to analyse fuel quality control procedures, conduct engine durability tests with alternative fuels and perform key testing to support qualification and certification of jet biofuels from alcohols, organic matter and other renewable materials. The FAA expects these activities to support the next round of fuel approvals, scheduled to begin in 2014¹⁶⁹.

At an industry level, investment in sustainable biofuels has been unprecedented. Aircraft manufacturers, airlines and airports have joined forces either among themselves or together with the public sector, providing financing and expertise for the carrying out of numerous projects around the world¹⁷⁰.

In Europe, the so-called Green Sky programme involves the conversion of tonnes of municipal waste destined for landfill sites into jet fuel. The project initially involved Solena Group (a platform company developing facilities worldwide to produce sustainable aviation and marine fuels from biomass) and British Airways as a risk-sharing partner. Specifically, British Airways undertook to purchase all the fuel produced by Solena’s plant in London¹⁷¹. The project soon gained momentum, Alitalia and Solena signing a letter of intent to initiate a study on the feasibility of implementing a system for the conversion of municipal solid waste into aircraft biofuel in order to meet part of Alitalia’s fuel needs¹⁷². A few months later, the Air Transport Association of America followed suit, announcing that a core group of airlines has signed letters of intent with Solena for a future supply of jet fuel derived exclusively from biomass¹⁷³.

The Sea Green project of Cranfield University to develop micro-algae-based feedstock production for biofuels found an ally in the Sustainable Use of Renewable Fuels (SURF) consortium. The consortium, which comprises Airbus, British Airways, Rolls-Royce, Finnair, Gatwick Airport and IATA, was set up to serve as an advisory and steering group to Cranfield’s Sea Green project¹⁷⁴.

Moving on to Germany, in the year 2011 Lufthansa was the first airline worldwide to operate daily commercial passenger flights for a period of six months, using a biofuel blend, composed of 50% of regular kerosene and 50% biosynthetic kerosene, based on Hydro-processed Esters and Fatty Acids (HEFA). Airbus provided technical

¹⁶⁸ See http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=11538.

¹⁶⁹ See p. 14 of NextGen Implementation Plan.

¹⁷⁰ For an overview of ongoing projects, see ATAG: “Where are we with biofuels?”, October 2011, at: http://legacy.icao.int/sustaf/Docs/18_Steele.pdf.

¹⁷¹ See <http://www.greenaironline.com/news.php?viewStory=893>; see also London Biojet Project, at: http://legacy.icao.int/sustaf/Docs/19_Kershaw.pdf.

¹⁷² See Alitalia Press Release of 02.02.2011: “Agreement between Alitalia and Solena Group to start a study on the conversion of municipal solid waste into aircraft biofuel”, at: http://corporate.alitalia.com/en/Images/pr_02_02_2011e_tcm7-39632.pdf.

¹⁷³ See ATA Press Release of 20.06.2011: “Seven ATA member airlines sign letters of intent to negotiate purchase of biomass-derived jet fuel from Solena Fuels, LLC”, at: <http://www.airlines.org/Pages/Seven-ATA-Member-Airlines-Sign-Letters-of-Intent-to-Negotiate-Purchase-of-Biomass-Derived-Jet-Fuel-from-Solena-Fuels,-LLC.aspx>.

¹⁷⁴ See Cranfield University Press Release of 16.09.2010: “Airbus and British Airways join forces with Cranfield University to accelerate availability of algae for aviation fuel”, at: <http://www.cranfield.ac.uk/news/pressreleases/2010/page50413.html>

assistance and monitored the fuel properties. The cost of the project, estimated at € 6.6 million, was partly covered by the German Federal Ministry of Economics and Technology. Specifically, Germany granted € 2.5 million out of the so-called Future Aircraft Research (FAIR) budget, FAIR being a larger project looking into, inter alia, biofuels¹⁷⁵.

In Spain, Iberia, airport authority AENA and microalgae technology company Alga Energy have set up a research facility at Madrid Barajas Airport to explore the potential of micro algae as a biofuel to power airport ground vehicles and aircraft. The initial budget allocated to the project amounts to € 600,000. Iberia has also signed an agreement with Airbus and the Spanish government to develop a value chain for the production of biofuels. The project is structured around three phases, namely a feasibility study, demonstration trials and scaling up of production process. Iberia has contributed its airline and aircraft maintenance experience, as well as its engines and aircraft for the necessary tests¹⁷⁶. Lastly, Iberia has been engaged in yet another project to advance the use of aviation biofuels, i.e. Spain's "Green Flight" programme. In cooperation with Airbus and Spanish energy company "Repsol", Iberia was the first airline to perform a commercial domestic flight on a blended jet biofuel sourced from the camelina sativa plant¹⁷⁷.

Camelina as a feedstock is also being considered in the context of the "Romanian Camelina value chain" project, carried out by TAROM, Airbus, Camelina Company España and UOP. The consortium is working on the development of a sustainable biofuel supply chain capable of producing significant quantities of Camelina in the coming years in accordance with the European Biofuels FlightPath, aiming at two million tonnes of biofuels in 2020¹⁷⁸.

Moving on to America, one could not help mentioning the Sustainable Aviation Fuels Northwest (SAFN) initiative, the first regional stakeholder effort to explore the opportunities and challenges surrounding the production of sustainable aviation fuels. The initiative was launched in 2010 by Boeing, Alaska Airlines, the region's three largest airport operators and Washington State University. A non-governmental organisation was retained to manage a stakeholder process that included more than 40 organisations ranging across aviation, biofuels production, environmental advocacy, agriculture, forestry, federal and state government agencies, academic research and technical consultancies¹⁷⁹.

In the same vein, in May 2012 United Airlines, Boeing, Honeywell's UOP, the Chicago Department of Aviation and the Clean Energy Trust announced the formation of the Midwest Aviation Sustainable Biofuels Initiative (MASBI), designed

¹⁷⁵ For more information, see Air Transport News, 2011 Review, at: <http://airtransportnews.aero/content/c1194.pdf>; Lufthansa Press Release of 09/01/2012: "Practical trial of biosynthetic fuel at Lufthansa successful", at: <http://presse.lufthansa.com/en/news-releases/singleview/archive/2012/january/09/article/2061.html>; www.puresky.de. For a recent Lufthansa initiative, see Air Transport News, 19.02.2012: "Algae. Tec and Lufthansa sign collaboration agreement to build biofuel production facility in Europe", at: <http://www.airtransportnews.aero/article.pl?mcateg=&id=39098>.

¹⁷⁶ See, <http://greenaironline.com/news.php?viewStory=1200>.

¹⁷⁷ See www.greenaironline.com/news.php?viewStory=1548.

¹⁷⁸ See http://legacy.icao.int/sustaf/docs/19_dimitriu-eychenne.pdf.

¹⁷⁹ See <http://www.safnw.com/>.

to advance biofuel development in a 12-state region. MASBI has invited a diverse set of stakeholders, including airlines, fuel producers, feedstock growers, logistics providers and investors to add their knowledge and expertise to the effort. Organisation stakeholders are developing a feasibility study and an action plan, whilst MASBI's Advisory Council includes the US Department of Defence, US Department of the Navy, other federal agencies, non-governmental organisations and academic institutions¹⁸⁰.

Another initiative worth mentioning is the “Plan de Vuelo” project in Mexico under which the government seeks to supply biofuels to 18 Mexican airports. The stakeholders involved include raw material providers, biorefineries, aircraft manufacturers, airports, airlines, financial institutions and the government¹⁸¹.

In Brazil, aviation companies, biofuel producers and the sugar cane, algae and jatropha industries have formed the Brazilian Aviation Biofuels Alliance (ABRABA) to promote public and private partnerships to develop and certify sustainable aviation biofuels¹⁸². In addition to ABRABA, Embraer, Boeing and the São Paulo State Research Foundation (FAPESP) have embarked on a long-term aviation biofuel R&D programme with a view to creating the first biofuel research centre in Brazil¹⁸³. Embraer and Boeing have also partnered with the Inter-American Development Bank (IDB) to jointly fund a sustainability analysis concerning the production of direct sugar-to-hydrocarbon renewable jet fuel from Brazilian sugar cane. The study, which was led by a research think-tank in Brazil and was independently reviewed by the World Wildlife Fund (WWF), evaluates environmental and market conditions associated with the use of this fuel¹⁸⁴.

Asia could not abstain from the global efforts towards sustainable aviation biofuels. The Qatar Advanced Biofuel Platform (QAPB) consortium, composed of Qatar Airways, Airbus, Qatar Petroleum, Qatar University Science and Technology Park and Rolls-Royce are developing the first large-scale algae bio-jet fuel value chain in the world. Interestingly, the knowledge gained from the project will be used by Qatar University to develop a bioengineering course¹⁸⁵.

In Abu Dhabi, the Sustainable Bioenergy Research Consortium, founded by Etihad, Boeing and Honeywell subsidiary UOP and hosted by Masdar Institute, examines the viability of sustainable biofuel production as part of an integrated seawater agricultural system in Abu Dhabi and the potential for wider application and

¹⁸⁰ See Air Transport News, 23.05.2012: “Aviation and clean technology leaders launch Midwest Aviation Sustainable Biofuels Initiative”, at: <http://airtransportnews.aero/article.pl?mcateg=&id=36963>; A4A Press Release of 23.05.2012: “A4A lauds the formation of the Midwest Aviation Sustainable Biofuels Initiative”, at: http://www.airlines.org/Pages/news_5-23-2012.aspx.

¹⁸¹ See <http://www.weforum.org/best-practices/biofuels/plan-de-vuelo-mexico>.

¹⁸² See <http://biomasshub.com/abraba-brazil-aviation-biofuels-industry/>.

¹⁸³ See Boeing Press Release of 26.10.2011: “Boeing, Embraer and São Paulo Research Foundation to lead aviation biofuels program in Brazil”, at: <http://boeing.mediaroom.com/index.php?s=43&item=1988>.

¹⁸⁴ See Embraer Press Release of 26.10.2011: “Embraer keeps its eyes on a greener future”, at: <http://www.embraer.com/en-US/ImprensaEventos/Press-releases/noticias/Pages/EMBRAER-MANTEM-O-FOCO-NAS-QUESTOES-AMBIENTAIS.aspx>.

¹⁸⁵ See <http://www.weforum.org/best-practices/biofuels/qatar-advanced-biofuel-platform>.

commercialisation¹⁸⁶. Etihad specifically has contributed over USD 2 million to the programme¹⁸⁷.

Moving on to China, the Joint Research Lab for Sustainable Aviation Biofuels, established by Boeing and Qingdao Institute of Bioenergy and Bioprocess Technology, aims at accelerating research leading to commercialization of sustainable aviation biofuels. The parties have allocated to the Lab the amount of USD 3 million for a three-year start-up period¹⁸⁸. A very promising effort to develop new fuel types for commercial aviation is made by energy company LanzaTech and Virgin Atlantic. The parties seek to harness the waste gasses from steel manufactured in China and India in order to develop a next generation biofuel. LanzaTech estimates that its process can apply to 65% of the world's steel mills, as well as to metals processing and chemical industries, allowing the fuel to be rolled out for worldwide commercial use. Virgin Atlantic will be the first airline to use this fuel and has further undertaken to contribute towards achieving the technical approval required for the commercialization of the fuel¹⁸⁹. A further promising partnership has been forged by China's National Energy Administration (NEA) and Boeing. The parties have agreed to carry out a study, whose results will help support future efforts to establish a sustainable aviation biofuels industry in China and also form the foundation for a proposed renewable energy agreement between the United States Trade and Development Agency and the NEA¹⁹⁰.

Last but not least, in Australia, a consortium including Airbus, Virgin Australia, the UK's Manchester Metropolitan University and an entity developing sustainable farming systems as part of the Australian Government's Cooperative Research Centre (CRC) programme is exploring a new pathway to produce sustainable aviation fuels from eucalyptus mallee trees, indigenous to Australia, via a process called pyrolysis. The partnership agreement aims to develop a complete sustainable aviation biofuels production capability in Australia, using only sustainable resources¹⁹¹. The conditions needed for the production of aviation biofuels from sustainable sources within Australia are also being examined by Qantas, which is preparing a feasibility study. The study is sponsored by the Australian Government under the Emerging Renewables Programme, whilst Shell is providing technical support¹⁹².

Summing up, the Sustainable Aviation Fuel Users Group (SAFUG) epitomizes the industry's joint efforts in the area of biofuels. SAFUG was formed in 2008 with support and advice from the world's leading environmental organisations, such as the Natural Resources Defence Council and the Roundtable for Sustainable Biofuels

¹⁸⁶ See <http://www.weforum.org/best-practices/biofuels/masdar-sustainable-bioenergy-research-centre>.

¹⁸⁷ See Air Transport News, 25.01.2012: "Etihad Airways operates first biofuel powered delivery flight", at: <http://airtransportnews.aero/article.pl?mcateg=&id=34555>.

¹⁸⁸ See http://english.qibebt.cas.cn/ic/ji/201011/t20101103_60856.html.

¹⁸⁹ See <http://www.biofuelsdigest.com/bdigest/2011/10/11/virgin-atlantic-lanzatech-partner-for-aviation-biofuels-in-india-china/>.

¹⁹⁰ See Boeing Press Release of 28.10.2011: "Air China, Boeing and industry partners conduct first Chinese sustainable biofuel flight", at: <http://boeing.mediaroom.com/index.php?s=43&item=1991>.

¹⁹¹ See Airbus Press Release of 21.03.2012: "Airbus and Virgin Australia study new alternative fuel process", at: <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-and-virgin-australia-study-new-alternative-fuel-process/>.

¹⁹² See Qantas Press Release of 13.04.2012: "Qantas announces feasibility study for sustainable aviation fuel", at: <http://www.qantas.com.au/travel/airlines/media-releases/apr-2012/5389/global/en>.

(RSB). Its members, who have all signed a sustainability pledge, represent approximately 32% of commercial aviation fuel demand, whilst its affiliates represent the entirety of the core manufacturing industry¹⁹³.

2. Air Traffic Management (ATM)

In the area of modernisation of the air traffic control infrastructure, ICAO's role and contribution are pivotal, ICAO being vested by the Chicago Convention with the power to develop the principles and techniques of international air navigation so as to encourage, inter alia, "the development of air navigation facilities"¹⁹⁴. The nature of ICAO as a primarily technical-standard setting body implies significant investments in the area of ATM. Indeed, the transition of the aviation community from the air traffic control environment of the 20th century to the performance-based, integrated and collaborative ATM system of the 21st century could never occur without ICAO's guidance and leadership. As a matter of fact, both NextGen in the United States and SESAR in Europe, which focus on improving safety, capacity, fuel consumption and environmental impact, are aligned with ICAO's Global Air Navigation Plan, which was developed in consideration of the ICAO Global ATM Operational Concept and ICAO's Strategic Objectives¹⁹⁵. Besides the vast number of Documents, Circulars and Guidance Manuals issued by ICAO for the assistance of its Member States, ICAO has always been active in gathering the aviation community round Conferences, Symposia and similar events in preparation of the industry's global action. In September 2011, ICAO hosted a special Global Air Navigation Industry Symposium to frame the key issues and solutions to be presented at the Twelfth Air Navigation Conference. The Conference, scheduled for November 2012, will seek broad agreement on aviation's new strategic plan¹⁹⁶. ICAO estimates that investment in the transformation of air transportation systems in the next 10 years will amount to \$ 120 billion. While NextGen and SESAR account for a large share of this spending, parallel initiatives are underway in many other areas, including Latin America, Russia and Japan¹⁹⁷.

In Europe, the launch of the Single European Sky initiative brought ATM under EU competence¹⁹⁸. The technological element of the Single European Sky, that is to say the modernization of the air traffic control infrastructure, is the subject-matter of the SESAR project. SESAR consists of three phases: a definition phase, a development

¹⁹³ See <http://safug.org/>; see also Air Transport News, 17.08.2012: "United Airlines joins Sustainable Aviation Fuel Users Group", at: <http://airtransportnews.aero/article.pl?mcatag=&id=38513>.

¹⁹⁴ See Article 44 (c). See also Article 37, which entitles ICAO to adopt international standards and recommended practices and procedures on air navigation issues.

¹⁹⁵ See Document 9750, at: http://www.icao.int/publications/Documents/9750_3ed_en.pdf

¹⁹⁶ See ICAO Preview: Global Air Navigation Industry Symposium, Defining the Future of Air Traffic Management, at: http://www.icao.int/publications/journalsreports/2011/6604_en.pdf. See also Commission Press Release IP/10/761, 18.06.2010, on the EU and the US agreement to "coordinate their technical efforts in support of global standardization of ATM systems through the ICAO".

¹⁹⁷ Ibid, at p. 7. See also Avinor Press Release of 16.12.2011: "Norway and Russia create highways in the sky", at:

http://www.avinor.no/en/avinor/press/newsarchive?NORWAY_AND_RUSSIA_CREATE_HIGHWAYS_IN_THE_SKY&id=181-138672; NAV Canada Press Release, 30.04.2012: "NAV Canada projects 20 million metric tons of greenhouse gas emission reductions to 2020", at: <http://www.marketwire.com/press-release/nav-canada-projects-20-million-metric-tons-of-ghg-emission-reductions-to-2020-1650369.htm>.

¹⁹⁸ See Regulation (EC) No 549/2004, OJ L 96, 31.03.2004, p. 1.

phase and a deployment phase. The definition phase, which lasted from 2005 to 2008, was co-financed by the Community and the European Organisation for the Safety of Air Navigation (Eurocontrol). During that time, the realization of the magnitude of the project led to the establishment of the SESAR Joint Undertaking, tasked with the management of the funds assigned to the project during its development phase from 2008 to 2013¹⁹⁹. The financing of the Joint Undertaking should come from contributions from its members, including private undertakings. Given the R&D nature of the Joint Undertaking's activities, EU funding should be paid in particular out of the R&D Framework Programmes. Additional funding could be paid out of the Trans-European Network programme²⁰⁰. The Union's contribution to the SESAR Joint Undertaking has been set at € 700 million, divided in equal parts between the Seventh Framework Programme and the Trans-European transport network programme for the period 2007-2013²⁰¹.

Title XVI of the TFEU (Articles 170-172) regulates the area of Trans-European networks (TENs). The establishment and development of TENs in the areas of transport, telecommunications and energy infrastructures is deemed instrumental in achieving a functioning internal market, as well as economic, social and territorial cohesion²⁰². The Union's action in this respect "shall aim at promoting the interconnection and interoperability of national networks, as well as access to such networks"²⁰³. One of the main obligations of the Union in pursuance of those objectives is the identification of projects of common interest²⁰⁴. The development and deployment of air traffic management systems which ensure interoperability between national networks has been singled out as a project of common interest²⁰⁵ and has been allocated an estimated budget of € 350 million over the period 2007-2013²⁰⁶.

¹⁹⁹ See Regulation (EC) No 219/2007 of 27 February 2007 on the establishment of a Joint Undertaking to develop the new generation European ATM system (SESAR), OJ L 64/1, 02.03.2007, in conjunction with Council Regulation (EC) No 1361/2008 of 16 December 2008 amending Regulation (EC) No 219/2007, OJ L 352/12, 31.12.2008. See also the ongoing public consultation on the extension of the SESAR Joint Undertaking under Horizon 2020, at: http://ec.europa.eu/transport/air/consultations/2012-10-22-sesar_en.htm.

²⁰⁰ Ibid.

²⁰¹ Ibid.

²⁰² See Article 170(1) TFEU.

²⁰³ See Article 170(2) TFEU.

²⁰⁴ See Article 171(1) TFEU.

²⁰⁵ See Article 5(f) of Regulation (EC) No 680/2007 of the European Parliament and of the Council of 20 June 2007 laying down general rules for the granting of Community financial aid in the field of the trans-European transport and energy networks, OJ L 162/1, 22.06.2007.

²⁰⁶ The need for the adoption of multi-annual work programmes for grants in the field of trans-European transport networks is explained by the large scale of those projects and the time required for their completion. In this respect, see paragraph 19 of Regulation (EC) No 680/2007: "For the implementation of Community financial support for large-scale projects phased over several years, it is advisable to allow a commitment from the Community on a multiannual basis, differentiating by project financed and by commitment appropriations authorised annually. Only firm, attractive financial commitments binding on the Community over the long term will make it possible to reduce the uncertainties connected with the completion of these projects and to mobilise both public and private investors. The projects included in the multiannual programme represent the highest priorities in the development of TEN-T as referred to in Decision No 1692/96/EC and require continuing Community action to ensure their smooth and efficient completion". See also Article 8 of Regulation (EC) No 680/2007.

SESAR's definition phase resulted in the European ATM Master Plan, which specifically addressed the financing and investment aspects of the project's deployment phase²⁰⁷. The estimated cost of the deployment phase, which involves the production and implementation of the new ATM infrastructure, is € 30 billion over the period 2008-2020²⁰⁸. The cost of deployment will be covered by the industry, i.e. by the airlines, airport operators and air navigation service providers. The Master Plan provides a breakdown of the total investments and the investments over time per stakeholder. To mitigate the risk of delays in the deployment of the new infrastructure, the Commission has suggested potential solutions for innovative funding and financing schemes²⁰⁹.

On the other side of the Atlantic, the NextGen programme is similarly a collaborative effort between the Federal Aviation Administration and industry stakeholders, namely operators and airports. The FAA has emphasized the importance of synchronization of investments to achieve timely NextGen benefits. At the same time, it has acknowledged the complexity and cost the transition to the new system entails and the reluctance of operators to proceed with the necessary investments, especially during the first stages of deployment. Specifically, the FAA recognizes that: "Quantitatively, equipage questions become complicated. Operators must consider the costs of equipment; installation, training and operations; incentives to equip; the timetable for FAA deployment of capabilities; users' confidence in benefit estimates, and other factors. Many of these decision criteria remain uncertain, leading many operators to take a wait-and-see approach to equipping"²¹⁰. This is why the FAA stays focused on the steady refinement of its benefit estimates, enabled by analysing a continuing stream of data from the demonstrations, trials, flight evaluations and simulations conducted as a normal part of developing NextGen systems and procedures²¹¹. To foster a common understanding of NextGen priorities in the context of overall NextGen capabilities and implementation constraints, the FAA requested the formation of an advisory committee, representative of all stakeholders. The advisory committee has come up with a number of recommendations on issues especially of metrics, equipage and related incentives, prompting the FAA to streamline NextGen accordingly. The FAA estimates that the overall NextGen initiative has a benefit-to-cost ratio of more than two-to-one²¹², the break-even point being estimated in the year 2020. Although, as appears from the 2012 Implementation Plan, budget constraints and limitations are an issue of concern for the FAA, budget requests to Congress not

²⁰⁷ See http://ec.europa.eu/transport/air/single_european_sky/doc/european_atm_master_plan.pdf. See also Study prepared for DG MOVE by the consultant booz&co. on adequate and innovative funding mechanisms for the preparation and transition to the deployment phase of the SESAR Programme, at: http://ec.europa.eu/transport/air/sesar/doc/2-2010_09_28_funding_and_financing_of_sesar.pdf.

²⁰⁸ See SESAR Master Plan, at p. 83.

²⁰⁹ See Commission Staff Working Paper on preparing a deployment strategy for the SES technological pillar, SEC (2010) 1580 final, 10.12.2010.

²¹⁰ See p. 20 of NextGen 2012 Implementation Plan.

²¹¹ Ibid. See also Appendix A of the Implementation Plan, which outlines the opportunities for investment by operators and airports.

²¹² Ibid, at p. 20.

always being met in their entirety²¹³, projected investments for the years to come remain considerable²¹⁴.

A joint environmental initiative between the FAA and the European Commission, which, arguably, paved the way for the EU-US Memorandum of Cooperation signed in 2011²¹⁵, is the Atlantic Interoperability Initiative to Reduce Emissions (AIRE). Under this initiative, ATM stakeholders work collaboratively to perform integrated flight trials and demonstrations in an effort to validate solutions to reduce CO2 emissions for surface, terminal and oceanic operations. On the European side, AIRE is managed by the SESAR Joint Undertaking, whilst in the United States the FAA is the authority in charge²¹⁶. In 2011, the FAA, the European Commission, the European air navigation service providers and 40 European airlines joined forces to demonstrate NextGen and SESAR capabilities on transatlantic flights. The effort involved several gate-to-gate projects, including transatlantic green flights, using procedures designed to reduce environmental impact and requiring no special equipage. AIRE entered its third phase in 2012²¹⁷.

3. Aeronautics Industry

Innovation in aeronautics has not only manifested itself in the area of air traffic management, but also in the area of aircraft and engine construction. ICAO's role is catalytic in this regard, since it is the body in charge of encouraging the arts of aircraft design and operations²¹⁸ and promoting generally the development of all aspects of international civil aeronautics²¹⁹. ICAO's role is expressed by adopting international standards and recommended practices and procedures with which States must, in principle, comply²²⁰. Understandably, ICAO's considering of aviation's environmental footprint predates the EU ETS. In fact, aircraft have long been required to meet the environmental certification standards adopted by ICAO concerning noise and engine emissions. These certification standards, contained in Annex 16 of the Chicago Convention²²¹, have been designed and are kept up to date in order to respond to concerns regarding the environmental impact of aviation on communities in the vicinity of airports, as well as society at large. ICAO, under the CAEP process, has undertaken an effort to establish medium and long-term environmental goals relating to three types of technologies, i.e. noise, NOx and fuel burn. In addition,

²¹³ See, for instance:

http://www.faa.gov/about/office_org/headquarters_offices/aba/budgets_brief/media/2010_budget_highlights.pdf.

²¹⁴ See FAA Capital Investment Plan for the fiscal years 2013-2017, at:

[http://www.faa.gov/air_traffic/publications/cip/files/FY13-17/FY13-](http://www.faa.gov/air_traffic/publications/cip/files/FY13-17/FY13-17_CIP_Appendix_C_March_2012.pdf)

[17_CIP_Appendix_C_March_2012.pdf](http://www.faa.gov/air_traffic/publications/cip/files/FY13-17/FY13-17_CIP_Appendix_C_March_2012.pdf).

²¹⁵ Supra note 138.

²¹⁶ For more information on AIRE, see SESAR and the environment, at p.10-11. See also:

http://ec.europa.eu/transport/air/environment/aire_en.htm.

²¹⁷ See NextGen Implementation Plan, at p. 18 and p. 20; see also Swedavia Press Release of

11.05.2012: "Green flights from gate to gate with Green Connection", at:

http://www.lfv.se/Global/press/PRESSmeddelanden/2012/PRESSmeddelande%20Green%20Connection_EN.pdf.

²¹⁸ See Article 44 (b) Chicago Convention.

²¹⁹ See Article 44 (l) Chicago Convention.

²²⁰ See Articles 37 and 38 Chicago Convention.

²²¹ For ICAO Environmental Publications, see <http://www.icao.int/environmental-protection/Pages/environment-publications.aspx>.

assessments of environmental improvements expected from operational initiatives in the medium and long term are also underway. This process is being led by panels of independent experts to ensure transparency and the involvement of all stakeholders. The purpose of this goal-setting exercise is to provide strict yet reasonable targets for industry R&D to aim at in cooperation with States²²².

More specifically, concerning engine emissions, of particular relevance is the standard for NOx, a precursor for ozone, which at altitude is a greenhouse gas. The standard for NOx was first adopted in 1981 and then made more stringent in 1993, 1999 and 2005. In 2010, CAEP/8 agreed on a new NOx standard with an effective date of 31 December 2012, as well as a production cut-off of engines complying with the current standard with an effective date of 31 December 2012. As already mentioned, an aviation CO2 emissions standard is in the making, expected to be fully developed by the end of 2013²²³. With regard to fuel burn, a workshop to consolidate the knowledge base for fuel burn improvements through weight reduction, aerodynamic improvement, engine fuel efficiency improvement and aircraft system optimization was conducted in 2009 and a follow-on review was conducted in 2010. A report of these reviews and workshops and the resultant medium and long-term goals for fuel burn reduction technologies will be presented at the CAEP/9 meeting in 2013. CAEP/9 is similarly going to consider more stringent noise standards which are currently under development²²⁴. The progressive tightening of ICAO standards is evidently a healthy reaction to the growing climate change concerns. Moreover, it pioneers technical innovation in the sector, setting all the higher thresholds. The work involved in this process is considerable as is the capital expenditure required.

Indisputably, although the inclusion of aviation in the EU ETS functions in itself as a catalyst for green innovation in aeronautics, aircraft operators have a significant share in this process, since they are the ones who place orders for greener aircraft and assume the associated cost. Nevertheless, as their buying power is limited and innovation is expensive, aircraft manufacturers are incentivised to rationalize their cost base in order to protect their market share in an industry which is notoriously antagonistic. It is, therefore, clear that a share of the innovation cost should be met by aircraft manufacturers. Considering that the environmental benefits of green innovation are reaped by society at large, and not only by the industry, the EU has put in place mechanisms that aspire to evenly distribute the cost of innovation. EU mechanisms in this regard fall broadly into two categories, i.e. EU programmes to support R&D&I activities and EU rules to facilitate the granting of State aid.

In recognition of aviation's immense contribution to the European economy and its pivotal role in social cohesion, in the year 2000, the Commission invited personalities from key stakeholders to chart the flightpath that would lead Europe to global leadership in the field of aeronautics. The so-called Group of Personalities deployed its vision in a report, entitled: "European Aeronautics: A vision for 2020". At the same time, it agreed to establish a new Advisory Council for Aeronautics Research in Europe (ACARE), tasked with the development of a strategic research agenda (SRA). ACARE was launched in 2001 and soon attracted over 50 members, including the European Commission, 27 Member States, manufacturers, airlines, airports, air

²²² See, <http://www.icao.int/environmental-protection/Pages/technology-standards.aspx>.

²²³ Ibid.

²²⁴ Ibid.

navigation service providers, the European Aviation Safety Agency, Eurocontrol, research centers and universities, the energy industry and regulators²²⁵. Ever since its establishment, ACARE has stayed faithful to its mission, counting numerous examples of successful research²²⁶. At the same time, it has expanded its horizon beyond 2020 and towards 2050 and has embarked on the development of a new Strategic Research and Innovation Agenda (SRIA) for aviation²²⁷. To ensure the dissemination of the SRIA and raise the profile of EU research in the aeronautics sector on a global scale, the European Commission is supporting via Seventh Framework Programme financing a Communication project, AERA-Pro. AERA-Pro will organize and promote a number of dissemination events all around the European Union²²⁸. In the same vein, the Commission has created a single portal for all transport research conducted at European and national levels and in ERA countries. The Transport Research and Innovation Portal (TRIP) provides the most up-to-date information on transport research projects, programmes and activities to increase awareness, understanding and the take-up of transport research results. TRIP is also funded by the Seventh Framework Programme²²⁹.

In its Strategic Research Agenda, ACARE emphasised that technological changes are needed in order to achieve by 2020 the goals of cutting CO₂ emissions by 50%, NO_x emissions by 80%, perceived external noise by 50%, and making substantial progress in reducing the impact of manufacture, maintenance and disposal of aircrafts and related products on the environment. The Seventh Framework Programme provides for a Community contribution to the establishment of long-term public-private partnerships in the form of Joint Technology Initiatives (JTIs), which could be implemented through Joint Undertakings within the meaning of Article 187 TFEU. To this end, in 2007 the Council invited the Commission to submit proposals for the setting up of JTIs that have reached an appropriate stage of preparedness. Council Regulation No. 71/2007 setting up the so-called Clean Sky Joint Undertaking²³⁰, is an expression of the realization that the extent of the effort required to address the environmental challenges to the air transport system is such that it justifies the setting up of a legal entity to ensure the coordinated use and efficient management of the funds assigned to the JTI. The Clean Sky JTI aims at mitigating the various risks of market failure which discourage private investment in aeronautics research in general and in clean air transport technologies in particular. The Clean Sky JTI has attracted all key stakeholders, who are equally responsible for its financing. Specifically, the total budget allocated to Clean Sky for the period 2008-2017 amounts to €1.6 billion, €800 million being contributed by the Community and the remainder by other members of the Joint Undertaking²³¹.

²²⁵ About ACARE, see <http://www.acare4europe.org/about-acare>.

²²⁶ Ibid.

²²⁷ SRIA is aligned with the Report of the High Level Group on Aviation Research, entitled: "Flightpath 2050 – Europe's Vision for Aviation", adopted in 2011 and commissioned by the European Commission. The report is available at: <http://ec.europa.eu/transport/air/doc/flightpath2050.pdf>. See also http://ec.europa.eu/transport/air/hlg_aviaiton_aeronautics_en.htm.

²²⁸ See <http://www.aera-pro-project.eu/web/>.

²²⁹ http://ec.europa.eu/transport/research/trip_en.htm.

²³⁰ Council Regulation (EC) No. 71/2007 of 20 December setting up the Clean Sky Joint Undertaking, OJ L 30/1, 01.04.2008.

²³¹ For more information, see <http://www.cleansky.eu/>. See also Article 5 of Regulation 71/2007. See also Airbus Press Release of 12.09.2012: "Airbus supports extension of Clean Sky programme", at:

In the United States, the Federal Aviation Administration has also expressed its commitment to environmental stewardship by forging partnerships with the private sector to develop green aircraft and engine technologies. The Continuous Lower Energy, Emissions and Noise (CLEEN) programme is NextGen's main tool to develop new technologies, procedures and, as already mentioned, sustainable alternative jet fuels. Specifically, CLEEN's goals include developing and demonstrating by 2015:

- certifiable aircraft technology that reduces aircraft fuel burn, energy consumption and GHG emissions;
- certifiable aircraft technology that reduces noise levels; and
- suitability of new technology for engine and aircraft retrofit to accelerate penetration into the commercial fleet²³².

In 2010, the FAA awarded five-year agreements to Boeing, General Electric, Honeywell, Pratt & Whitney and Rolls Royce to pursue the CLEEN goals. The total federal investment amounts to \$ 125 million. CLEEN being a cost-sharing programme, the industry's contribution has to be at least commensurate, raising the total value of investments to \$ 250 million²³³.

Besides those initiatives, green innovation in the area of aeronautics has been greatly supported by the EU Member States themselves via the EU State aid regime. Government subsidies have always been a means to support industry, yet the European Union is the only trading block in the world that has regulated the granting of subsidies by means of a comprehensive set of rules. The EU State aid regime justifies the granting of aid for a wide range of objectives of common interest. Innovation is one of them.

State aid may only be granted when it targets a genuine market failure and, even then, upon strict conditions. Investment in green technologies in aeronautics is costly and risky. As a result, the private sector is reluctant to step in. The State aid regime aims at addressing this reluctance by dividing the risk between the public and the private sectors. The main legislative instrument that has been employed in this respect is the 2006 Research, Development and Innovation Framework²³⁴. It should be mentioned that State aid for innovation may also be granted under the 2006 Risk Capital

http://www.airbus.com/no_cache/presscentre/pressreleases/press-release-detail/detail/airbus-supports-extension-of-clean-sky-programme/.

²³² For more information, see:

http://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/.

²³³ See http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=11538; General Electric Aviation Press Release of 24.06.2010: "General Electric Aviation receives award for FAA CLEEN research, at: http://www.geaviation.com/press/other_20100624.html; Rolls-Royce Press Release of 19.07.2010: "Rolls-Royce receives \$ 16 million FAA CLEEN technologies programme award", at: http://www.rolls-royce.com/civil/news/2010/cleen_technologies_programme_award.jsp; See also FAA presentation of 27.10.2010: "CLEEN Program – Overview", at: http://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/2010_consortium/media/FAA%20CLEEN%20Overview%20-%20Consortium%202010.pdf; see also p.13 of 2012 Implementation Plan.

²³⁴ Community Framework for State aid for research and development and innovation, OJ C 323/1, 30.12.2006.

Guidelines²³⁵, the 2008 General Block Exemption Regulation (GBER)²³⁶ and the 2008 Environmental Guidelines²³⁷. Nevertheless, the capital-intensive nature of investments in aeronautics in principle rules out the application of the Risk Capital Guidelines and the General Block Exemption Regulation. Whilst it is true that the European aeronautic industry numbers approximately 82,000 aeronautical companies, including a significant share of small and medium-sized enterprises²³⁸, the thresholds provided for in the Risk Capital Guidelines and the GBER are easily met, rendering individual notification under the R&D&I Framework necessary²³⁹. At the same time, the R&D&I Framework applies also to relevant measures in the environmental field, in recognition of the fact that there are many synergies to exploit between innovation for quality and performance and innovation to optimize energy use, waste and safety²⁴⁰. Therefore, the R&D&I Framework is the most appropriate instrument to apply in the field of aeronautics, hence the Commission's reliance on and scrutiny of innovation aid measures under its prism²⁴¹.

Since the adoption of the State Aid Action Plan in 2005²⁴², the Commission has advocated a more refined economic approach in the field of State aid law. This has been mainly expressed in the form of a balancing test, whereby the positive impact of the aid measure in reaching an objective of common interest is balanced against its potentially negative side effects by distortion of competition and trade²⁴³. More specifically, the balancing test operates in three steps. First, the Commission examines whether the aid measure is aimed at a well-defined objective of common interest. Second, it looks into whether the proposed aid addresses a market failure. This presupposes an examination of the appropriateness of the aid, its incentive effect and its proportionality. Lastly, it examines whether the distortions of competition and effect on trade are limited, so that the overall balance is positive. Especially with

²³⁵ Community Guidelines on State aid to promote risk capital investments in small and medium-sized enterprises, OJ C 194/2, 18.08.2006.

²³⁶ Commission Regulation (EC) No 800/2008 of 6 August 2008 declaring certain categories of aid compatible with the common market in application of Articles 87 and 88 of the Treaty, OJ L 214/3, 09.08.2008.

²³⁷ Community Guidelines on State aid for environmental protection, OJ C 82/1, 01.04.2008.

²³⁸ See Report of the High Level Group on Aviation Research: "Flightpath 2050 – Europe's vision for Aviation", 2011.

²³⁹ On the scope of the Risk Capital Guidelines, see section 2.1. thereof, at p. 7. On the aid intensity of risk capital measures, see Communication from the Commission amending the Community guidelines on State aid to promote risk capital investments in small and medium-sized enterprises, OJ C 329/4, 07.12.2010. On the scope of the GBER, see Article 1 thereof, at p. 14. On notification thresholds, see Article 6 of GBER, at p. 13.

²⁴⁰ On the Framework's scope of application, see section 2.1., at pp. 8-9, in conjunction with paragraph 60 of the environmental Guidelines at section 2.1., p. 2.

²⁴¹ On the R&D&I Framework, see: Rubin de Cervin and Zuleger, "Large R&D projects – Commission Practice under the R&D Framework from 1996 to 2006", 1 EStAL (2006), 15-22; Kleiner, "The New Framework for Research, Development and Innovation, 2007-2013", 2 EStAL (2007), 231-248; Friederiszick and Röller, "Using Economic Analysis to Assess R&D&I State Aid Measures", 4 EStAL (2007), 592-604; Von Wendland, "R&D&I – State Aid Rules at the Crossroads – Taking Stock and Preparing the Revision", 2 EStAL (2012), 389-409; On the GBER, see: Deiberova and Nyssens, "The General Block Exemption Regulation (GBER): What Changed?", 1 EStAL (2009), 27-38; Berghofer, "The GBER: A Giant on Feet of Clay", 3 EStAL (2009), 323-336; on risk capital, see Morais and Sousa Ferro, "Risk Capital as State Aid: Revising the Commission's Market Failure Approach", 3 EStAL (2011), 425-432.

²⁴² State Aid Action Plan – Less and Better Targeted State Aid: a Roadmap for State Aid Reform 2005-2009. COM (2005) 107 final – SEC (2005) 795; adopted on 7 June 2005.

²⁴³ See section 1.3. of the Framework.

regard to measures that, due to their aid intensity, carry a higher risk of distortion of competition, the Commission carries out a more detailed assessment²⁴⁴. R&D&I aid to aeronautics by and large exceeds the thresholds set in the Framework, being subject to a detailed assessment²⁴⁵.

For reasons of transparency and legal certainty, the Commission has devised a methodology to be followed in cases of detailed assessment. Looking first into the positive effects of the aid, special emphasis is laid on the incentive effect of the measure, i.e. on the recipient changing its behaviour so that it increases its level of R&D&I activity in size, scope, amount spent or speed. Where the R&D&I activity commences prior to the beneficiary applying for aid to the national authorities, the aid is deemed not to present an incentive for the beneficiary²⁴⁶. Moreover, the intended change in behaviour has to be well-specified and identified by counterfactual analysis, i.e. by comparing the intended activity with and without the aid. The difference in the two scenarios is considered to be the impact of the aid and defines the incentive effect²⁴⁷. Additional indicators, such as the level of profitability, the amount of investment and the time path of cash flows or the level of risk, are also considered²⁴⁸.

Whether an aid contributes to an objective of common interest can be understood in terms of its contribution to efficiency by remedying a market failure. The burden of proof on the Member States to identify the R&D&I market failure, either general within the EU or specific, becomes heavier the more the aid intensity increases. Generally, the Commission takes into account knowledge spillovers, imperfect and asymmetric information and coordination failures²⁴⁹.

In the aerospace industry, all these market failures are generally present. R&D&I activities bring about positive externalities that cannot be fully appropriated by the companies that carry them out. The Commission has accepted that the pyramid architecture of the aeronautic sector facilitates knowledge dissemination throughout the industry chain.²⁵⁰ Moreover, aeronautical technologies spill over into other economic and technological sectors, contributing to the growth of the European economy as a whole²⁵¹. Yet, the main market failure that plagues the industry is that of imperfect and asymmetric information on the financial markets. Generally, the capital-intensive nature of R&D&I in aeronautics, the technical and commercial risks involved and the insufficient and uncertain levels of profitability discourage private investment. Projects targeting the development of new products with high up-front investment and long delays for the return on capital are deemed highly risky by the

²⁴⁴ See section 7 of the Framework.

²⁴⁵ See, for instance, Commission Decision S.A. 30169 (N 3/2010) – Spain. State loan for R&D to AERNNOVA, 26.01.2011, (2011) 264 final; SD 30282 (N 204/2010) – Sweden. R&D aid to Volvo Aero for Trent XWB ICC, 23.02.2011, C (2011) 995 final; State aid N 357/2009 – United Kingdom. Individual R&D aid to GKN ASL, 15.09.2009, C (2009) 6874 final.

²⁴⁶ On this point, see, for instance, paragraphs 16, 19, 78 and 79 of Commission Decision on R&D aid to Volvo Aero. *Ibid*.

²⁴⁷ *Ibid*, paragraphs 78-85.

²⁴⁸ See section 7.3.3. in conjunction with section 6 of the Framework. See, in this respect, section 4.4. of Commission's Decision in Volvo Aero. See also section 3.6. of Commission's Decision in GKN ASL and section 3.4.3. of Commission's Decision in AERNNOVA, *supra* note 237.

²⁴⁹ See section 7.3.1. of the Framework.

²⁵⁰ See paragraph 40 of Volvo Aero Commission Decision, *supra* note 237.

²⁵¹ See Flightpath 2050, at p. 5, *supra* note 230.

market. When assessing risks, the Commission takes into account in particular the irreversibility of the investment, the probability of commercial and technical failure, the risk that the project will be less productive than expected and the risk that the project costs undermine the company's financial viability²⁵². Lastly, the coordination failure is linked to the change of business model of the aircraft industry. The merger wave that occurred between 1990 and 2000 marked a structural change from an organization "in rake" to a pyramidal set-up. Whilst this evolution could lead to a long-term increase in technological ability and productivity, it is initially costly to implement in terms of transaction costs²⁵³. Although the Commission has recognized the general nature of the coordination problem, it is reluctant to accept its presence in specific cases²⁵⁴.

Once the positive effects of the aid have been determined, the Commission measures them against possible distortions of competition and trade on the market concerned. Generally, the Commission examines the potential of the aid measure to distort dynamic incentives, i.e to crowd out competitors, to create market power or to maintain an inefficient market structure. In each step of its analysis, the Commission considers a number of elements, specified in the Framework.

As already mentioned, the aeronautics sector has absorbed 29% of total R&D&I aid above €3 million approved under the Framework in the period 2007-2010. All those measures are linked, one way or another, to the environmental performance of the industry, aiming at improved fuel efficiency, reduced CO2 emissions and lower noise levels.

Although the EU State aid regime is unique, the EU is not alone in the subsidization of the aeronautics industry. It suffices to mention that a comparative study carried out by WTO in 2006 suggests that the level of aid granted by EU Member States is comparable to the levels granted by the EU's main trading partners²⁵⁵. According to data reported by the FAA, the NextGen research, engineering and development portfolio absorbs a considerable amount of government funding. For fiscal year 2010, the FAA's request to the government amounted to \$ 180 million, representing an increase of \$ 9 million above the fiscal year 2009 enacted level²⁵⁶.

VI. Synthesis/Assessment

²⁵² On the Commission's assessment of market failures, see section 3.4.1. of Commission Decision in AERNNOVA, section 3.4. of Commission Decision in GKN ASL and section 4.2. of Commission Decision in Volvo Aero, *supra* note 237.

²⁵³ On this point, see section 3.4.1.3. of Commission Decision in AERNNOVA, *supra* note 237.

²⁵⁴ *Ibid.*

²⁵⁵ See World Trade Organisation Report 2006: "Exploring the links between subsidies, trade and the WTO", at: http://www.wto.org/english/res_e/booksp_e/anrep_e/world_trade_report06_e.pdf. See Section II: "Subsidies, Trade and the WTO", Chapter E: "The Incidence of Subsidies". For another aspect of subsidisation of civil aircraft manufacturing, see Knorr, Bellmann and Schomaker, "Subsidies in Civil Aircraft Manufacturing: The World Trade Organisation (WTO) and the Boeing-Airbus Dispute", 3 *EStAL* (2012), 585-599.

²⁵⁶ See FAA Budget Highlights, Fiscal Year 2010, May 2009, at: http://www.faa.gov/about/office_org/headquarters_offices/aba/budgets_brief/media/2010_budget_highlights.pdf.

Undoubtedly, the decision of the EU to include international aviation in the EU ETS has been a checkmate move innovation-wise. Despite the contestable legality of this initiative, the message was communicated that air transport can no longer escape its environmental obligations. Amazingly, the message was so strong that it immediately permeated the entire industry, generating an innovation fever. Whilst the outcome is indisputable, the reasons and the process that led to it might not be so obvious. Was the absorption of the message and its immediate effect a corollary of the realization that the environment is in danger or are there other reasons that brought about this outcome?

Arguably, the green-innovation fever that has gripped the industry is not simply an expression of environmental conscience. Nor are the EU enforcement mechanisms so powerful as to induce compliance at a global level. Whilst innovation might be expensive in the short and medium term, in the long run it brings about efficiencies that, in the industry's language, are translated into cost savings (€€→\$\$). Given air transport's notoriously low profitability margins, innovation appears to be the one-way ticket to the other side. Yet, since innovation is too expensive to be borne by the industry alone, the ticket must be subsidized²⁵⁷.

Tracing the flightpath to innovation from an EU policy perspective, it appears that the point of departure has been the environmental policy integration (EPI) principle, enshrined in Article 11 TFEU and Article 37 EU Charter of Fundamental Rights. The duty to consider the environment in the design and implementation of the Union's policies and activities is further strengthened and, in fact, has to be coupled with the principle of consistency, provided for in Article 7 TFEU. The EPI principle may only be effective if it is not defeated due to inconsistencies and controversies between different EU policies and actions. At the same time, the EPI principle itself works in the direction of the convergence of EU policies and actions, binding them together in a family relation. As the example of biofuels illustrates, policies at first sight irrelevant to each other, such as air transport and energy, are gradually converging, being defined by common environmental priorities and, as such, sharing common interests. EU energy policy cannot neglect air transport needs in biofuels and air transport, in its turn, cannot overlook the progress achieved in the development of

²⁵⁷ In 2008, leaders of the aviation industry signed a Declaration, committing themselves to action on climate change. In 2012, at the 6th Aviation and Environment Summit, convened in Geneva, Switzerland, from 21-22 March, the industry reported on and assessed its environmental progress thus far. The Summit culminated in a Declaration that calls on governments to pursue the common goal of economic prosperity and sustainable development through: 1. continued investment in academic and international collaborative research for the development and implementation of new green technologies and operational practices; 2. urgent action for advancement of a highly-efficient air traffic control capacity; 3. encouraging the use of alternative renewable energy by providing appropriate policies and incentives to facilitate the timely, cost-effective and sustainable development of aviation biofuels; 4. continued development of sustainable airport infrastructure to meet the anticipated future demand for aviation services within the context of the economic, social and environmental needs of society; 5. providing a positive regulatory environment that encourages aviation development as part of a broader government economic growth policy, co-ordinated across national borders; and 6. urging governments to reach agreement at the ICAO for a global framework for reduction of emissions from aircraft operations using technology development, efficient operations and infrastructure, and the use of international multilateral market-based measures to address any remaining emissions gap. See [http://www.airtransportnews.aero/analysis.pl?id=1209&keys=2012 Aviation & Environment Summit](http://www.airtransportnews.aero/analysis.pl?id=1209&keys=2012%20Aviation%20&Environment%20Summit). To access the Declaration, visit: <http://www.airtransportnews.aero/content/p1209.pdf>.

biofuels. Innovation is a facilitator of this process, spanning all EU policies and paving the way to the overarching goal of sustainable development.

Innovation as a means to achieve the objectives of the various EU policies and actions, rather than as an objective in itself²⁵⁸, is fostered in manifold ways. Whilst it does not appear that the EU has in place a fully-fledged innovation policy, that is to say an autonomous system of horizontal rules on innovation, it does have a number of tools and instruments that encourage innovation, either indirectly, by inducing it, such as the EU ETS, or directly, by actively supporting it, such as the EU State aid regime or the Seventh Framework Programme.

Arguably, triggering innovation indirectly is not always a conscious choice of the EU, but it may also occur incidentally. For instance, whilst the EU ETS is a rather straightforward way to ignite innovation²⁵⁹, the methodology for setting airport landing charges and air navigation services charges is not. If one considers that landing charges and air navigation services charges paid by airlines to airports and ANSPs respectively are a function of aircraft weight²⁶⁰, which means in practice that

²⁵⁸ On this point, see Laguna de Paz, “Protecting the Environment Without Distorting Competition”, (2012) *Journal of European Competition Law & Practice*, 1-10, who contends that: “Environmental goals cannot impede competition law to ensure a non-distorted functioning of the market. Taking into account environmental objectives is not the same as putting competition policy at the service of environmental protection. Competition law cannot be instrumentalised, becoming environmental, industrial or social policy”. This argument seems to have been endorsed by EU legislation. See, for instance, Article 2 (2) (a) of Decision No 661/2010/EU on Union Guidelines for the development of the trans-European transport network (supra note 9), which reads: “The network must ensure the sustainable mobility of persons and goods within an area without internal frontiers under the best possible social and safety conditions, while helping to achieve the Union’s objectives, particularly in regard to the environment and competition, and contribute to strengthening economic and social cohesion”. Arguably, in contrast to the EU policies and actions defined in the Treaty, which are hierarchically at the same level, innovation can be instrumentalised, being itself a means to achieve each objective pursued by the various EU policies and actions..

²⁵⁹ Arguably, the EU ETS functions in itself as a catalyst for innovation. The EU has tried to simultaneously facilitate and magnify the innovation outcome, by recommending that revenues generated from the auctioning of allowances be “used to tackle climate change in the EU and third countries, inter alia, to reduce greenhouse gas emissions, to adapt to the impacts of climate change in the EU and third countries, especially developing countries, to fund research and development for mitigation and adaptation, including in particular in the fields of aeronautics and air transport, to reduce emissions through low emission transport and to cover the cost of administering the Community scheme”(see Article 3d (4) of Directive 2008/101/EC). Similar recommendations have been made in the 2011 EU Implementation Plan: “2 million tons per year: A performing biofuels supply chain for EU Aviation” (see page 19 thereof). At this point it should be emphasized that the aviation industry has resolved that revenues generated from market-based measures should be re-invested in the industry to address its environmental impact. See guiding principle (n) for the design and implementation of market-based measures for international aviation, included in the Annex of ICAO’s Assembly Resolution A37-19: Consolidated Statement of Continuing ICAO Policies and Practices related to environmental protection – Climate Change. Generally, for a critique of Resolution A 37-19, see Adam, “ICAO Assembly’s Resolution on Climate Change: A “Historic” Agreement?”, supra note 98. Moreover, it is characteristic that the EU ETS considers biofuels to be zero emissions for compliance purposes, something which may only stimulate investment in aviation biofuels, supra note 113.

²⁶⁰ In this respect, see ICAO’s Policies on Charges for Airports and Air Navigation Services, Doc. 9082/7, 7th edn (2004), whose underlying principles and overall philosophy have been endorsed by the European Union in Directive 2009/12/EC of the European Parliament and of the Council of 11 March 2009 on airport charges (OJ L 70/11, 14.03.2009) and in Commission Regulation (EC) No 1794/2006 of 6 December 2006 laying down a common charging scheme for air navigation services (OJ L 341/3, 7.12.2006), as amended by Commission Regulation (EU) No 1191/2010 of 16 December 2010 (OJ L 333/6, 17.12.2010). According to paragraph 26 of ICAO Doc. 9082/7 on landing charges: “Landing

the heavier an aircraft is, the higher the charges are going to be, then the airlines have a strong incentive to place orders for lighter aircraft. If one further considers that in Europe landing and air navigation services charges combined represent approximately 11% of airlines' total operating costs²⁶¹, financing innovative composite technologies is meaningful. The latter outcome is further fostered by the EU ETS, whose charges are a function of fuel consumption, which, in its turn, is a function of aircraft weight. Although these two policies in association provide a strong innovation incentive, this is rather coincidental²⁶². Nevertheless, what is achieved is a spontaneous but very effective coordination of EU policies.

Direct support of innovation presupposes a certain capital expenditure. The EU has orchestrated this process around two main sources of funding, i.e. Member State funding and EU funding. A combination thereof is also possible. With regard to Member State funding, the EU has devised comprehensive rules on State aid to innovation. These are mainly contained in the 2006 R&D&I Framework, the 2006 Risk Capital Guidelines, the 2008 Environmental Guidelines and the 2008 GBER²⁶³. Especially with regard to air transport, the main document resorted to has been the 2006 R&D&I Framework and the main industry subsidized is that of aeronautics. Strikingly, whilst the Member States have been very generous towards the aeronautical industry, it does not appear that they have been equally supportive in the area of aviation biofuels. This is even more striking if one considers that, generally, biofuel production is an area that has absorbed a large percentage of R&D&I State aid²⁶⁴. The reasons for this discrepancy have been touched upon by the Commission in the Implementation Plan: "2 million tons per year: A performing biofuels supply chain for EU Aviation"²⁶⁵. The Commission has pointed to the difference in incentives for renewable fuels related to on-road applications and aviation use as a critical policy hurdle for commercializing aviation biofuels^{266 267}.

charges should be based on the weight formula, using the maximum certificated take-off weight as indicated in the certificate of airworthiness (or other prescribed document) as the basis for assessment. However, allowance should be made for the use of a fixed charge per aircraft or a combination of a fixed charge with a weight-related element, in certain circumstances, such as at congested airports and during peak periods". According to paragraph 45 of ICAO Doc. 9082/7 on route air navigation services charges: "The charge should be based essentially on: i) the distance flown within a defined area; ii) the aircraft weight".

²⁶¹ See IATA Economics, at: www.iata.org/economics. More specifically, see IATA Economic Briefing Infrastructure Costs, July 2009, at:

http://www.iata.org/whatwedo/Documents/economics/Infrastructure_Costs_Jul09.pdf.

²⁶² Whilst the EU ETS is a European policy, the methodology for setting airport and air navigation services charges is an ICAO Policy. Nevertheless, the fact that the EU has endorsed ICAO's recommendations in ICAO Document 9082/7, by harmonizing Member State legislation accordingly, indirectly but effectively renders ICAO policy EU policy also. In this respect, see Ruwantissa Abeyratne, "A Critical Look at ICAO Policies on Charges Levied for Airports and Air Navigation Services", *Air and Space Law* 34, No. 3, 2009, pp. 177-187. At this point, it should be clarified that the weight element in the calculation of charges is mainly an expression of the principle of cost-relatedness. Therefore, it appears that whilst the rationale behind the adoption of the relevant rules was not in any way innovation-nuanced in its inception, nevertheless, the application of the rules amounts to a strong incentive to innovation.

²⁶³ All four documents are currently under revision in the context of the Commission's State Aid Modernisation initiative.

²⁶⁴ See Commission Staff Working Paper – Mid-Term Review of the R&D&I Framework, 10.08.2011.

²⁶⁵ Supra note 156.

²⁶⁶ "One critical policy hurdle for commercializing aviation biofuels is the difference in incentives for renewable fuels related to on-road applications and aviation use. The on-road applications have been encouraged by several measures (e.g. tax breaks and mandates) but these measures do not differentiate

The industry has confirmed this view²⁶⁸ and has called on governments to: 1. foster research into new feedstock sources and refining processes, 2. de-risk public and private investments in aviation biofuels, 3. provide incentives for airlines to use biofuels from an early stage, 4. encourage stakeholders to commit to robust international sustainability criteria, 5. make the most of local green growth opportunities, and 6. encourage coalitions encompassing all parts of the supply chain²⁶⁹. At the same time, in an effort to raise the profile of aviation biofuels, the industry has addressed the market failure in the allocation of biofuels by juxtaposing aviation's comparative advantages in relation to other modes of transport. Thus, whilst aviation represents a small customer for fuel producers, accounting for only 10% of liquid transport fuel use²⁷⁰, it possesses a highly concentrated distribution system. It is characteristic that a mere 190 airports control 80% of the world's passengers, when, at the same time, in the United States alone there are more than 160,000 gas stations²⁷¹. Additional countervailing advantages are that fuel is already highly controlled, that no change in equipment is needed to switch to biofuels, that customer demand is strong and that the sector enjoys a high profile²⁷².

Another instrument in the EU's innovation toolbox, which has not been touched upon in this paper, yet which is worthwhile mentioning, *inter alia* due to its affinity with State aid law, is EU public procurement law²⁷³. Strategic use of public procurement in

between the qualities of the biofuels; it is left up to the market operators to use any biofuel as long as the sustainability criteria of the RED are met. On the contrary, there are no comparable incentives for using biofuels in aviation. In the aviation sector only high physical quality biofuels (e.g. those with low freezing point or high purity) can be used to ensure the operability of the jet engines. This has led to the situation where high quality biofuels are finding applications in road transport although lesser quality biofuels could also satisfy the road transport needs...", at p. 16-17. The other two hurdles identified by the Commission are the lack of adequate financial instruments in constructing the plants and the lack of long term off-take agreements between the biofuel producers and the aviation industry. In this respect, see also European Commission Press release IP/12/975, 18.09.2012: "Transport and Innovation: Commission pushes to accelerate development and market uptake of new transport technologies".

²⁶⁷ On the same wavelength it appears to be also the other side of the Atlantic. See Document published by the USDA in conjunction with Airlines for America (A4A, formerly the Air Transport Association of America) and the Boeing Company: "Agriculture and Aviation: Partners in Prosperity", January 2012, at p. 12: "Currently, there are more than 20 second-and third-generation biofuel development projects occurring throughout the United States [...]. However, these projects need additional funding to support biofuel development in the near term. The ethanol industry, the Internet, and global positioning system (GPS) may have failed were it not for initial public investments and support. Thanks to this support, the success of these industries has exceeded expectations. To grow and maintain the commercialization of the next generation of biofuels, including those that can serve as aviation biofuel, this type of support is needed".

²⁶⁸ To be mentioned that the 2011 Implementation Plan has been jointly drafted by the European Commission, the paraffinic biofuel producers and the aviation sector.

²⁶⁹ See IATA Press Release of 15.11.2011 on the occasion of IATA Fuel Forum in Paris: "IATA: Working together on fuel – Biofuels are an industry priority", at: <http://www.iata.org/pressroom/pr/pages/2011-11-15-01.aspx>. See also 2012 Declaration, *supra* note 257.

²⁷⁰ Total transport fuel use in 2008 was over two billion tonnes. Of that, commercial aviation used 215 million tonnes of Jet A-1, see ATAG presentation: "Where are we with biofuels?", *supra* note 170.

²⁷¹ *Ibid.*

²⁷² On this point, see "Agriculture and Aviation: Partners in Prosperity" document, at p. 10. *Supra* note 267.

²⁷³ EU Public Procurement law consists of Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors, OJ L 134/1, 30.04.2004 and Directive 2004/18/EC of the

accordance with EU priorities has manifested itself either in the form of incentives to contracting authorities to invest in innovation or in the form of obligations defining their buying choices²⁷⁴. Considering that public procurement accounts for approximately 17% of the EU's GDP, representing an important market particularly in areas such as energy and transport²⁷⁵, its potential for fostering innovation is immense and, to a large extent, still untapped. The EPI principle in the definition of the Europe 2020 strategy has led to the emergence of innovation as a key enabler of policy convergence. In practice this means that innovation procurement cannot be dissociated from green procurement, as expressed in the various industries. This nexus is very strong in the area of air transport and if properly explored, it could rapidly and significantly contribute to the overarching goal of sustainable development. Unlike the United States, where public procurement in aviation is already being used, *inter alia*, as a means to spur fresh green innovations to success²⁷⁶, it does not appear that similar initiatives are under way in Europe.

With regard to EU funding, the principal mechanism activated to support innovation in air transport has been the Seventh Framework Programme for research, technological development and demonstration activities (FP 7). In fulfillment of the Lisbon strategy that set the noble (albeit somewhat too explicit) objective of Europe becoming the most competitive and dynamic knowledge-based economy in the world by the year 2020, the Seventh Framework Programme is the main EU instrument to complement the efforts of the Member States and the European industry²⁷⁷. Based on the triangle of knowledge, education, research and innovation, it is meant to contribute to growth, sustainable development and environmental protection by supporting a number of activities²⁷⁸. Transport (including aeronautics) has been identified as one of the areas of EU support²⁷⁹.

Perhaps the most interesting aspect of the way the European Union has managed FP 7 funding for air transport projects is its ample use of the possibilities offered under Article 187 TFEU for the setting up of joint undertakings. It is no coincidence that the two projects that have absorbed the largest part of FP 7 funding, i.e., the SESAR project and the Clean Sky Joint Technology Initiative, are both public-private partnerships²⁸⁰. A similar approach has been espoused in the United States in the

European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts, OJ L 134/114, 30.04.2004.

²⁷⁴ See, in this respect, Green Paper on the modernization of EU public procurement policy – Towards a more efficient European Procurement Market, COM(2011) 15 final, 27.01.2011, p. 33 et seq.

²⁷⁵ See “Europe 2020 Flagship Initiative, Innovation Union” Communication, at p. 16, *supra* note 1.

²⁷⁶ See, in this respect, the “Agriculture and Aviation: Partners in Prosperity” document, at p. 12, *supra* note 267. On this point, see also “Europe 2020 Flagship Initiative, Innovation Union” communication, at p. 17, *supra* note 1.

²⁷⁷ See paragraph 2, paragraphs 20-21 and paragraph 35 of Decision 1982/2006/EC, *supra* note 8.

²⁷⁸ See paragraph 29 of Decision 1982/2006/EC. *Ibid.*

²⁷⁹ See Article 2 (1) (g) of Decision 1982/2006/EC. *Ibid.*

²⁸⁰ In this respect, see Annex I of Decision 1982/2006/EC, which recognizes that: “In a very limited number of cases, the scope of an RTD objective and the scale of the resources involved could justify setting up long term public private partnerships in the form of Joint Technology Initiatives. These initiatives, mainly resulting from the work of European Technology Platforms and covering one or a small number of selected aspects of research in their field, will combine private sector investment and national and European public funding, including grant funding from the Seventh Framework Programme and loan and guarantee finance from the European Investment Bank. Each Joint

context of the NextGen programme. Pooling public and private resources is deemed justified by the magnitude of the relevant projects.

A further interesting feature, pertaining in particular to the management of SESAR, is the strategic use of EU funding. It is characteristic that EU funding is higher at the initial phases of the project and regresses as the project is deployed. Thus, whilst, for instance, the definition phase of SESAR is co-financed by the EU and Eurocontrol, the development phase is partly financed by the EU and partly by other public and private sector sources and the deployment phase is the sole responsibility of Member States and industry stakeholders²⁸¹. This strategy, which obviously aims at incentivising and engaging public and private stakeholders to a point of no return, might, nevertheless, be defeated by the latter's reluctance to commit adequate resources, especially in times of budget constraints. The precedent of the Functional Airspace Blocks and the delays in their implementation is, in this respect, telling²⁸². A question that arises is whether the EU has adequate enforcement mechanisms to safeguard the appropriate deployment and completion of the various projects without itself releasing more funding.

This last point should probably be seen against the additional opportunities offered at EU level for funding. The Trans-European Networks framework programme, for instance, has not remained a theoretical possibility in air transport.²⁸³ It is characteristic that EU financial support has been granted to all Functional Airspace Blocks through the Trans-European Network – Transport programme²⁸⁴. Whilst it is true that the very nature of SESAR renders the Trans-European Network mechanism an appropriate instrument to resort to, this should only occur when absolutely justified. In State aid law jargon, cumulation of aid under different EU instruments for the same eligible costs should be prevented²⁸⁵. Moreover, it should not be forgotten that the rationale behind the adoption of multi-annual work programmes for grants in the field of trans-European transport networks and, therefore, the commitment of the Union over a long period of time, aims to reduce the uncertainties connected with the completion of these projects and to mobilise both public and private investors²⁸⁶. It is

Technology Initiative will be decided upon individually, either on the basis of Article 171 of the Treaty (this may include the creation of a joint undertaking) or on the basis of Specific Programme Decisions in accordance with Article 166(3) of the Treaty”.

²⁸¹ To ensure the smooth transition to the deployment phase, the Commission ordered a study on adequate innovative funding mechanisms. The study has been carried out by consultant booz&co. and is available at: http://ec.europa.eu/transport/air/studies/sesar_en.htm.

²⁸² Supra note 132.

²⁸³ See Article 4 (2) of Regulation (EC) No 219/2007. See also paragraphs 5-6 of Regulation (EC) No 1361/2008, supra note 199.

²⁸⁴ See Report from the Commission to the European Parliament and the Council on the implementation of the Single Sky legislation: time to deliver, COM (2011) 731 final, 14.11.2011, p. 8. For an overview of all air projects funded under the TEN-T budget, visit: http://tentea.ec.europa.eu/en/ten-t_projects/ten-t_projects_by_transport_mode/air_including_airports.htm.

²⁸⁵ On this point, see Annex I (Cooperation) of Decision No 1982/2006/EC, at p. 9: “Particular attention will be paid to the overall coherence and coordination between JTIs and programmes and projects in the same fields...”, supra note 8.

²⁸⁶ See Paragraph 19 of Regulation (EC) 680/2007, supra note 205.

paramount that the Union's role as a risk-sharing partner, as opposed to a sole investor, is protected²⁸⁷.

In summary, using the example of aviation to approach the question of whether the EU possesses an innovation policy, it appears that the starting point must be the overarching goal of growth. Growth, in our times, is synonymous with sustainable development. In this sense, the environmental policy integration principle is a reflection of current needs and priorities. Its implicit role is to coordinate the various EU policies and actions to achieve the objective of sustainable development. The principle of consistency operates as a safety net, safeguarding the effectiveness of the environmental policy integration principle. Innovation is the catalyst in this process. The question that arises is whether the EU possesses that catalyst. If the example of aviation is suggestive of anything, it is that the EU has plenty of instruments that, if well-orchestrated, could produce an innovation concert. In this sense, innovation is in the air.

→ → → → → → → → → → → →

Opera: "Growth/Sustainable Development"

Composer: European Union

Conductor: Environmental Policy Integration Principle

Prompter: Principle of Consistency

Singers: EU Policies and Internal Actions

Orchestra: EU Innovation Policy

→ → → → → → → → → → → →

²⁸⁷ See paragraph 20 of Regulation (EC) 680/2007, in conjunction with Article 6(1) and Annex thereto. See also Article 13 thereof on cancellation, reduction, suspension and discontinuance of aid. Ibid.