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Agenda Item 8: Environment Matters
8.3 Aviation and Global Climate

Sustainable Aviation: A Comprehensive Approach to Mitigating Environmental Impacts

(Presented by the United States)

SUMMARY

This working paper outlines the efforts the U.S. Federal Aviation Administration (FAA) is making to mitigate aviation's environmental impacts under the auspices of the Next Generation Air Transportation System (NextGen) plan and achieving environment protection that allows for sustained aviation growth.

1. INTRODUCTION

1.1 Aviation has become an essential element of the world's economy over the past 60 years. It has made the world a neighborhood and redefined the nature of opportunity. Aviation is a crucial driver of economic development in large parts of the world and supports the world's largest industry, tourism. Yet aviation's success has been accompanied by concerns over its environmental impacts.

1.2 Aviation has made significant strides in lessening its environmental impact. Over the last 35 years in the United States, there has been a six-fold increase in the mobility provided by the air transportation system. At the same time there has been a 60% improvement in aircraft fuel efficiency and a 95% reduction in the number of people impacted by aircraft noise.[1] However, environmental issues have already resulted in the delay and/or down-scaling of capacity projects over the past decade, and this challenge is anticipated to grow.

[1] For Greener Skies: Reducing Environmental Impacts of Aviation, National Academy of Sciences (2002)

1.3 Anticipated increases in air transportation demand, despite the current global economic downturn, will place significant environmental pressures on various segments of the global air transportation system. In the United States, operational trends show that environmental impacts resulting from aircraft noise and aviation emissions will be principal constraints on the capacity and flexibility of the Next Generation Air Transportation System (NextGen) unless managed and mitigated.

1.4 For that reason, the United States has placed addressing environmental issues at the heart of our NextGen plan. We have launched a systematic approach that relies on better scientific understanding of impacts to ensure we address the right issues, improve models, advance more efficient operational procedures, enhance aircraft technology, develop and deploy sustainable alternative aviation jet fuels, and implement appropriate policy and market measures to address the present and evolving environmental challenges.

2. THE ENVIRONMENTAL RECORD

2.1 Aircraft noise remains the most significant environmental impediment to airport expansion in the United States in spite of an exceptional record over the past three decades. In the 30 years between 1975 and 2005, as the U.S. system went from just over 200 million to about 730 million passengers, exposure to significant aircraft noise decreased over 90%. [2]

2.2 Much of this improvement resulted from the introduction of the turbofan engine in the late 1960s and early 1970s, which also greatly reduced fuel burn. Engine technology is one of a number of technological and operational improvements that have led to a 50% drop in the average perceived noise from a single aircraft operation.[3] Yet a variety of noise "restrictions" continue to proliferate at airports around the world.

2.3 Advances in aircraft engine and airframe technology and better operating procedures have significantly improved aircraft fuel efficiency. The Boeing 777 is 300 times more efficient than the early Convair, Douglas, and Boeing jets.[4] Since 1985, aircraft energy efficiency has improved more than any other transportation mode – including trains. The efficiency of today's aircraft is as good as the typical U.S. family car. In fact, if cars and trucks had simply kept up with the energy efficiency improvements of U.S. aviation over the past 20 years, the United States would be importing 1.5 million fewer barrels of oil each day.

2.4 While aircraft noise remains the primary environmental concern in communities across the United States, air quality has become a growing issue. Although aviation remains a small contributor to total transport emissions, about 25% percent of U.S. commercial service airports are in nonattainment areas or maintenance areas for national ambient air quality standards – including 40 of the top 50 airports.

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[2] The FAA employs a noise metric of 65 decibels DNL (Day-Night Noise Level) in defining what is significant noise. DNL is a 24-hour, time-weighted energy average noise level based on A-weighted decibel.

[3] Over the last 25 to 30 years, the average aircraft noise certification level has decreased by 10 dB, which equates to about 50% reduction in perceived noise from a single aircraft operation.

[4] Colpin, J. and Altman, R., "Dependable Power Reinvented," AIAA 2003-2882, AIAA-ICAS International Air and Space.

2.5 As stricter ozone and particulate matter standards are put in place, concerns regarding air carriers' contribution to nitrogen dioxide emissions (that contribute to ozone production), particulate matter and other pollutants continue to grow. Not surprisingly, airports located in air quality nonattainment or maintenance areas increasingly find that air emissions add to the complexity, length, and uncertainty of the environmental review and approval of expansion projects.

2.6 Compounding concern over air quality issues is a growing focus on the contribution of aviation to climate change. U.S. aviation greenhouse gas emissions represent about three percent of total such emissions in the United States, similar to aviation's contribution to the global total. While there remain a number of scientific uncertainties regarding their impacts,[5] the potential effects of aircraft emissions on climate change may be the most serious long term environmental issue facing the growth of aviation. This results from the fact that unlike other transport modes, there is currently no alternative to either jet fuel derived from fossil sources or drop in replacements with similar properties. Without a fossil fuel alternative such a renewable jet fuel, aviation's global percentage of carbon emissions may continue to grow, given the likelihood of decreases from other sources and significant growth over the next 20 years despite the current economic downturn.

3. THE NEXTGEN PLAN

3.1 To meet the challenges aviation's growth poses in an effective manner, it is imperative that a well-structured and long-term approach is put in place to allow growth while managing environmental impacts. The FAA is undertaking this through the NextGen Plan. Our objective is to achieve *environmental protection that allows sustained aviation growth.* The challenge is to achieve a balance between aviation's environmental impacts and other societal objectives, both domestically and internationally. To realize this, we have put in place a systematic, comprehensive approach.

3.2 First, we are improving our scientific understanding and modeling capabilities. For example, with respect to emissions, while the impacts of carbon dioxide ($CO_{2)}$ are understood, our understanding of other emissions impacts -- especially at altitude -- ranges from fair to poor. We must gain sufficient knowledge to develop appropriate solutions. We are doing this through the Aviation Climate Change Research Initiative (ACCRI), launched in partnership with NASA and other U.S. agencies. Because noise remains an environmental concern, we are seeking to develop a more fundamental understanding of noise impacts. For example, we are studying human response to low frequency noise, noise in naturally quiet areas, and aircraft noise characteristics other than loudness. And we are continuing efforts to better characterize the impacts of aircraft emissions on human health and welfare.

3.3 With regard to decision-making tools, in designing aircraft engines, operating the aviation system, or choosing standards or policies, there are trade-offs between many kinds of performance. For example, while the high-bypass ratio engine led to reduced fuel burn and CO_2 emissions – as well as reduced noise – the increases in engine pressure ratios led to increased nitrous oxide (NO_x). In the past, decisions on technology, policies, and standards for noise and emissions tended to be made without consideration to interdependencies between them. Today, the FAA is building the modeling tools that will allow a more integrated approach to better inform policy makers; help maximize the benefits of proposed actions; guide research investment to optimize payoff; influence design practices; and inform the public about noise and emissions interactions.

[5] Intergovernmental Panel on Climate Change, 2007

3.4 Second, we are accelerating the implementation of operational improvements to reduce fuel burn. Improving the energy efficiency of the aviation sector has the dual benefit of improving both environmental and financial performance of the aviation sector. We have saved millions of tons of carbon emissions over the past few years since establishing Reduced Vertical Separation Minimum (RVSM) in the high altitude structure. We are accelerating implementation of Required Area Navigation (RNAV), Required Navigation Performance (RNP), and other terminal procedures to further improve the fuel efficiency of the system. Testing and gradual deployment of continuous descent arrival (CDA) procedures have shown great promise. CDA keeps aircraft at higher, more fuel efficient altitudes longer, and utilizes an idle descent profile to touchdown, reducing noise, fuel burn, and air quality impacts.

3.5 Third, we are taking steps to hasten the development of promising environmental improvements in aircraft technology. This builds upon the fact that the improvement in aviation's environmental performance the last three decades is based primarily on enhancements in engines and airframe technology. The recently launched Continuous Low Energy, Emissions, and Noise (CLEEN) Program is focused on reducing current levels of aircraft noise, emissions that degrade air quality, greenhouse gas emissions, and energy use by helping to mature technologies to the point where they are ready for incorporation into product design and manufacturing.

3.6 Fourth, as part of this technology push, we are advancing and deploying alternative fuels for aviation -- fuels that improve aviation's emissions performance at both the local and global level. This not only improves environmental performance but also energy security. The FAA is a major partner in the Commercial Aviation Alternative Fuel Initiative, or CAAFI. This partnership between airlines, manufacturers, airports, petroleum firms, and other federal agencies is implementing a road map to facilitate the use of alternative fuels for commercial aviation. The CLEEN Program will also advance alternative fuels for aviation use, with a particular focus on renewable options.

3.7 Renewable alternative fuels are real and on the horizon. We have already seen limited use of coal to liquid fuels in aviation and several flight demonstrations of renewable jet fuels options. A subcommittee of the international standard-setting body ASTM approved in June 2009 use of a 50 percent generic blend of conventional jet fuel and jet fuel derived via the Fischer-Tropsh (F-T) process. The blend is generic in that the F-T process could use biomass, coal or gas as its feedstock. Full approval by ASTM is expected by the end of 2009. Beyond this, CAAFI has set aggressive goals to establish further alternative fuel standards through the ASTM process along the following timeline:

100% F-T generic fuel including biomass	2010
50% Hydrotreated Renewable Jet (HRJ) blend biofuel	2010
100% HRJ biofuel	2013

3.8 Important challenges must be addressed, including competition between renewable energy crops and food crops, detrimental land-use change, identification of appropriate feedstocks, and production at scale. If these concerns as well as performance and cost issues can be overcome, renewable fuels could be blended with synthetic or conventional jet fuels, used as drop-in fuels compatible with the current fleet, leading to a more-sustainable aviation fuel. Renewable alternative fuels may very well be the revolutionary technology that enables carbon-neutral aviation growth, and eventually moves aviation toward carbon-neutral operations.

3.9 Finally, appropriate policy approaches, including market-based measures may offer assistance in managing aviation emissions growth. We are developing goals and metrics for NextGen. Approaches such as emissions trading or carbon offsets may have a role to play. The key is that global market-based measures must respect the prerogative of States to develop and implement the measures they believe appropriate.

4. INTERNATIONAL COOPERATION

4.1 Aviation is an inherently global activity. Addressing aviation's environmental impacts can only be strengthened through international cooperation. The United States is pursuing international collaboration in a number of arenas. In research, our Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence has Canadian sponsorship and ongoing research endeavors with seven countries. In air traffic management, we have undertaken initiatives over both the Atlantic with European partners (Atlantic Initiative to Reduce Emissions -- AIRE) and over the Pacific with South Pacific partners (Asia-South Pacific Initiative to Reduce Emissions -- ASPIRE) to accelerate the use of air traffic procedures that reduce fuel burn and improve emissions performance. We look forward to including up to two new Asian partners in the ASPIRE initiative in May. In addition, CAAFI has participation from a number of international companies and research organizations representing six continents.

4.2 The International Civil Aviation Organization (ICAO) is responsible for global standards. It offers the best forum to address aviation's environmental issues. Although it must guide 190 member countries to consensus decisions, it has achieved a significant record of environmental improvements. Over the last 10 years it has fostered adoption by the international aviation community of environmental goals in noise, air quality, and climate change; a new noise standard; two increases in NOx stringency for engines; guidance on operational measures to reduce fuel burn; and guidance for States that wish to adopt emissions trading.

4.3 The United States strongly supports the Program of Action put forward by the ICAO Group on International Aviation and Climate Change (GIACC) in May and recently adopted by the Council for consideration by all Contracting States at the ICAO High Level Meeting on International Aviation and Climate Change October 7-9, 2009, in Montreal. The Program of Action contains several key components of note:

- Global aspirational goal of two percent annual fuel efficiency improvement in the short (2012), medium (2020), and long (2050) terms.

- Basket of measures (e.g., new technologies, operational procedures, and market-based measures) from which States may choose in designing their respective approaches to contributing to the global goal of addressing international aviation greenhouse gas emissions, on the basis of the most effective for their respective circumstances, including the development of assistance for developing countries in the form of financing, technology transfer, and capacity building.

- Mandatory annual reporting of traffic and fuel burn by all States per Article 67 of the Convention on International Civil Aviation.

- Submission by States of action plans to contribute to the global goals.

- Development of a CO_2 standard for new aircraft types.

- Establishment of a process to develop a framework for applying market-based measures internationally.

4.4 Much work remains to be done. Following the High Level Meeting, further efforts by Contracting States and ICAO will be necessary to make more concrete and robust the Program of Action. We believe ICAO offers the best venue to develop a collaborative, performance-based approach to tackle the critical issue of climate change and encourage all States to support the effort.

5. CONCLUSION

5.1 Aviation succeeded in its first century because it constantly met the challenge of innovation – flying faster, safer, quieter and cleaner. The United States is committed to continuing this record of success on environment. We recognize the imperative to be environmental stewards as we grow the aviation system. We have to manage capacity growth in an environmentally sound manner. If aviation is to grow and continue to contribute to the world economy, it will require partnership and shared responsibility – airlines operating quieter and cleaner fleets; airports implementing environmental management systems; air traffic service providers facilitating environmentally effective procedures; government policies and regulatory environment that encourages research and development of new technologies. We believe NextGen puts in place the right framework—built on sound scientific understanding and focused on technology and operational innovation—that will deliver the results to ensure environmentally responsible growth during aviation's second century.

5.2 International cooperation is a crucial component of the partnership and shared responsibility that are necessary to mitigate aviation's environmental impact.

5.3 The United States invites the participants in the10th Meeting of Directors of Civil Aviation of the Central Caribbean to note the information in this paper. We would be pleased to provide further information and to include interested participants in the projects described here.

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