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ASSEMBLY — 36TH SESSION

EXECUTIVE COMMITTEE

Agenda Item 17: Environmental protection

THE POTENTIAL USE OF ALTERNATIVE FUELS FOR AVIATION

(Presented by the United States)

EXECUTIVE SUMMARY

Interest in alternative fuels for commercial aviation has grown in tandem with concerns about rising fuel costs, energy supply security and the environmental effects of aviation. At the moment, the largest single driver for industry adoption of alternative fuels is the high cost of petroleum. If oil prices remain high, alternatives will remain attractive. However, energy security and possible environmental benefits are also powerful drivers. And, if oil demand outpaces supplies, jet fuel availability could become a constraint to growth. The United States has determined that it is prudent to explore now the potential move toward alternative fuels. This should be done with caution and in a global fashion. In the United States, in coordination with potential international collaborators, we have launched the Commercial Aviation Alternative Fuels Initiative (CAAFI) to develop a national roadmap for assessing, and possibly adopting, alternative aviation fuels. The aviation industry is interested in the possible savings and price stability offered by alternative fuels. Industry is willing to produce these fuels if there is a viable market for them. From an environmental perspective, we may be able to use alternative fuels to deal with some local air quality issues, allowing us to focus engine design on noise reduction and/or other environmental issues. Thus, alternative fuels efforts may offer opportunities to ICAO as it seeks balanced and robust strategies to mitigate aviation's environmental impact. This paper serves to update ICAO on U.S. alternative aviation fuels efforts.

Strategic Objectives:	This working paper relates to Strategic Objective C (*Environmental Protection – Minimize the adverse effect of global civil aviation on the environment*).
Financial implications:	Not applicable.
References:	

1. INTRODUCTION

1.1 Concerns about rising fuel costs, energy supply security and the environmental effects of aviation are providing a significant stimulus to take a fresh look at the use of alternative fuels for aviation. At the moment, the largest single driver for adoption of alternative fuels by industry is the high cost of petroleum. If oil prices remain high, alternatives may continue to be attractive. Energy security and possible environmental benefits are also powerful drivers. And, if oil demand outpaces supplies, jet fuel availability could become a constraint to future growth. The United States has identified a new window of opportunity for the introduction of alternative aviation fuels today and is taking steps to potentially advance such fuels. We have launched the Commercial Aviation Alternative Fuels Initiative (CAAFI) to develop a national roadmap, in coordination with potential international collaborators, for assessing, and possibly adopting, alternative aviation fuels.

2. BACKGROUND

2.1 Alternative fuels for aviation are not a new concept. Early jet engines were developed that used hydrogen, but, eventually, the realization that aircraft need a fuel that has high energy content per weight and volume led to the adoption of kerosene as the standard aviation fuel. The U.S. Department of Defense (DoD) as well as the UK Ministry of Defence (MOD) developed "synthetic" aviation fuels from a number of sources (shale oil, tar sands and coal liquids) in the late 1970s and early 1980s, driven by concerns about the stability of oil supplies. The oil glut of the latter part of the 1980s led both the U.S. DoD and the UK MOD to largely abandon their programs, as the fuels were not cost effective.

2.2 Between 1980 and 1984 Brazil developed PROSENE, an alternative combustible lipofuel (vegetable oil) used as an alternative to aviation kerosene. Pure biokerosene was used to power Embraer turboprop aircraft, between the cities of São José dos Campos and Brasília. In 1984, however, Brazil ceased its National Biodiesel and Biokerosene Program because of lack of interest by energy and economic authorities.

2.3 The embargo to end apartheid in South Africa provided the impetus for the adoption of the semi-synthetic aviation fuel Sasol, which is a blend of petroleum derived and synthetic kerosene in use today. U.S. engine manufacturers are pursuing efforts to qualify pure Sasol for operational use.

2.4 In 2003, the UK's Imperial College of the University of London published the results of the Potential for Renewable Energy Sources in Aviation (PRESAV) study (http://www.iccept.ic.ac.uk). The report concluded that methanol, ethanol, and biogas are unsuitable for jet aircraft, and that nuclear power is not a suitable alternative; however, Fisher-Tropsch (FT) kerosene (such as Sasol), hydrogen, and bio-diesel may offer potential benefits. The study noted that all three options would be significantly more expensive to produce compared to the then-current cost of producing kerosene. The authors noted, however, that production costs may drop sufficiently in the long-term for hydrogen and FT kerosene to become viable options. As hydrogen aircraft would require new engines and airframes, the study concluded that hydrogen fuelled aircraft would not be viable for several decades. The authors felt that, ultimately, renewable fuels would be used for applications such as road transport or electricity generation in preference to aviation.

2.5 Growing concerns about rising fuel costs, energy supply security and the environmental effects of aviation have created opportunities to take a fresh look at the use of alternative fuels for aviation. In the fall of 2005, the U.S. Federal Aviation Administration's Office of Environment and Energy held a long-term strategic brainstorming session with its Research and Engineering Development Advisory Committee (REDAC) subcommittee. All stakeholders – community representatives, airports, airlines, manufacturers, government – cited fuel-efficiency, cost, and supply availability as potentially the single most challenging issue facing aviation. The committee drafted a series of scoping questions to look at the potential of alternative fuels to impact the environment and capacity in civil aviation. The committee also urged the FAA to start a modest investment to address this potentially critical issue.

2.6 The dramatic rise in fuel prices we have experienced in the last year has caused intense concern in the aviation industry. Although prices have receded somewhat, interest remains high. Discovery of new crude oil resources has been falling while global demand has been rising. Some are concerned that future global fuel demands will outstrip current supplies and that jet fuel price could escalate with oil constraints. Boeing forecasts that various scenarios may lead to fuel prices ranging from $50 to $175 per barrel, which could translate to jet fuel prices ranging from $1 to $5 per gallon. The US Air Force consumed over 3 billion gallons of aviation fuel in FY 2005, at a cost of about $4.7 billion. Every $10 price increase per barrel of oil drives up their fuel costs by $600 million per year. Faced with these challenges, national and international stakeholders are urging government, industry and academia to come together and take proactive steps to meet these challenges. Also, the Aviation and the Environment Summit held in Geneva, Switzerland, April 25-27, quickly organized a fuels panel in which numerous stakeholders noted many of the promises and drawbacks of alternative fuels for aviation and brought attention to this important issue. And in the UK, Virgin Airlines launched an ambitious initiative to seek alternative fuels for aviation. Virgin has now teamed with the Boeing Company to demonstrate renewable alternative aviation fuels in 2008.

3. WEIGHING THE ISSUES

3.1 Adoption of alternative aviation fuels may play an important role for commercial aviation by: 1) improving price stability in the face of rising fuel costs; 2) increasing energy supply security given increasing global demand for petroleum and potential geo-political vulnerabilities; and 3) providing possible reductions in local air quality and greenhouse gas emissions. However, we must answer a number of technical, environmental and policy questions before advancing. Which fuels are feasible, and how do they affect current infrastructure? What are the environmental costs and benefits? What are the drivers for adoption of fuels? What, if anything, should we do to promote alternative fuels?

3.2 Of the current options, synthetic liquid fuels manufactured from coal, biomass or natural gas are viable, nearly identical replacements for kerosene, and in fact are in limited use today. The U.S. DoD is embarking on an aggressive program to promote synthetic fuels manufactured from domestic sources and conducted several successful tests with synthetic jet in the summer and fall of 2006. The DoD is working with manufacturers to procure significant quantities of jet fuel made from alternative sources. As military jet fuel is essentially identical to commercial jet fuel, the DoD efforts could stimulate alternative aviation fuel viability for the commercial sector.

3.3 Bio-jet – jet fuels made from agricultural oil crops – are deemed a midterm option but are handicapped by limited production capacity. Ethanol is not a good option for long haul aircraft but may be relevant to regional, short haul and general aviation. However, the interest of Virgin Airlines and the

Boeing Company in renewable fuels may stimulate innovation and accelerate the introduction of these fuels.

3.4 Hydrogen is a very long-term option dependent on technological developments and potentially prohibitive infrastructure investment.

3.5 Synthetic fuels could be environmentally promising. Synthetics contain no sulphur, and zero or, if blended, reduced aromatic components. Limited experiments have shown that such fuels produce less particulate matter (a growing concern for local air quality). Also, because synthetics have fewer tendencies to decompose, such fuels could allow more fuel-rich combustor design options that could reduce emissions of nitrogen oxides. And, because synthetic fuels have higher hydrogen content, they may offer some reductions (~1-2%) in CO2 emissions.

3.6 Aviation, because it is a relatively "compact" industry, could be a logical first adopter, but its demand may not be sufficient by itself to induce investment. Airports offer a nucleus for alternative fuels distribution for a community – aviation could play a role as a promoter of "clean" environmental practices throughout the communities surrounding airports. Thus, aviation would not be perceived as lagging behind as other sectors adopt cleaner fuels. However, in assessing potential benefits, we must consider the entire fuel production cycle. Synthetic kerosene produces equivalent levels of CO2 to petroleum kerosene when combusted. But, the production process for synthetic kerosene could ultimately lead to even more greenhouse gas emissions. Bio-jet and ethanol can produce less CO2, but require considerable land resources, which may present environmental and social costs associated with land use choices and single crop production. Hydrogen produces no particulates or CO2, but only if made using renewable energy sources. The processes to produce hydrogen from sources such as coal would lead to a relative production of CO2 higher than that of oil derived kerosene. In sum, the environmental benefits of alternative fuels are promising, but need to be carefully analyzed for tradeoffs.

3.7 Currently, the largest single driver for adoption of alternative fuels by industry is the high cost of petroleum. If oil prices remain high, alternatives will continue to be attractive. If oil prices drop, fiscal or other measures might be needed to maintain a viable market. Ultimately, while not solving all aviation environmental issues, alternative fuels may provide new solutions to multiple constraints on aviation. Local air quality is a concern for communities near many urban airports, which is likely to intensify as traffic increases. We may be able to use alternative fuels to allay such concerns, allowing us to focus engine design on noise reduction and other environmental issues..

4. FUTURE U.S. PLANS

4.1 Together with the U.S. DoD, the FAA is pursuing a scoping study to address the questions noted in Section 3.1 to clarify technical feasibility, quantify environmental benefits, identify the drivers for adoption of alternative fuels, and determine what, if anything, should we do to promote alternative fuels. We expect this study to be largely completed toward the end of calendar year 2007. The FAA is also sponsoring work to determine the emissions characteristics of both synthetic and renewable alternative aviation fuels.

4.2 In May 2006, representatives from the FAA, the DoD, Department of Energy and National Aeronautics and Space Administration (NASA), and members of the national and international fuel supply, aircraft and engine manufacturers, and airline industries came together in Seattle, Washington for a one-day workshop exploring alternative fuels for aviation. The workshop was sponsored by the

FAA, the Air Transport Association of America, Inc. (ATA), and the Aerospace Industries Association (AIA) with support from The Boeing Company and The Port of Seattle. As noted in Section 3.2, the U.S. DoD is driven by a mandate from its leadership to adopt alternative fuels and is pressing ahead. The workshop participants agreed that commercial aviation sponsors and stakeholders should work together with DoD/DOE to pursue alternative fuels for the purpose of securing a stable fuel supply, furthering research and analysis, and quantifying the ability to reduce environmental impacts and improve aircraft operations.

4.3 A follow-up meeting was held in October 2006 bringing together approximately 80 representatives of airlines, aircraft and engine manufacturers, energy companies and a number of U.S. government agencies. Out of this meeting the Commercial Aviation Alternative Fuels Initiative (CAAFI) emerged, lead by AIA, ATA, FAA and new member, Airports Council International-North America (ACI-NA). Participants in the workshop, including international representatives, focused on four areas: the present state and future requirements of R&D, the process for certification and qualification, environmental benefits and costs, and business cases and policy needs for alternative fuels. Over the course of two days, CAAFI agreed on a set of high level goals and next steps to pursue going forward. The FAA and commercial partners have enlisted the aid of the Partnership for AiR Transportation Noise & Emissions Reduction (PARTNER), centered at the Massachusetts Institute of Technology and connected to 10 universities, to go forward with relevant research.

4.4 The U.S. considers that current conditions provide a window of opportunity for the introduction of alternative aviation fuels. Petroleum price volatility and public support are high. The U.S. DoD is taking the lead in advancing alternative fuels for aviation–driven by energy security considerations. The U.S. Air Force completed flight tests this summer using a B-52 in which two of the bomber's engines burned a mix of petroleum jet fuel and synthetic jet fuel produced from natural gas. Testing of other types of Air Force aircraft with synthetic jet fuel is planned. In the United States, CAAFI is exploring collaborating with the U.S. DoD and providing leadership to the civil sector. Nevertheless we understand that history has shown the difficulty of predicting energy markets, and we must be cautious about pursuing alternative aviation fuels solely as a response to high prices or an impending energy crisis. We must note that we have been down a similar road before in the late 1970s and early 1980s. Heavy investment in alternative fuel options was stranded by the oil glut of the mid 1980s. We understand that progress is predicated on a long-term vision and the will of all stakeholders to see it through; we are working to foster such a long-term vision.

5. CONCLUSION

5.1 The United States considers it prudent to explore now the potential move toward alternative aviation fuels. This should be done with caution and in a global fashion. We have launched an integrated approach to developing a national roadmap, in coordination with international stakeholders, for alternative aviation fuels. The aviation industry is interested in the possible savings and price stability offered by alternative fuels. The fuel industry is willing to start producing these fuels if given market guarantees (protection from drastically falling oil prices) to do so. Alternative fuels may provide environmental benefits and could become an element of the environmental strategy for sustainable future growth of aviation. We may be able to use alternative fuels to deal with some local air quality issues, allowing us to focus engine design on noise reduction and other environmental issues such as greenhouse gases. Alternative fuels efforts may offer future opportunities to ICAO as it seeks balanced and robust strategies to mitigate aviation's environmental impact.

5.2 This paper serves to inform ICAO of U.S. alternative aviation fuels efforts. We will continue to update members on our progress, and invite collaboration.

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