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WORKING PAPER

ASSEMBLY — 38TH SESSION

EXECUTIVE COMMITTEE

Agenda Item 17: Environmental Protection

SUSTAINABLE ALTERNATIVE JET FUELS

(Presented by the United States)

EXECUTIVE SUMMARY

Sustainable alternative jet fuels have the potential to contribute to the environmental sustainability, energy security and economic stability of international aviation. The United States has undertaken considerable effort to advance research, development, demonstration and deployment of sustainable alternative jet fuels. T he United States will continue to pursue such efforts and welcomes the opportunity to collaborate with other States. The United States also supports ICAO's continued role of supporting States in their efforts to develop and deploy sustainable alternative jet fuels.

Action: The Assembly is invited to:

a) note progress being made in the advancement of alternative fuels through testing, analysis, fuel supply development and engagement;
b) reaffirm the importance of alternative jet fuels in addressing international aviation's environmental goals; and
c) reaffirm the role of ICAO to support member States' efforts and facilitate exchange of information among States and the sharing of best practices on research, development, demonstration and deployment of alternative jet fuel.

Strategic Objectives:	This working paper relates to Strategic Objective C – *Environmental Protection and Sustainable Development of Air Transport.*
Financial implications:	No additional funding required.
References:	

1. INTRODUCTION

1.1 Sustainable alternative jet fuels have the potential to contribute to the environmental sustainability, energy security and economic stability of international aviation. Lifecycle CO_2 emissions reductions from sustainable alternative fuels relative to conventional fuels have the potential to significantly contribute towards ICAO climate goals. Sustainable fuels also offer the potential to reduce emissions that impact local air quality. These fuels have the potential to serve as a direct replacement for conventional jet fuel, requiring no modification to existing infrastructure or aircraft engines.

1.2 Within the United States, considerable effort is underway to advance the research, development, demonstration and deployment of sustainable alternative jet fuels. Testing is being conducted to support certification of additional alternative jet fuels to expand the range of renewable feedstocks that can be used to power aviation. Analysis continues to assess the environmental sustainability of alternative jet fuel options as well as to understand and reduce costs. Cooperation within

the United States has been established via the Commercial Aviation Alternative Fuels Initiative (CAAFI) to share and communicate best practices and develop alternative jet fuel supply chains. CAAFI is a public-private partnership established in 2006 with the objective of advancing alternative jet fuels with equivalent safety/performance (drop-in), comparable cost, environmental improvement, and security of energy supply for aviation. Work through CAAFI has also expanded internationally. Fuel production capability is beginning to emerge, including with a recently announced airline and fuel producer agreement. Ultimately, efforts conducted by the United States, other countries, and partnerships like CAAFI are leading to the deployment of sustainable alternative fuels for international aviation.

1.3 Internationally, a number of countries and regions are making good progress in the development and deployment of sustainable alternative jet fuels through initiatives like CAAFI, as well as other innovative approaches. Since 2009, States have recognized a role for ICAO in facilitating the exchange of information among States and enabling the sharing of best practices on research, development, demonstration and deployment of alternative jet fuel. It is important to recognize that States should continue to lead in developing and deploying alternative fuels working with stakeholders such as the airlines, fuel providers, finance community, manufacturers, and other partners. ICAO should support States efforts, but not take on a more expansive role or seek to develop standards or policies in the area of sustainable alternative jet fuels.

2. UPDATE ON ACTIVITIES

2.1 Alternative Jet Fuel Testing

2.1.1 At present, ASTM International through the ASTM D7566 specification has approved the use of a 50% blend of synthetic hydrocarbon jet fuel made via either the "Hydroprocessed Esters and Fatty Acids" (HEFA) process or Fischer-Tropsch (F-T) synthesis. The ASTM International specification is structured so that additional fuel processes and sources can be approved as testing is completed and data become available.

2.1.2 To support the ASTM International certification process, the Federal Aviation Administration (FAA) and its industry partners in the Continuous Low Energy, Emissions and Noise (CLEEN) program, Boeing, Honeywell International, Inc., Pratt & Whitney, and Rolls-Royce, among others, are conducting laboratory and rig testing of drop-in alternative jet fuels. Work includes development of new fuel pathways and fuel components, as well as engine performance testing. Results of this work will be made available for evaluation by ASTM International as it works to develop additional fuel approvals. Since many States recognize the ASTM International jet fuel specification directly or have jet fuel specifications that are able to be revised to be consistent with the ASTM International specification, approval of an alternative fuel pathway through the ASTM International process allows for widespread use of the fuel across the world.

2.2 Alternative Jet Fuel Environmental and Cost Analyses

2.2.1 CAAFI has developed environmental sustainability guidance and an environmental progression for alternative jet fuels[1]. These two documents provide broad background information on environmental sustainability as well as the steps a fuel producer could take to evaluate sustainability.

2.2.2 Researchers have examined the life cycle greenhouse gas emissions (GHG) of alternative jet fuels. The analysis confirms that with an appropriate set of technologies, it is possible to get large reductions in life cycle GHG emissions and pollution affecting air quality. However, it is also possible in some cases, to have life cycle GHG emissions from alternative fuels that are significantly larger than those of conventional jet fuel from petroleum. Freshwater use and impacts on food production must also be considered. Ongoing analyses are examining lifecycle GHG emissions and sustainability impacts of algae fuels, pyrolysis fuels, "sugar" based pathways including alcohol-to-jet, catalytic conversion and

[1] Available on the CAAFI website at http://www.caafi.org

direct fermentation of sugars, and also waste oils to HEFA jet fuel. This analysis suggests that while there are many jet fuel options that offer great benefit, choices must be made with care.

2.2.3 Researchers have also developed economic production cost analysis methods and estimated alternative fuel production costs for HEFA and F-T fuels. The results show that HEFA production costs are dominated by feedstock cost while F-T fuel costs are dominated by capital expenditures. The cost model was combined with a multi-sector, global economic model to examine the costs of using HEFA to meet a goal of 1 billion gallons of alternative jet fuel use. The results show that the use of a rotation crop, grown on otherwise inactive land, has the potential to achieve a cost of below US$4.00 per gallon of HEFA fuel. This analysis points to the opportunity for using otherwise inactive cropland to grow rotation crops for biofuel production.

2.2.4 Efforts are also underway to examine the costs of other fuels and processes in the research and development stage. The effort will establish the current status of each fuel's cost of production, as well as understand the potential future commercial scale production costs for each pathway.

2.3 Developing Fuel Production

2.3.1 Significant effort continues to be devoted to supporting the development of alternative jet fuel production capacity in the United States.

2.3.2 United Airlines and Altair Fuels entered into the first cost-competitive commercial agreement between an airline and a biofuel producer in the United States in June, 2013. Altair fuels will supply 15 million gallons of waste oil HEFA fuel at Los Angeles International Airport over three years beginning in 2014. AltAir Fuels will retrofit part of an existing petroleum refinery to become a 30 million gallon, advanced biofuel refinery to produce low-carbon, renewable jet fuel and other products. The airline is reported to be purchasing the advanced biofuel at a price competitive with traditional, petroleum-based jet fuel.

2.3.3 The United States Government is funding grants to four pilot-scale biorefineries in California, Iowa, and Washington[2]. These facilities will test a variety of non-food biomass feedstocks, waste-based materials, and algae in innovative conversion processes to cost-effectively produce jet fuel and diesel advanced drop-in biofuels. The results will assist with the scale-up of processes to commercial levels. These projects complement a portfolio of over a dozen projects supported by DOE that include alternative jet fuel in their production.

2.3.4 The United States is also providing funding in partnership with industry to support development of commercial-scale integrated biorefinery projects that will produce drop-in alternative jet and diesel fuels. The awards for the first phase of the project were made in May 2013 companies will match investments. Under the grants, the companies will develop plans for biorefineries of up to 170 million gallon capacity (50 million of which will be jet fuel). The second phase of the project could award up to $180 million in additional contracts to accelerate the construction of at least one biorefinery capable of providing cost competitive renewable fuels.

2.3.5 At the Paris Airshow in June, 2013, CAAFI unveiled Guidance for Selling Alternative Fuels to Airlines[3], a guide for potential producers and other supply-chain participants to understand how to develop purchase agreements with airlines for non-petroleum-derived jet fuels. The guide outlines key steps and criteria for successful business arrangements between fuel producers and airlines.

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[2] See DOE press release http://energy.gov/articles/energy-department-announces-new-innovative-projects-develop-advanced-drop-biofuels-military

[3] Available on the CAAFI website at http://www.caafi.org/files/CAAFI_Business_Team_Guidance_Paper_060413.pdf

2.4 **U.S. Initiatives**

2.4.1 As noted in paragraph 1.2, the United States has supported the development and deployment of sustainable alternative jet fuels through the CAAFI public-private partnership. CAAFI is helping to coordinate U.S. Government efforts to facilitate deployment of sustainable alternative jet fuels. For example, CAAFI works with local lead organizations and points of contact to provide context, advice, strategy, and benchmarking. And CAAFI facilitates networks and links between stakeholders. The Midwest Aviation Sustainable Biofuels Initiative (MASBI) brought together key stakeholders to examine the potential for aviation biofuels production and use in the U.S. Midwest region with results published in an action plan to accelerate alternative jet fuel commercialization[4].

2.4.2 In April 2013, the United States and commercial and business aviation stakeholders agreed to extend by five years the "Farm to Fly" program. "Farm to Fly 2.0" is an initiative to help develop viable alternative jet fuel supply chains to meet an ambitious goal of 1 Billion gallons of alternative jet fuel used by U.S. Aviation by 2018. Agriculture support programs will be focused in cooperation with CAAFI's state and regional effort to support supply chain development across the United States.

2.4.3 The effort to develop and deploy alternative jet fuel is a global enterprise with many different initiatives emerging around the world; including public-private partnerships, public research and development initiatives, supply chain development efforts and others. The United States collaborates internationally at ICAO and also via formal and informal bilateral partnerships. The United States is part of government-to-government cooperation declarations with Australia, Brazil, Germany and Spain. The United States participates in key meetings and exchanges information with international stakeholders directly or via CAAFI. We believe that all States have opportunities to develop alternative jet fuels, even States with more limited resources or who are only now beginning to focus on this area. We would encourage States to communicate with the United States and other States to make use of the work that has been done and identify their own opportunities for alternative jet fuel development and production.

3. CHALLENGES

3.1 Breakthroughs in sustainable alternative jet fuels are key to meeting U.S. and ICAO climate goals. There are many promising developments and these fuels are just beginning to become commercially available. However, it is also important to recognize that even with concerted efforts, significant challenges to cost-competitive, scaled-up deployment of alternative jet fuels remain. There are uncertainties across the alternative jet fuel supply chain including feedstock availability, fuel conversion, fuel approval, fuel sustainability, and investment for production facilities that are impacting deployment. Furthermore, this deployment is expected to begin with relatively small amounts of fuel (millions of gallons a year) and increase only incrementally for some time. It is important to keep these challenges in mind in setting expectations regarding the role that sustainable alternative fuels can play in addressing greenhouse gas emissions in the near term. With sufficient time and investment, the intent is to address many of the challenges that will lead to production that will make a significant contribution to aviation's annual fuel needs.

4. CONCLUSION

4.1 The United States is very engaged in the effort to make alternative jet fuels a reality and is investing resources to conduct needed research and development. Questions around lifecycle GHG emissions, sustainability and costs of alternative jet fuels need to be addressed, and there are many ongoing efforts to do so. The United States is optimistic but recognizes that it will take a concerted, earnest effort to work through challenges that remain to significant scale-up of these fuels. The successful development, qualification, and deployment of sustainable alternative aviation fuels are crucial to ensuring the environmental sustainability and economic strength of international aviation over the long

[4] The MASBI final report can be found at http://www.masbi.org

term. The United States, in partnership with industry and interested States, will continue to strive for development and deployment of sustainable alternative jet fuels.

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