STATEMENT OF DR. LOURDES MAURICE, EXECUTIVE DIRECTOR OF THE OFFICE OF ENVIRONMENT AND ENERGY, OFFICE OF POLICY, INTERNATIONAL AFFAIRS, AND ENVIRONMENT, FEDERAL AVIATION ADMINISTRATION BEFORE THE SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION'S AVIATION SUBCOMMITTEE HEARING ON "AVIATION FUELS: NEEDS, CHALLENGES, AND ALTERNATIVES."JULY 28, 2011

Madam Chair, Senator Thune, and Members of the Subcommittee:

Thank you for inviting me to testify before you today on "Aviation Fuels: Needs, Challenges, and Alternatives." I am the Executive Director of the Office of Environment and Energy for the Federal Aviation Administration (FAA). In that role, I also serve as the environmental team co-leader for the Commercial Aviation Alternative Fuels Initiative (CAAFI). I am pleased to speak to the Subcommittee today about the development and deployment of sustainable alternative jet fuels.

Today, commercial aviation faces a number challenges--fuel cost, environmental impacts and energy security--that sustainable jet fuels can help to address. Fuels that are derived from biomass may offset a portion of the carbon produced by the aircraft as well as mitigate air quality issues such as emissions of sulphur and particulate matter. And domestic alternatives to petroleum jet fuel can expand and diversify the jet fuel supply and contribute to price stability and supply security.

Industry, government and academia all need aviation to get these fuels off the drawing board and into the gas tank. Indeed, the Future of Aviation Advisory Committee, which was founded by Transportation Secretary LaHood in 2010, singled out aviation fuels and the environment in one of its recommendations.

I believe that today's hearing is well timed. Aviation continues to make enormous progress in identifying, testing, and approving alternative jet fuels for use by commercial airlines. As you may know, the FAA has the responsibility to make sure that any aircraft, aircraft engine or part, or fuel that is used in aviation is safe and performs to set standards. In partnership with industry, we have identified a number of alternative jet fuels (including sustainable jet fuels) that can replace petroleum jet fuel without the need to modify aircraft, engines, and fueling infrastructure. These are often referred to as "drop in" fuels. Drop-in fuels are a near-term solution to addressing aviation environmental and energy challenges, and enable us to maintain the existing commercial airline fleet.

The aviation sector is well positioned to adopt alternative fuels and is in fact beginning to do so.[1] Moreover, this effort is critical to achieving the level of environmental and energy performance that will allow sustained growth of the nation's aviation system. FAA has set an aspirational target for use of 1 billion gallons of alternative jet fuel per annum by 2018.

Overview of FAA Role and Activities

Alternative jet fuels are a key component of the FAA's environmental and energy approaches for Next Generation Air Transportation System (NextGen). Over the past 5 years the FAA has taken a comprehensive approach, in cooperation with other departments and agencies, industry, and academia to address barriers, and enable the adoption, production, and end use of sustainable jet fuels in commercial jet aircraft. Beginning in 2006, we have worked with industry and government partners through CAAFI to address the business, research and development, environmental, and certification issues related to creating "drop-in" sustainable jet fuels for today's commercial aircraft.

The FAA's role has been multifold. It includes support of fuel properties and performance testing and demonstration; facilitation of fuel approval by the industry

standard setting organization, ASTM International; conducting environmental measurements and analysis; and facilitating information exchange among industry and government stakeholders as a co-sponsor of CAAFI. FAA has worked in partnerships with the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), the Environmental Protection Agency (EPA), the Department of State (DOS), Department of Commerce (DOC), and the Department of Agriculture (USDA) to advance technical research and development, as well as environmental, fuel standard setting, and deployment efforts needed to support sustainable alternative fuels for jet aircraft.

The FAA's Continuous Lower Energy, Emissions and Noise (CLEEN) program, as well as NextGen investments in environment and energy research, are vehicles available to address the certification and environmental issues of alternative fuels. We appreciate the Subcommittee's support for these efforts.

Fuel Approvals

FAA does not directly approve jet fuel. Rather the FAA approves aircraft to operate on fuel whose quality and safety is managed by industry-developed specifications, such as ASTM International. FAA personnel and funding have, however, been crucial to facilitation of this specification development process at ASTM International. The ASTM alternative jet fuels standard (also known as Specification D7566) was first issued in September 2009 and at that time approved use of blends of up to 50% synthetic fuels made via the Fischer-Tropsch process, which produces synthetic fuels from feedstocks including coal, natural gas or biomass.[2] The specification is structured to allow for the addition of new fuels as they are qualified for use. The writing of the specification and its revisions are accomplished via a collaborative and consensus driven process that is facilitated by FAA's leadership of the CAAFI certification and qualification team.

On July 1, 2011, the aviation community reached a major milestone when ASTM International approved a revision of the D7566 specification to add alternative jet fuels

made from bio-derived oils. Known as HEFA (hydroprocessed esters and fatty acids) jet fuels, they can be made from renewable plant oils such as camelina, jatropha, and algae or waste fats which are then mixed with petroleum jet fuel up to a 50% blend level. This represents the culmination of more than 3 years of collaborative work by FAA, DOD, and industry, including the engine and aircraft manufacturers, airlines, and fuel suppliers. The approval assures the safety and performance of the fuel and is enabling, for the first time, the commercial use of biofuel by airlines globally.

HEFA was the second alternative jet fuel to be approved for use by ASTM since 2009, but it will not be the last. Cooperative testing of additional advanced alternative jet fuels is already underway by FAA, DOD, and industry. From FAA's perspective, this is part of a strategic approach to approving as many commercially viable and environmentally sustainable alternative jet fuel options as possible.

Some of the fuel testing to support approval is being done through the FAA's CLEEN program. CLEEN supports maturation of green engine and airframe technologies and development and testing of alternative fuels. Under the CLEEN program, FAA leverages the Federal investment by partnering with industry.[3] For example, CLEEN has supported the Boeing Company to conduct aircraft fuel system materials compatibility testing of HEFA fuels. With Honeywell, we are testing the use of fully renewable jet biofuels. With Rolls Royce, we are doing fuel property, performance and engine testing to support evaluation of early stage, promising novel sustainable jet fuels.

Through the Department of Transportation/Research and Innovative Technology Administration's (DOT/RITA) Volpe National Transportation Systems Center (Volpe Center), the FAA will shortly be announcing grant awards to benchmark fuel quality control procedures, to conduct engine durability tests with alternative fuels, and to perform key testing to support qualification and certification of novel jet biofuels from alcohols, pyrolysis, and other processes. These are intended to support the next round of fuel approvals that are currently targeted to begin in 2013.

Environmental Assessment

In addition to certification and qualification of fuels, FAA is working to improve our understanding of the environmental benefits and impacts of alternative jet fuels. The U.S. has National Ambient Air Quality Standards for particulate matter emissions, and 44% of our 50 largest airports reside in areas of non-attainment. Common to all alternative fuels under consideration is their potential to reduce particulate matter emissions. Working with NASA, we have obtained direct measurements of in-service aircraft engines that clearly validate these benefits.

Through the Partnership for AiR Transportation Noise and Emission Reduction (PARTNER) Center of Excellence, FAA is funding assessments of emissions for alternative fuels including sustainable jet fuels.[4] The National Academies of Science's Airports Cooperative Research Program (ACRP) is supporting a project to understand the costs and the potential air quality benefits of alternative jet fuel use at commercial airports.

Reducing aviation's contribution to carbon dioxide emissions and climate change impacts are key potential benefits of alternative jet fuels. Measuring those benefits requires quantifying the full life cycle emissions from alternative fuel production, distribution, and operation. The FAA and the U.S. Air Force are jointly funding the development of greenhouse gas life cycle analyses (LCA) through the FAA's PARTNER Center of Excellence.[5]Results show that certain alternative jet fuels could realize CO2 lifecycle reductions as high as 80 percent. We continue to work and consult with EPA, DOE and a team of researchers to improve and broaden these analyses. The CAAFI Environment team, which FAA co-leads, is similarly involved in coordinating a broad group of experts to look at sustainability questions such as water use, food versus fuel, and invasiveness to provide insight into how sustainability certification may be conducted. And, through Volpe Center grant awards mentioned above, the FAA will support evaluation of biofuel sustainability criteria.

Key Recent Developments

A review of recent developments will give you a sense of the tremendous momentum behind alternative jet fuels and demonstrate the broad industry and interagency cooperation and innovative partnerships that are providing the push.

Jet Biofuels Approval and Flights

The July 1st 2011, ASTM International approval of HEFA alternative jet fuels made from bio-derived oils was a landmark. This has been followed by the first commercial service flights with HEFA biofuels by four airlines in Europe and has energized plans for possible production and fuel purchase agreements here in the United States.

Paris Air Show Alternative Aviation Fuels Showcase

In June 2011, the FAA and CAAFI worked with the Department of Commerce to showcase alternative jet fuel suppliers and U.S. and international airlines as a central event at the Paris Airshow. The event included visits of support by Secretary of Transportation Ray LaHood, FAA Administrator Babbitt, Acting Secretary of Commerce Sanchez, and Secretary of Agriculture Vilsack. It was successful in focusing the attention of the biofuels and agriculture communities and the media on the need and opportunity presented by aviation. Significant industry highlights at the airshow included the announcement by 7 U.S. airlines of negotiation with biofuel supplier Solena for 16 million annual gallons of fuel from waste in Northern California and two successful transatlantic biofuel flights to the airshow by Honeywell and Boeing.

U.S. – Brazil Partnership for the Development of Aviation Biofuels

During President Obama's visit to Brazil in March 2011, the United States and Brazil announced the creation of a "Partnership for the Development of Aviation Biofuels" under the Memorandum of Understanding between the United States and Brazil to Advance Cooperation on Biofuels signed on March 9, 2007. The FAA is a key participant and is engaged with the DOD, DOE, USDA, and other federal departments and agencies to identify and carry out cooperative activities with Brazilian counterparts

under this MOU. This agreement represents cooperation by the world's two largest biofuels producers and two important aviation States to support the development of sustainable jet fuels. It builds upon and will leverage existing collaboration with Brazil already underway via CAAFI.

FAA and USDA Partnership to Develop Renewable Jet Fuels

In October 2010, the FAA and the U.S. Department of Agriculture (USDA) signed a 5 year agreement that creates a framework of cooperation between FAA's Office of Environment and Energy, the USDA's Agricultural Research Service (ARS), and the USDA Office of Energy Policy and New Uses (OEPNU). Under the partnership, the three offices bring together their experience in research, policy analysis and air transportation to assess the availability of different kinds of feedstocks that will be needed by biorefineries to produce sustainable jet fuels. The collaboration has created the feedstock readiness level (FSRL)[6] tool, developed by the USDA and FAA to enable the determination of the stage of readiness of agricultural or forest-based feedstock for the production of commercial and military aviation biofuels. A public version is expected to be released soon.

Farm to Fly Partnership Formed between Airlines, USDA, and Boeing

In July 2010, the USDA joined with CAAFI sponsor Air Transport Association of America (ATA) and the Boeing Company in a resolution to "accelerate the availability of sustainable aviation biofuels in the United States, increase domestic energy security, and establish regional supply chains and support rural development." The agreement included the formation of a "Farm to Fly" working group that is identifying opportunities for accelerating a domestic jet biofuel production industry and supporting economic development in rural communities. This is a promising innovative effort that can further the interests of U.S. agriculture and U.S. aviation.

Challenges Ahead

To achieve the successful development and deployment of sustainable jet fuels in commercial aviation, we view the following areas as hurdles, as well as opportunities for future focus:

We must foster the development and production of appropriate feedstocks for aviation biofuels. Expanding the number and availability of crops appropriate for jet fuel conversion and optimizing their production are necessary to reduce costs, enable commercial deployment, and maintain sustainability. Our work with the USDA on the feedstock readiness level is a promising start, and we expect to continue to build on this collaboration.

We must continue to support the development, testing and approval of advanced biofuel conversion processes for high energy "drop in" hydrocarbon biofuels. Our past successes with Fischer-Tropsch and HEFA fuels would not have been possible without the leadership and contributions of the FAA, and this level of support must be maintained to move forward with new renewable and sustainable jet fuels. In addition to the CLEEN program and Volpe Center grant awards, the FAA resources will need to be allocated to support the ASTM International process to qualify and approve these new fuels. Investments by DOE, USDA, and DOD's Defense Advanced Research Projects Agency (DARPA) in these areas have been and will continue to be crucial. FAA must continue to work with DOD to coordinate the qualification and certification testing of both commercial and military fuels to make the best use of our limited resources.

The next hurdle is accurately quantifying environmental impacts. Assessments of both air quality and greenhouse gas life cycle emissions impacts must continue to be timely and thorough as new fuel options emerge. For example, FAA, in collaboration with EPA and NASA, needs to populate emissions prediction models with measured emissions data for emerging sustainable jet fuels. Acquiring such data is empirical in nature and requires significant testing and investment. Reducing the uncertainties associated with

land use changes, fertilizer use, and impacts on the quality and quantity of water resources, greenhouse gas inherent in-life cycle analyses (that is, from harvest to processing to transport and use of the sustainable jet fuels) will also require significant effort and investment. The collaboration of all stakeholders involved is needed to ensure an agreeable and accurate framework. We must continue to facilitate defined national and international sustainability criteria and Life Cycle Analysis (LCA) methodologies to provide certainty and compatibility regarding how fuels will be judged and accepted.

The final hurdle is the lack of jet biofuel infrastructure investment by private industry. The economic slowdown diminished the ability and interest of conventional investment sources to respond to the opportunities that aviation uniquely provides. However, we believe that successful production facilities can be built with relatively modest investment at locations which combine feedstock availability, existing biofuel infrastructure, need for air quality gains, access to airports and U.S. airlines eager to use sustainable jet fuels. Progress being made by the Farm to Fly effort and via USDA, DOE and DOD programs suggest that early deployment may be close at hand, but will continue to require near term support.

Aviation's dependence on high-density liquid hydrocarbon fuels for the foreseeable future is perhaps unique. Unlike surface transportation, we won't have an electric option in the near future. Another unique characteristic of U.S. commercial aviation is concentrated fueling infrastructure, where 80% of all jet fuel is used in only about 35 locations, i.e., at our busiest airports. Airports also provide an opportunity for distributing the co-products of sustainable jet fuel production (such as diesel) due to the many different fuel users on airports. The National Academies of Science's ACRP is sponsoring projects to assess the opportunity presented to airports of alternative fuel production and distribution. These realities of dependence and concentrated infrastructure should lead to aviation becoming a "first mover" in the deployment of alternative fuels. A final plus is the enthusiasm and commitment of the aviation industry to pioneer sustainable alternative jet fuels.

The nation has often counted upon the skills of the aerospace industry to lead the way in technical innovation. Renewable jet fuels offer the opportunity to team aerospace science and technology efforts with those of agriculture, energy, and environment to address the challenges that we face.

Madam Chair and Members of the Subcommittee, thank you again for the opportunity to testify on how the aviation community is leading the way to develop and realize the potential of emerging aviation sustainable jet fuels. This completes my prepared remarks. I welcome any questions that you may have.

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[1] Following ASTM approval Lufthansa, KLM and UK airline Thompson Airways have begun regular commercial flights using HEFA biofuels sourced from Finnish fuel supplier Neste Oils (Lufthansa) and U.S. fuel supplier Dynamic Fuels (KLM, Thompson).

[2]The Fischer-Tropsch (FT) process created in Germany in the 1930s and later commercialized in South Africa by SASOL, produces synthetic fuels from any source of carbon and hydrogen via gasification and then conversion to fuels using chemical catalysts. Feedstocks include coal, natural gas or biomass (e.g. crop residue, wood chips, or waste).

[3] All CLEEN projects include a one to one cost share commitment by industry although the industry contribution leveraged is sometimes greater.

[4] This PARTNER project is *Emissions Characteristics of Alternative Aviation Fuels* and *Ultra Low Sulfur (ULS) Jet Fuel Environmental Cost Benefit Analysis*. More information about PARTNER is available at http://web.mit.edu/aeroastro/partner/projects/index.html

[5] For work to develop alternative jet fuel life cycle analyses, see PARTNER Center of Excellence *Project 17: Alternative Jet Fuels* and *Project 28: Alternative Jet Fuel Environmental Cost Benefit Analysis* at http://web.mit.edu/aeroastro/partner/projects/index.html

[6] The *Feedstock Readiness Level* (FSRL) tool was developed by the USDA and FAA to enable the determination of the stage of readiness of agricultural or forest-based feedstock for the production of commercial and military aviation biofuels. The FSRL tool was structured to complement the *Fuel Readiness Level* (FRL) tool in use by the aviation industry. FSRL can be used to facilitate a coordinated allocation of resources to effectively develop a viable aviation biofuels industry.