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Testimony

Examining How Federal Infrastructure Policy Could Help Mitigate and Adapt to Climate Change: The Airlines' Climate Change Commitment

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On behalf of our A4A members, thank you Chairman DeFazio, Chairman Larsen, Ranking Member Graves and Ranking Member Graves for the opportunity to testify today. As you know, the U.S. airlines have a tremendous fuel and greenhouse gas (GHG) emissions record, accounting for 2 percent of the nation's GHG emissions inventory while driving 5 percent of its GDP. In fact, between 1978 and year-end 2017, the U.S. airlines improved their fuel efficiency by more than 125 percent, saving over 4.6 billion metric tons of carbon dioxide (CO_2), equivalent to taking 25 million cars off the road *each of those years*. And we carried 34 percent more passengers and cargo in 2017 than we did in 2000, while emitting no more CO_2.[1]

These numbers are not happenstance. As an industry, we have achieved this record by driving and deploying technology, operations and infrastructure advances to provide safe and vital air transport as efficiently as possible within the constraints of our air traffic management system. Indeed, for the past several decades, airlines have dramatically improved fuel efficiency and reduced CO_2 emissions by investing billions in fuel-saving aircraft and engines, innovative technologies like winglets (which improve aerodynamics), and cutting-edge route-optimization software. But despite our strong record to date, A4A and our member airlines are not stopping there nor are we resting on our laurels.

Since 2009, A4A and our members have been active participants in a global aviation coalition that committed to 1.5 percent annual average fuel efficiency improvements through 2020, with a goal to achieve carbon neutral growth in international aviation from 2020, subject to critical aviation infrastructure, technology, operations and sustainable fuels advances by government and industry. Further, we are working toward an additional aspirational goal to achieve a 50 percent net reduction in CO_2 emissions in 2050, relative to 2005 levels.

The initiatives we are undertaking to further reduce our GHG emissions are designed to responsibly and effectively limit our fuel consumption, GHG contribution and potential climate change impacts while allowing commercial aviation to continue to serve as a key contributor to the U.S. economy. A4A and our members are keenly focused on these initiatives, both at the national and international levels. We welcome this hearing on federal infrastructure policy to help address climate change as there is a critical role for the federal government to play in advancing aviation infrastructure, technology and energy policy to complement our efforts.

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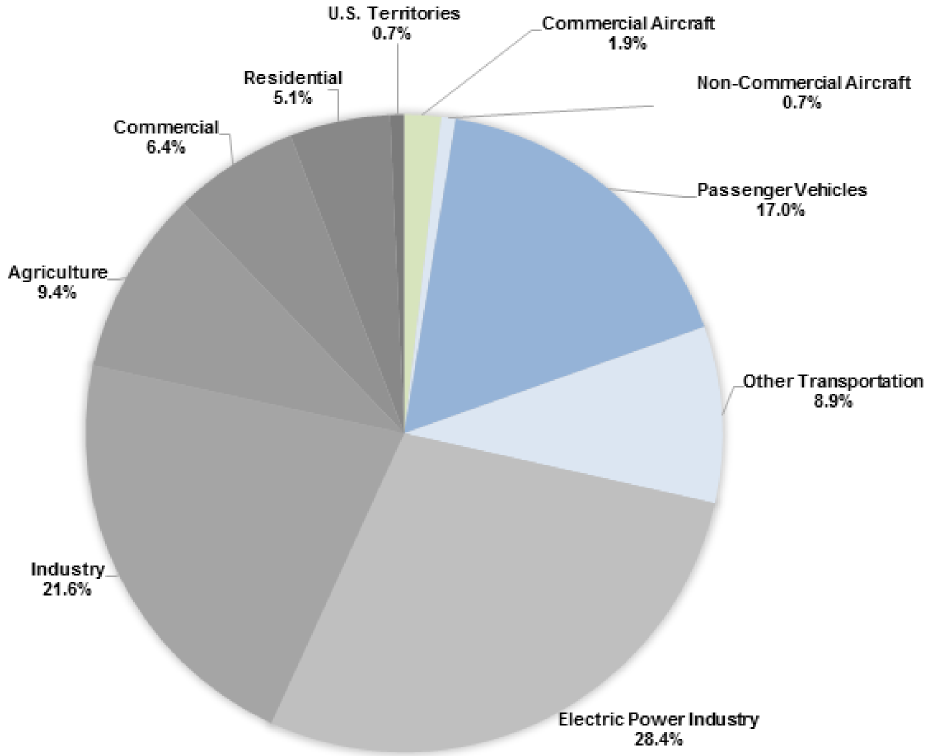
[1] Fuel savings facts are from data from the U.S. Department of Transportation Bureau of Transportation Statistics. Carbon dioxide savings and equivalencies were calculated using EPA tools at: www.epa.gov/cleanenergy/energy-resources/calculator.html.

The U.S. Airlines Are Extremely GHG Efficient and Are Committed to Further Limiting Their GHG Footprint

The U.S. airlines have a decidedly strong GHG emissions track record that is often overlooked or misstated. We contribute just under 2 percent of the nation's GHG emissions inventory. To put that into context, as illustrated in Figure 1 below, passenger vehicles (cars and light duty trucks) account for over 17 percent and power plants for 28 percent of the total inventory. The picture is similar when viewed on a global basis with worldwide commercial aviation contributing approximately 2 percent of man-made GHGs.[2]

FIGURE 1. THE U.S. GHG INVENTORY BY SECTOR[3]



At the same time, U.S. commercial aviation is vitally important to local, national, and global economies, supporting a large percentage of U.S. economic output. Indeed, in 2014, commercial aviation drove 10.2 million U.S. jobs, $1.5 trillion in economic activity and 5 percent of our nation's GDP.[4] And in 2017, U.S. air-travel exports of $41 billion helped fuel $211 billion

[2] Air Transport Action Group, Aviation Benefits Beyond Borders (2018), available at https://aviationbenefits.org/media/166344/abbb18_full-report_web.pdf (citing the 2017 Global Carbon Project, Global Carbon Budget, available at https://www.icos-cp.eu/GCP/2017).

[3] U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016 (April 2018), Table ES-6: U.S. [GHG] Allocated to Economic Sectors at ES-24; Table A-119: Total U.S. [GHG] Emissions from Transportation and Mobile Sources at A176-77.

[4] *See* FAA, *The Economic Impact of Civil Aviation on the U.S. Economy* (Nov. 2016), available at https://www.faa.gov/air_traffic/publications/media/2016-economic-impact-report_FINAL.pdf.

in other U.S. travel and tourism exports.[5] Comparing the U.S. airline industry's economic output to its GHG output, it is clear that commercial aviation is an extremely GHG-efficient economic engine.

Our global aviation coalition continues to meet our 2009 commitment of a 1.5 percent annual average fuel efficiency improvement, and we are working on our goal to achieve carbon neutral growth in international aviation from 2020, subject to critical aviation infrastructure and technology advances achieved by government and industry. As detailed below, our primary focus is on getting further fuel efficiency and emissions savings through new aircraft technology, operations and infrastructure improvements and sustainable alternative jet fuel (SAJF). In addition, consistent with the mandates in Public Law 112-200, A4A and our member airlines have supported two significant international fuel efficiency and GHG savings agreements adopted in 2016 under the auspices of the United Nations body that sets standards and recommended practices for international aviation, the International Civil Aviation Organization (ICAO). Notably, industry and government collaboration remains critical to our efforts.

Examples of Technology, Operations and Infrastructure Initiatives

With fuel being one of the highest and most volatile cost centers for airlines – and every penny of increased fuel price equating to an additional $200 million fuel bill per year – the U.S. airlines' environmental and economic interests in saving fuel and reducing emissions align. Accordingly, the U.S. airlines have been able to deliver tremendous economic output while reducing our emissions through reinvestment in technology and more fuel-efficient operations on the ground and in the sky. Indeed, today's airplanes are more technologically advanced – they are quieter, cleaner and use less fuel than ever before – and airlines are flying them in ways that take maximum advantage of the technology within the constraints of our current air traffic management (ATM) system. This flight optimization reduces fuel burn and environmental impacts. Some examples of the advancements that have resulted in the U.S. airlines' 125 percent fuel efficiency improvement since 1978 and will continue to support improvements include:

- **Upgrading Fleets**. With recently improved finances, the U.S. airlines and aircraft operators have been able to invest billions of dollars to upgrade their fleets with newer, quieter aircraft that produce less noise and fewer emissions. For example, U.S. airlines purchased more than 480 new aircraft in 2017, with more than 1,550 additional planes expected in the coming years. Our airlines have also made significant investments in winglets, altering fan blades, and other measures that improve aerodynamics. By way of example, in 2017, Alaska Airlines finalized installation of split scimitar winglets on all of its eligible 737 aircraft. With such winglets enabling aircraft to be approximately 4.5 percent more fuel efficient than those without winglets, Alaska improved average fuel efficiency by over 34,000 gallons per aircraft *each year*. And Alaska's new 737NG aircraft are modified when they receive them, making the aircraft as fuel efficient as possible upon entry into service.[6] Accordingly, in

[5] Bureau of Economic Analysis, International Transactions (ITA) Table 3.1 - U.S. International Trade in Services Lines 8, 12 and 1, available at http://www.bea.gov/iTable/iTable.cfm?ReqID=62&step=1#reqid=62&step=6&isuri=1&6210=1&6200=51, and http://travel.trade.gov/research/reports/recpay/index.html.

[6] This and other fuel and emissions savings initiatives are detailed in Alaska's sustainability report, available at http://www.flysustainably.com/wp-content/uploads/2018/09/AlaskaAirReport-Final-092418.pdf.

2017, Alaska's scimitar winglets modification saved an additional 4.5 million gallons of fuel, equating to a reduction of 42,633 metric tons of CO_2.

- **Introduction of Innovative, Cutting-Edge Technologies and Improved In-Flight Operations**. Our airlines also are investing billions of dollars in technologies to enable more efficient flight paths. For example, the airlines have undertaken equipage for Required Navigation Performance (RNP) and Performance-Based Navigation (PBN) procedures, which provide navigation capability to fly a more precise path into and out of airports.[7] A4A airlines also have deployed increasingly sophisticated software to analyze flight paths and weather conditions, allowing aircraft to fly more direct, efficient routes where the ATM system is able to accommodate them.

  A4A airlines continue to do all they can within the existing ATM system to utilize programs to optimize speed, flight path and altitude, which not only reduces fuel consumption and emissions in the air but avoids wasting fuel waiting for a gate on the ground. In addition to pursuing the use of RNP approach procedures at additional locations, A4A carriers – such as UPS Airlines at its hub in Louisville – have worked with FAA to pioneer protocols for optimized profile descents (OPDs) (also referred to as "continuous descent arrivals"), which reduce both emissions and noise, and we are doggedly pursuing implementation of OPDs where the existing ATM system allows. Demonstrating that the efforts extend to the smallest details of airline operation, our members also have worked on redistribution of weight in the belly of aircraft to improve aerodynamics and have introduced life vests on certain domestic routes, allowing them to overfly water on a more direct route.

- **Improved Ground Operations**. A4A airlines also are employing single-engine taxiing when conditions permit, redesigning hubs and schedules to alleviate congestion and converting to electric ground support equipment (GSE) when feasible. For example, as part of Southwest Airlines' ongoing program to modernize its GSE fleet, the company invested $7.9 million in electric vehicles in 2017.[8] Further, our airlines are improving ground operations by plugging into electric gate power where available to avoid running auxiliary power units (APUs). By way of example, American Airlines' "Fuel Smart" program is securing emissions reductions by such means, as well as washing engine components for maximum efficiency, and other initiatives.[9] Similarly, while Hawaiian Airlines already provides external gate power to its narrow-body fleet between the Hawaiian Islands, the airline has made significant headway toward its goal of having gate power available to its entire wide-body fleet within three minutes of arrival as aircraft fly between Hawaii, 11 U.S. gateway cities and 10 international

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[7] In fact, Alaska Airlines pioneered the application of RNP technology during the mid-1990s to help aircraft land at some of the world's most remote and geographically challenging airports in the state of Alaska.

[8] *See* Southwest Airlines, "One Report" (2017), available at http://southwestonereport.com/2017/stories/electricity-sparks-fuel-savings/.

[9] *See* American Airlines, 2017 Corporate Responsibility Report, available at http://s21.q4cdn.com/616071541/files/doc_downloads/crr/CRR-Report-2017.pdf. In addition to achieving savings in costs and GHG emissions, Fuel Smart translates a portion of its APU fuel savings into a donation to the Gary Sinise Foundation for the purposes of providing travel for active duty military members, veterans, first responders and their family members in need. Since Fuel Smart launched in 2010, American has generated nearly $4 million in contributions through the program, helping more than 6,800 service members and their families travel to receive the support they need.

destinations, with the potential to reduce Hawaiian's APU usage by an estimated 30 minutes per flight, saving some 620,000 gallons of fuel annually and cutting CO_2 emissions by 5,933 metric tons.[10]

- **Reducing Onboard Weight**. A4A airlines continue to exhaustively review ways, large and small, to reduce aircraft weight – removing seat-back phones, excess galley equipment and magazines, introducing lighter seats and beverage carts, stripping primer and paint and a myriad of other detailed measures to improve fuel efficiency. For example, by replacing flight bags with flight crew tablets, UPS reduced the weight associated with these critical materials by 70 pounds, with the reduced fuel burn equating to 1,400 metric tons of CO_2 emissions avoided.[11]

In addition to the above types of measures, A4A and our members continue to partner with FAA, NASA, research entities and other aviation stakeholders to advance research, development and deployment of breakthrough technologies and operational and infrastructure advances. The Continuous Lower Energy, Emissions & Noise or "CLEEN" program is a key initiative in this regard. This FAA-industry public-private partnership is focused on near-to-medium term aircraft engine and technology breakthroughs for lower emissions and noise, enhanced energy efficiency and aviation alternative fuels. The program, which requires a one-to-one match of private dollars, has enabled the development of new technologies such as the Adaptive Trailing Edge (ATE) on the aircraft wing, providing up to a 2 percent reduction in aircraft fuel burn and a 1.7 decibel reduction in aircraft noise; the Twin Annular Premixed Swirler (TAPS) II advanced engine combustor, yielding significant reductions in emissions of oxides of nitrogen (NOx); and geared turbofan engine technologies, contributing to a 20 decibel aircraft noise reduction and a 20 percent fuel burn reduction.

Another critical program is the FAA Center of Excellence for Alternative Jet Fuels and the Environment (ASCENT), the university-based research vehicle for the FAA to discover, analyze, and develop science- and technology-based solutions to support the growth of the U.S. aviation industry by addressing the energy and environmental challenges the industry faces. This program also requires a one-to-one match of private-to-federal funding and supports work by sixteen university partners across the country. In addition to providing a better understanding of aviation environmental impacts that shape industry and government energy and environmental work, ASCENT's applied research has helped with the development of air traffic procedures and airport infrastructure configuration to enhance the efficiency of U.S. aviation.

And for advanced, future airframe and engine technologies, the aviation industry collaborates with NASA through its Aeronautics Research (ARMD) program, which is considering transformative configurations, including light weight, high aspect ratio wings; unconventional structures; advanced propulsion; and electrified aircraft propulsion, among other radical concepts.

[10] *See* Hawaiian Airlines' Airport Operations Lowering Fuel Use, Carbon Emissions, available at https://newsroom.hawaiianairlines.com/releases/hawaiian-airlines-airport-operations-lowering-fuel-use-carbon-emissions.

[11] *See* UPS 2017 Corporate Sustainability Progress Report available at https://sustainability.ups.com/media/2017_UPS_CSR.pdf.

The Development and Deployment of SAJF

Recognizing that improving fuel efficiency with today's petroleum-based energy supply can only take us so far, A4A and our members are dedicated to developing commercially viable, environmentally friendly alternative jet fuel, which could be a game-changer in terms of aviation's output of GHG emissions while enhancing U.S. energy independence and security.

To be sustainable, alternative jet fuel must meet three core criteria. It must be demonstrated to be (1) as safe as petroleum-based fuels for powering aircraft; (2) more environmentally friendly than petroleum-based fuels; and (3) capable of being produced to provide cost-competitive, reliable supply. A4A and our members have been working with government partners and other stakeholders in a concerted effort to meet these criteria – and we have made tremendous progress, having moved from test flights to commercial and military flights with SAJF. But we must continue to tackle each challenge, using every tool to attain full viability.

As the challenges to standing up a self-sustaining aviation alternative fuels industry cut across multiple disciplines – from aviation, to agriculture, fuel production, investment capital, logistics and beyond – no one initiative or program can do it all. Yet, the U.S. aviation industry determined early on that a coordinating body would be needed to establish a clear vision and leverage the efforts across initiatives. Accordingly, in 2006, A4A, FAA, the Aerospace Industries Association (AIA) and Airports Council International-North America (ACI-NA) co-founded the Commercial Aviation Alternative Fuels Initiative® (CAAFI) to serve as the driving and coordinating force for the industry's efforts. "CAAFI's goal is to promote the development of alternative jet fuel options that offer equivalent levels of safety and compare favorably on cost with petroleum-based jet fuel, while also offering environmental improvement and security of energy supply."[12] Through CAAFI, we have worked to address and overcome the challenges to commercial-scale deployment of SAJF – ensuring safety and environmental benefit while working to achieve supply reliability and cost-competitiveness.

1. SAJF – Ensuring Safety

No matter what issue or challenge we face, airlines never lose sight of their core mission: safety. Our fuels must meet rigorous specifications that ensure safe operation, whether in the icy cold at 30,000 feet or while filling tanks on the ground at airports crowded with activity. Accordingly, before an alternative fuel can be approved for commercial use, it must meet rigorous safety and performance standards set out in the applicable specification, which is controlled by ASTM International, an organization devoted to the development and management of standards for a wide range of industrial products and processes. This specification, in turn, is included in FAA product approvals and required air-carrier manuals.

One of CAAFI's most significant contributions to date has been the development of the approval process for alternative jet fuels through ASTM. Not surprisingly, the original jet fuel specification, ASTM D1655, titled "Standard Specification for Aviation Turbine Fuels," covered only jet fuels derived from specific fossil-fuel sources. The CAAFI team worked within ASTM to identify means for gaining approval of jet fuels derived from alternative feedstocks provided that those

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[12] *See* www.caafi.org.

fuels are equally safe and effective.[13] As a result, in August 2009, after completing its rigorous review process, ASTM approved D7566, "Aviation Turbine Fuel Containing Synthesized Hydrocarbons." This specification allows for alternatives that demonstrate that they are safe, effective and otherwise meet the specification and fit-for-purpose requirements to be deployed as jet fuels, on par with fuels under ASTM D1655. It is structured, via annexes, to accommodate different classes of alternative fuels when they are demonstrated to meet the relevant requirements. As shown in Figure 2, we now have five approved "pathways" for SAJF production, and more are currently undergoing the rigorous review and approval process.

FIGURE 2. Approved SAJF "Pathways" Under ASTM D7566

PATHWAYS/PROCESS	FEEDSTOCK EXAMPLES	DATE OF APPROVAL	BLENDING LIMIT
Fischer-Tropsch Synthetic Paraffinic Kerosene (FT-SPK)	Biomass (forestry residues, grasses, municipal solid waste)	2009	Up to 50%
Hydroprocessed Esters and Fatty Acids (HEFA-SPK)	Oil-bearing biomass (e.g., algae, jatropha, camelina, carinata)	2011	Up to 50%
Hydroprocessed Fermented Sugars to Synthetic Isoparaffins (HFS-SIP)	Microbial conversion of sugars to hydrocarbon	2014	Up to 10%
FT-SPK with aromatics (FT-SPK/A)	Renewable biomass such as municipal solid waste, agricultural wastes and forestry residues, wood and energy crops	2015	Up to 50%
Alcohol-to-Jet Synthetic Paraffinic Kerosene (ATJ-SPK)	Agricultural wastes products (stover, grasses, forestry slash, crop straws)	2016 (plus added feedstocks 2018)	Up to 30%

By meeting the rigorous jet fuel specification and fit-for-purpose requirements, sustainable alternative jet fuels are demonstrated to be "drop-in" fuels, completely compatible with existing airport fuel storage and distribution methods and airplane fuel systems. Accordingly, they do not carry added infrastructure costs for airlines, fuel distributors or airport authorities, enhancing prospects for their commercial viability.

2. Ensuring Environmental Benefit

We also have made tremendous progress on demonstrating whether a particular alternative jet fuel provides environmental benefit relative to petroleum-based fuel. As carbon is fundamental to powering aircraft engines, this and the CO_2 generated upon combustion cannot be eliminated from drop-in jet fuels, but they can be reduced, either through increasing the per-unit energy provided in the fuel, reducing carbon somewhere along the "lifecycle" of the fuel, or some combination of the two. Indeed, there can be emissions all along the "life" of the fuel – from growing or extracting the feedstock, transporting that raw material, refining it, transporting the finished fuel product and using it. By examining the emissions generated at each point in the

[13] CAAFI worked within ASTM to issue a specific standard to facilitate the approval of alternative jet fuel made from varying feedstocks and production processes, ASTM D4054, "Standard Practice for Qualification and Approval of New Aviation Turbine Fuels and Fuel Additives."

lifecycle, one can ensure that the emissions benefits that are sought are in fact real and do not create emissions "dis-benefits" along the way.

Ensuring the environmental benefit of alternative aviation fuels is critical to A4A and its member airlines. Accordingly, as far back as 2008, we agreed on a set of alternative fuels principles, which include a commitment that the alternative fuels we accept need to have reduced lifecycle GHG emissions compared to today's fuels and not compete with food production. In that commitment, we agreed to work through CAAFI to ensure this. Accordingly, CAAFI's Sustainability Team,[14] which I co-lead along with Dr. James Hileman of the FAA, has developed and supported seminal guidance on the methodologies for lifecycle analysis of alternative aviation fuels[15] and case studies that use these methodologies.[16] SAJF has been demonstrated to achieve up to an 80 percent lifecycle GHG savings relative to petroleum-based fuel.[17] In addition, a comprehensive assessment under the Transportation Research Board's Airport Cooperative Research Program (ACRP) confirms that the use of SAJF can reduce more than just GHG emissions, including emissions of sulfur oxides (SOx), particulate matter (PM), carbon monoxide, unburned hydrocarbon emissions, and NOx.[18]

While seeking emissions benefits from SAJF, A4A and its members also recognize that use of such fuels must not create environmental problems in other areas. SAJF must be produced in a fashion meeting all relevant environmental criteria, including land use, water management and the like. Put another way, the production, transport and use of these fuels generally must be deemed "sustainable." Accordingly, CAAFI also has provided peer-review guidance on making sure relevant sustainability criteria are met.[19]

3. Fostering Supply Reliability and Commercial Viability

As noted by Bill Harrison, Technical Advisor for Fuels and Energy at the U.S. Air Force Research Laboratory, scaling up supply and making SAJF cost-competitive may well be the

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[14] CAAFI's Sustainability resources are available at: http://www.caafi.org/focus_areas/sustainability.html.

[15] *See* "Framework and Guidance for Estimating Greenhouse Gas Footprints of Aviation Fuels (Final Report) (2009, AFRL-WP-TR-2009-2206); *see also* Young, CAAFI Environment Team: Developing Tools & Means to Address Environmental Issues (April 16, 2013), available at http://www.caafi.org/files/presentations/Environment_Young_ABLC_Apr17_2013.pdf.

[16] *See, e.g.*, Stratton, Wong & Hileman, Life Cycle Greenhouse Gas Emissions from Alternative Jet Fuels (April 2010).

[17] International Air Transport Association, Sustainable Aviation Fuels: Fact sheet, available at https://www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-alternative-fuels.pdf.

[18] *See* Transportation Research Board, ACRP Project 02-80: "State of Industry Report on Air Quality Emissions from Sustainable Alternative Jet Fuels," at 5 (April 2018) (available at http://www.trb.org/Aviation1/Blurbs/177509.aspx).

[19] *See* CAAFI, Alternative Jet Fuel Environmental Sustainability Overview (July 2013), available at http://www.caafi.org/information/pdf/Sustainability_Guidance__Posted_2013_07.pdf. CAAFI also provides a step-by-step overview of sustainability review processes on its webpage at http://www.caafi.org/focus_areas/sustainability.html.

most significant challenge to its full-scale commercial deployment.[20] A key role that A4A and its member airlines are playing as end-users of such fuels is to send appropriate market signals to would-be producers, the farmers and others who generate energy feedstock, and investors in the alternative fuels industry.[21] Further, A4A entered into a "Strategic Alliance for Alternative Aviation Fuels" with the U.S. Department of Defense's Defense Logistics Agency-Energy (DLA-Energy, which previously was known as the Defense Logistics Agency's Defense Energy Support Center) to further encourage alternative fuel producers to include SAJF in their product slate. Our vigorous pursuit of SAJF has sent an unmistakable signal: U.S. airlines are committed to making SAJF viable and will do their part to overcome the obstacles that may stand in the way. But we recognize that we cannot do it alone. Ongoing commitment in public-private partnerships is needed to get the alternative aviation fuels industry over the cusp, just as was the case when the federal government jump-started the Internet, satellite systems and other backbone infrastructure – working with industry to help make these ventures self-sustaining.

While CAAFI has focused on supply reliability and commercial viability, other public-private partnerships and initiatives have been needed to spur investment in this new supply chain. Perhaps most notable in this regard is the *Farm to Fly* initiative, which A4A, the U.S. Department of Agriculture (USDA) and Boeing created in 2010 to help meet the direction set in the 2008 Farm Bill that U.S. programs aimed at energy crops should be equally available for air transportation fuels as for ground transportation fuels.[22] Indeed, the aim of the original *Farm to Fly* initiative was "to accelerate the availability of a commercially viable sustainable aviation biofuel industry in the United States, increase domestic energy security, establish regional supply chains and support rural development."

The initial *Farm to Fly* initiative helped make accessible to farmers, fuel producers, airlines and military aviation a number of the tools and programs that had been available to ground-based alternative fuels for some time. It also resulted in a two-part report in January 2012 which offered a blueprint for continuing to advance opportunities for Rural America and the aviation sector through aviation biofuels.[23] Moreover, the initial *Farm to Fly* initiative helped spawn two regional initiatives to foster the development and deployment of alternative jet fuels derived from sustainable biomass grown in the United States. The first of these, the Sustainable Aviation Fuels Northwest (SAFN) initiative, led in part by A4A member Alaska Airlines, together with the Port of Seattle, Port of Portland, Spokane International Airport, Boeing and Washington State University, found that an aviation biofuels industry can be commercially viable in the Pacific

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[20] Harrison, *Alternative Fuels: How Can Aviation Cross the Valley of Death* (Massachusetts Institute of Technology Master's Thesis, 2008).

[21] One of many such signals is a "how to" document on how alternative aviation fuels producers can work with airlines on purchase agreements. This document, "Guidance for Selling Alternative Fuels to Airlines," is available on the CAAFI website at http://www.caafi.org/files/CAAFI_Business_Team_Guidance_Paper.pdf.

[22] Conf. Rpt. 110-627, on H.R. 2419; p. 911, May 13, 2008.

[23] *See* Agriculture and Aviation: Partners in Prosperity, available at http://www.airlines.org/Documents/usda-farm-to-fly-report-jan-2012.pdf; *see also* Agriculture and Aviation: Partners in Prosperity: Putting Aviation at the Forefront of the President's Biofuels Targets, Part II. Industry Recommendations, available at http://www.airlines.org/Documents/Farm_to_Fly_Recommendations-A4A-Boeing-Jan2012.pdf.

Northwest and identified four, particularly promising feedstocks; oilseeds, forest residues, municipal solid wastes and algae; for generating advanced aviation biofuels.[24] The second, the Midwest Sustainable Aviation Biofuels Initiative (MASBI), led in part by A4A member United Airlines, Boeing, Honeywell's UOP, the Chicago Department of Aviation, and the Clean Energy Trust, developed recommendations to help "achieve the potential economic, environmental, and energy security benefits that can be delivered from a robust sustainable aviation biofuels industry in the Midwest."[25]

In April 2013, we launched *Farm to Fly 2.0*, bringing in additional stakeholders and expanding the supply chain reach. Although the *Farm to Fly* initiative has been important for bringing together tools and the various participants in the aviation alternative fuels supply chain, there would be no such initiative without the Energy Title programs under the Farm Bill – the most recent version of which is the Agricultural Improvement Act of 2018. While the 2018 Farm Bill included a number of energy programs, some of which are accessible to those in the supply chain for providing SAJF, we urge Congress to fully fund programs like the Biomass Crop Assistance Program (BCAP) and the Biomass Research and Development Program (BRDI) to leverage the investments that the U.S. government and the private sector have already made and provide the stability needed for further progress.

While challenges remain, our joint efforts are bearing fruit. For example, United Airlines began using commercial quantities of SAJF at Los Angeles International Airport in 2016 pursuant to an off-take agreement with AltAir Fuels to purchase up to 15 million gallons of SAJF over 3 years. United has also made a $30 million equity investment in Fulcrum BioEnergy, which includes provisions to co-develop up to five facilities and purchase at least 90 million gallons of SAJF per year over ten years.[26] FedEx and Southwest Airlines have similarly committed to each purchase 3 million gallons per year from Red Rock Biofuels, and JetBlue has signed a 10-year off-take agreement with SG Preston for up to 10 million gallons per year. Further, both Alaska Airlines[27] and American Airlines[28] have signed Memoranda of Understanding with Neste for coordination and potential future deployment of SAJF. Moreover, while airlines purchase and manage all fuel purchases, they are increasingly partnering with airports and other stakeholders to help assess the potential for deployment of SAJF at particular airports in areas where SAJF production is being considered and may be commercially viable. For example, Alaska Airlines partnered with Boeing and the Port of Seattle on an infrastructure study for potential future deployment of SAJF at Seattle-Tacoma International (Sea-Tac)[29] and several airlines have entered into Memoranda

[24] *See* SAFN, Powering the Next Generation of Flight, available at http://www.safnw.com/wp-content/uploads/2011/06/SAFN_2011Report.pdf.

[25] *See* MASBI, Fueling a Sustainable Future for Aviation, available at http://www.masbi.org/content/assets/MASBI_Report.pdf.

[26] Details on United Airlines' SAJF program are available at http://crreport.united.com/our-environment/sustainable-fuel-sources.

[27] See Alaska Airlines Press Release, available at https://newsroom.alaskaair.com/2018-09-10-Alaska-Airlines-and-Neste-grow-innovative-partnership-to-fly-more-sustainably.

[28] See Neste Press Release, available at https://www.neste.com/neste-and-american-airlines-collaborate-explore-opportunities-renewable-fuel-use.

[29] The infrastructure report is available at https://www.portseattle.org/sites/default/files/2018-03/Aviation_Biofuel_Infrastructure_Report_Condensed.pdf

of Understanding with Sea-Tac and San Francisco International Airport (SFO) to explore potential SAJF coordination opportunities. In addition, in 2017, United and Atlas Air joined various foreign airlines and Chicago O'Hare International Airport in a special "Fly Green Day" commercial deployment of SAJF.

Although these initial purchase and cooperative agreements for SAJF deployment are promising, two critical observations capture why we cannot be complacent in our efforts. First, these projects would not exist without the public-private partnerships we have engaged in to date. And second, while meaningful to the parties involved, they still are relatively small scale, largely because producing SAJF to meet the rigorous jet fuel specification is a higher hurdle than the equivalent for alternative ground-based fuels. Accordingly, to expand upon these projects and spur more, we must continue to employ all the tools and partnerships we have identified and created to date and take further action to lay the foundation for all supply-chain elements to become self-sustaining.

Industry-Supported ICAO Agreements on Fuel Efficiency and CO_2 Emissions from International Aviation

Although the U.S. airlines' financial and environmental objectives have continually prompted fuel and GHG emissions savings, several countries have imposed or threatened to impose on international aviation unilateral carbon emissions trading, taxing and charging schemes, which are siphoning away from aviation the very funds the industry needs to purchase new, more fuel efficient aircraft and take other steps to meet our fuel efficiency and emissions savings goals. In fact, as of 2013, the Air Transport Action Group (ATAG) had estimated that $7 billion in such charges already were being levied on airlines, with more introduced or proposed since.

One of the most onerous of the unilateral measures has been the European Union's imposition of its emissions trading scheme (EU ETS) on international aviation. Despite international opposition from the outset, beginning in 2009, the EU required airlines and aircraft operators (including U.S. airlines and aircraft operators) with flights to European States and territories to monitor and report to the EU their emissions for the entirety of each individual flight to, from and within the EU, as a prelude to the emissions trading obligation that was due to begin in 2012. As a result of the pressure put on the EU from the U.S. and other countries, most significantly from the U.S. adoption of the "European Union Emissions Trading Scheme Prohibition Act" (PL-112-200), the EU "stayed" the extraterritorial application of the EU ETS to international aviation through year-end 2016, to take into account the progress in ICAO on an agreement for handling aviation's CO_2 emissions from international flights. In December 2017, the EU approved legislation to extend the stay until year-end 2024, again making the stay subject to ICAO action, this time with respect to progress on implementation of agreements reached in 2016 on aviation's international CO_2 emissions.

A4A greatly appreciated the leadership of this Committee in approving the "European Union Emissions Trading Scheme Prohibition Act" in 2012. Significantly, in addition to recognizing that the unilateral action of the EU in imposing its ETS on U.S. aircraft operators was unlawful and inappropriate, the statute directed that DOT, FAA and other appropriate U.S. officials "use their authority to conduct international negotiations . . . to pursue a worldwide approach to address aircraft emissions, including the environmental impact of aircraft emissions." Consistent with this directive, the U.S. played a significant role in developing two ICAO agreements to support aviation GHG emissions goals and stave off the proliferation of unilateral emissions taxes, charges and trading schemes – one agreement for a fuel efficiency and CO_2 certification standard for future aircraft and another to establish an international carbon offsetting system to help the industry work towards achieving carbon neutral growth in international aviation from 2020. Both of these agreements, which are supposed to be implemented in lieu of unilateral measures, are broadly supported by A4A, our members and the broader U.S. aviation industry.

1. The ICAO Fuel Efficiency and CO_2 Emissions Certification Standards for Future Aircraft

ICAO's Committee on Aviation Environmental Protection, which includes representatives from the U.S. EPA, FAA and State Department, the aviation industry, and environmental non-governmental organizations (NGOs), worked to develop, and then in 2016 proposed for adoption, a set of fuel efficiency and CO_2 emissions certification standards for future aircraft. The standards, which were approved by ICAO's governing body (the ICAO Council), confirm an agreed level of fuel efficiency for future aircraft, which equates to CO_2 emissions reductions. The standards applicable to new-type design large aircraft (i.e., aircraft used by airlines) are slated to go into effect in 2020, while the standards for the future manufacture of existing-type large aircraft (also referred to as "in-production aircraft") are slated to go into effect in 2023.[30]

Although some countries automatically incorporate ICAO standards into their laws, the United States adopts ICAO emissions standards through rulemaking, typically with EPA adopting the underlying standards and FAA adopting rules to certify aircraft to the standards. As aviation is a global industry, with airlines and aircraft operators operating internationally and aircraft manufacturers selling their aircraft in international markets, it is critical that aircraft emissions standards continue to be agreed at the international level and implemented by ICAO Member States.

A4A and our members support having EPA and FAA incorporate the ICAO fuel efficiency and CO_2 certification standards into U.S. law. Indeed, U.S. aircraft manufacturers will not be able to have their aircraft certified to the standards – a prerequisite for the manufacturers to be able to sell their aircraft in the international market – unless the United States adopts them into U.S. law. Further, if U.S. aircraft manufacturers cannot have their products certified to the internationally-agreed standards, U.S. airlines will not be able to purchase these aircraft for international service.

2. The ICAO Carbon Offsetting and Reduction Scheme for International Aviation

A4A and its members also supported the work that was undertaken in ICAO to develop proposals for a "global market-based measure," in the form of an international carbon offsetting system, to help work toward the industry's goal to achieve carbon neutral growth in international aviation from a 2020 baseline. This measure, the "Carbon Offsetting and Reduction Scheme for International Aviation" (CORSIA), has two parts. First, CORSIA requires that *all* 192 ICAO Member States have their aircraft operators monitor and report to them their international CO_2 emissions under a common set of rules beginning on January 1, 2019. Second, CORSIA includes an offsetting obligation, which is slated to commence on covered international routes beginning in 2021 and continue through 2035.

[30] The standards for smaller aircraft (those with less than 60 tons of maximum takeoff weight) have lower levels of stringency and slightly different effective dates, recognizing that flight physics complicate the adoption of certain of the more effective fuel-efficiency technologies into such aircraft.

The emissions target under the CORSIA agreement is to help support carbon neutral growth on the international flights of operators from the countries that are in the system. All are motivated to achieve emissions savings through technology, sustainable alternative jet fuels, operations and infrastructure measures, although the carbon offsetting requirement kicks in to help fill any gap toward meeting the goal.

While all countries were obligated to begin requiring emissions monitoring data from their aircraft operators as of the beginning of 2019, the offsetting system is slated to be implemented in phases, with the first six years of the offsetting system, 2021 through year-end 2026, being implemented amongst countries on an “opt-in” basis. After that, the offsetting obligation becomes mandatory for all ICAO Member States except the least developed countries and those with very low levels of international aviation activity. Although countries have until June 2020 to opt into the first phase of the offsetting provisions, as of January 2019, 78 countries, representing seventy-seven percent of international aviation activity, including the United States, had already signed up to participate from the beginning.[31]

Very importantly, only the flights to and from the covered countries will be subject to the offsetting requirement. In other words, there is a mutual exemption from the offsetting requirement on flights to and from countries that either are not in the two three-year opt-in phases or are exempt for the duration of the system. This is critical to avoid competitive distortion, satisfy the non-discrimination provisions in the international aviation treaty and ensure that U.S. operators are not disadvantaged by the United States’ opting in to the CORSIA offsetting obligation in the non-mandatory phases.

Critically, the agreement states that the CORSIA is to be “the” market-based measure applying to international aviation GHG emissions, precluding countries from imposing unilateral carbon measures on international flights from other countries.

In June 2018, the ICAO Council adopted a package of standards and recommended practices (SARPs) for implementing CORSIA. As with the ICAO CO_2 standard for future aircraft, it is up to the Member States of ICAO to implement these ICAO provisions. FAA and DOT have existing statutory and regulatory authority that allow them to adjust the fuel reporting requirements that currently apply to U.S. aircraft operators through a rulemaking to comport with the expected ICAO emissions monitoring standards. However, given the short time between ICAO adoption of the SARPs and the January 1, 2019 effective date of the emissions monitoring provisions, FAA and DOT were unable to issue a rulemaking before then. Accordingly, A4A has worked with FAA and other aircraft operator associations to commence the monitoring provisions under a voluntary agreement and we await the DOT/FAA announcement of this approach. Additionally, new, appropriately-tailored legislative authority will be needed for DOT/FAA to apply the 2021+ CORSIA offsetting obligation to U.S. aircraft operators. We would very much like to work with this Committee on a tailored approach to implement the CORSIA SARPs over the course of the next couple years.

[31] ICAO keeps a list of the countries that have signed up for the opt-in phase on its website at https://www.icao.int/environmental-protection/CORSIA/Pages/state-pairs.aspx.

Congress and the Administration Should Complement the Airline's Initiatives to Advance Aviation Infrastructure, Technology and Energy Policy

We are confident that the measures A4A and our members are taking will continue to limit and reduce aviation's carbon footprint, while allowing commercial aviation to continue to provide an invaluable service and be a key contributor to our nation's economy. However, support from Congress and the Executive Branch is needed in three key areas to complement the airlines' concerted efforts: (1) business-case-based implementation of the Next Generation Air Transportation System (NextGen) prioritizing existing equipage; (2) stable policies to further support making SAJF commercially viable; and (3) continuation of aviation environmental research and development programs.

As recognized by the Future of Aviation Advisory Committee (FAAC) in 2010, "NextGen will enable the [National Airspace System] to safely and efficiently accommodate greater numbers of aircraft, from large commercial airliners to smaller general aviation (GA) aircraft, while reducing the overall environmental impact and energy use of civil aviation."[32] Indeed, while A4A member airlines are doing all they can to promote efficiencies within the current ATM system, completing the transition to a satellite-based system will significantly reduce the inefficiencies that are inherent in the outdated, radar-based air traffic control system – saving up to 12 percent of fuel burn and emissions. Not only is an optimally functioning ATM system indispensable to ensure safety and the wellbeing of our industry, our nation's economy, the air traffic control workforce and airline customers, it is also critical to the environment.

As noted, in addition to enhancing U.S. energy independence and security, commercially viable, environmentally friendly SAJF could well be a game changer for the industry's GHG emissions. The aviation industry and would-be alternative jet fuel suppliers are on the cusp of creating a viable alternative jet fuel industry, but government support is needed in the near term to provide financial bridging and other tools necessary to help us get over the cusp. It is critical that Congress and the Administration continue to fund the programs under the Energy Title of the Farm Bill and support public-private initiatives such as CAAFI, the *Farm to Fly* initiative, and ASCENT.

Further, as recognized by the FAAC, "aviation-related R&D investments are vital for a high technology economy and enable solutions that can decrease emissions, create good jobs, increase U.S. competitiveness, and provide substantial enhancements to mobility that benefit the public."[33] As noted, FAA, NASA and the U.S. aviation industry are already partnering on a wide range of research and development projects through the CLEEN, ASCENT and NASA ARMD programs. These programs, which also include research dollars for FAA to maintain leadership in the ICAO environmental standard-setting process, are critical. While the agencies appear to be committed to continuing them, their funding has been under attack. We urge Congress to continue to fully support and fund the FAA and NASA aviation environmental research programs. This is vital to U.S. aviation competitiveness and the leadership role the U.S. plays in driving appropriate aviation energy and environmental standards.

[32] U.S. DOT, *Future of Aviation Advisory Committee, Final Report*, at 15.

[33] Id. at 13.

Conclusion

As an industry, aviation is a small part of the nation's GHG footprint, but we have nonetheless strived to reduce our impact through technology, operations, infrastructure and alternative fuel advances to provide safe, vital, efficient, and environmentally sustainable air transport within the constraints of our air traffic management system. We will not rest on our laurels in light of this record but will continue to invest where appropriate to maximize environmental benefits while supporting our nation's economy. We look forward to working with this Committee on policy initiatives to complement our efforts.

Again, thank you for the opportunity to testify, I look forward to your questions.